



## **Monticello Central School District Technology Plan**

Submitted by Shelley Rossitto, Executive Director of Instructional Technology and Professional Development

2010 – 2013

### ***ACCESS: Aligning Community Connections Educating Students and Staff.***

Our district technology plan is built to reflect the need to prepare our students to be 21<sup>st</sup> century ready. Our intent is to provide the needed support both instructionally and technically to build environments where learning will be transformed. The classroom will become a conduit for instruction as students leverage the necessary resources to be lifelong learners.

The vision for technical services that drives our decisions for instruction is to improve ACCESS for all.

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## **MONTICELLO CENTRAL SCHOOL DISTRICT**

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### **District Schools**

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<b>Cornelius Duggan School</b> <b>Grades K-5</b> <b>Route 55</b> <b>White Lake, New York 12786</b> <b>Patti Sonnenschein, Principal</b>	<b>Kenneth L. Rutherford School</b> <b>Grades 3-5</b> <b>9 Patricia Place</b> <b>Monticello, New York 12701</b> <b>Kim Patterson, Principal</b>
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Nestled in the Catskills, Monticello Central School District is the largest of eight school districts located within Sullivan County. Encompassing 191 square miles, it stretches east on Route 17 to the village of Wurtsboro, west to White Lake, south through the town of Forestburgh and north toward the village of Hurleyville. The residents of the towns of Thompson, Forestburgh, Bethel, Fallsburg, and Mamakating are served by the district. Based upon BEDS Data for 2005-2006 school year, the district's population was 3,539. Since then there has been a steady decrease in population, with the 2009-2010 BEDS report showing a loss of 7% in the student population to a total of 3,326.

The District has a very diverse socio-economic base; all information is based on the 2000 census. The area is predominately rural and had once been a thriving resort area. The dominant employment area, constituting 65.1% of all employment, is the service field. This includes retail sales; finance, insurance-real estate and rental services; educational/health/social services, arts entertainment, recreation, accommodation and food services. Manufacturing is nearly nonexistent with only 5.8% of the residents employed in that area. There is a large second home population and many of the county's residents are retired and have fixed incomes; 22.7% of the county residents are over 65. The school district reflects the cultural diversity of the community and serves a minority population of 44% ~ the largest groups are Afro-Americans/Black (22%) and Hispanic-Americans (19.8%). Fourteen percent of all households speak a language other than English at home. There is a significant population which is at the lower end of the economic spectrum. Based upon an analysis of poverty data as culled from the food service management system, MCSD demonstrated that 53% of its student body qualifies for free or reduced lunch.

Student mobility is an important issue in our district. We average a mobility rate of 30%. These are students transferring in and out. This is a major issue in regard to continuity of instruction, socialization of students into the district culture, and the constant assessment of new student skills.

At Risk: The Monticello Central School District serves a student population that may be termed at risk. According to the Office of Alcoholism and Substance Abuse Services (Prevention Risk Indicator Needs Assessment, 2005), Sullivan County, and thereby, the Monticello Central School District, serves a student population which is coping with a variety of problems including: families in poverty; family dysfunction; alcohol and drug abuse problems; delinquency; at-risk sexual behavior, and gang involvement. With a wide variety of needs and a diversity of backgrounds, the Monticello Central School District has endeavored to provide a myriad of programs which foster the educational and social development of all of its students.

With these factors in place it is even more essential that we build a supportive environment for instructional technology skill acquisition as this might be the only avenue for our students to learn the necessary skills to compete. This plan will outline our thinking as we move forward.

We built an enterprise fully managed high availability efficient network that acts as an educational tool for all staff and students. The bulk of the network was built to facilitate curriculum and instruction. It has also evolved to include the business side of the organization as it grew. In order to provide our clients with a reliable and stable experience we have needed to engineer solutions to accommodate their needs. This growth included phones, security cameras, large deployment of computing access, point of sale system, updates to transportation services, video conferencing, an improvement in access and use of multi-media.

Enterprise management allows us to fix desktops quickly. We can remote all workstations; repair time is much less (within hours). We have recovery oriented computing in place so recovery is within hours. Production is teaching time. Our network is built to minimize losses to teaching and administrative task time.

The infrastructure we focused on in the last tech plan cycle involved the development of systems to allow us to respond quickly, be effective, minimize disruption to teaching and administrative tasks, be reliable and expandable for the new instructional technology demands we are faced with monthly. The network is responsive to the changes in teaching and administration. As staff and students have become more reliant on technology our goals have had to change.

Our technical changes involve the following tasks that have all contributed to the minimization of the impact to teaching school and to improve teachers and students experiences.

The infrastructure updates included the following:

- Full virtualization of servers and data which increase efficiency and decrease downtime for needed updates and repairs
- Enterprise management of user access (desktop)
- Improved security and management of user access
- The desktop experience is different to accommodate the changing needs: Virtualization of software, standardization of desktop hardware, standardization of software
- Increased storage to accommodate instruction
- Storage is now dynamic and responsive
- The rebuilding of the MDF's and IDF's along with the addition of a NOC (our distribution frames or closets)
- Redundancy
- The building of successful business relationships to ensure disaster recovery

The instructional needs increased because of the embedded professional development given to our staff. We began with just a technology director with limited time to provide training. We now have 2.6 staff developers that have delivered 1000's of hours of personalized and differentiated training and modeling of effective lesson plan creation and teaching strategies that has driven what type of infrastructure we planned.

We have built a rich state of the art IT platform that was driven by the instructional needs as outlined in this document.

Vision and Goals

Mission Statement: The Monticello Technology Mission Statement is based on our district's educational philosophy as outline in our district mission statement. Our school district's mission statement states:

The Monticello Central School District is committed to developing students who achieve academic success, practice lifelong learning and become productive citizens through the development of inquiring minds, compassionate hearts, creative expression, healthy bodies, and service to the community.

Our core values: Decisions will be made and priorities will be set based on the following core values and beliefs which are held by every member of the Monticello Central School District community:

High Expectations for All Students  
Relevant and Rigorous Academic Programs  
Skills and Strategies for Lifelong Learning  
Reciprocal Responsibility and Accountability  
Productivity and Success  
Flexibility and Adaptability  
Personal Ethics and Integrity  
Dignity and Respect  
Safety and Security

The Technology Mission of the Monticello Central School District is to infuse technology into our educational programs so that we will help insure our graduates are well prepared for the world of work and/or post-secondary education in the global economy. To that end is our desire for technology to help:

- ❖ support student's ability to successfully meet state standards and assessments
- ❖ develop problem solving, creative thinking, and communication skills.
- ❖ support student centered education and encourage lifelong learning.
- ❖ encourage and assist effective district-wide communication
- ❖ enhance both instructional and administrative productivity
- ❖ provide equitable access to technology for all students and staff

B. Vision Statement: Our plan is based on the fundamental belief that technology implementation in the educational environment can contribute significantly to achieving our educational goals. The infusion of technology into the instructional and administrative programs is based on the beliefs that:

- ◆ technology creates new teaching and learning opportunities
- ◆ technology fosters creative problem solving and collaborative work
- ◆ technology offers powerful tools for engaging students systematically in higher order cognitive tasks
- ◆ technology helps students develop inquiry skills focusing on the acquisition, gathering and interpretation of information and relate this knowledge to real life situations

Our vision is to provide an environment which utilizes easily accessible technology to enable students, faculty, staff, and administrators to communicate effectively, increase productivity and access information to support learning so that all of our community can function as productive members of 21st century society.

Goal 1: *To build and sustain a reliable network infrastructure to support instruction.*

During the past four years we have been adding computers, laptops, increasing professional development leading to increased use, promoted the use of video, and brought in web 2.0 tools. Computing for both administrators and instruction has increased significantly. The administrative computing growth has contributed to our services becoming more critical to the day to day operation of the school and its safety. The growth in our instructional computing is due to the need to prepare our students to be 21<sup>st</sup> century learners. We have begun to align our technology goals with CDEP and our CEP plans. We are writing curriculum that will infuse technology in a project based environment for each grade level and best practices are being video taped and archived for use by staff. As we continue to leverage technology for learning we have to continue to improve the infrastructure. Technology is no longer an add-on but an embedded part of instruction. It has to work. It is for this reason we need to continue to develop new systems to manage these resources since they have to be reliable and dependable. Some of the new services we have added that need to continue to be maintained as part of this plan, in the past few years include:

- The expansion of the use of software to differentiate instruction specifically for our ELL, music, art, and Special Education students.
- We have put in a new student and financial management system that is housed at the Mid-Hudson Regional Information Center. It is used a higher rate and by more users than the previous systems as we have online purchase orders and budget access to administrators. Our student management system is used more widely for more than just attendance to include discipline, health, and registration of new students.
- E-docs – electronic archival system for documents. We have begun with school board packets and minutes
- Parent Portal
- Global Village – doubled in use – Cloud Computing Solution
- Increase use of video conferencing and online instruction
- Requirement for customized filtering to accommodate web 2.0
- Increased use of video streaming
- Addition of point of sale system

- More phones – which translates to additional computers requiring management and access to switches to route calls
- Updated transportation services that will continue to grow
- Added a help desk for buildings and grounds
- 80 security cameras
- Need for increased storage related to increased use
- Need for increased security related to increased use
- Increase in Mac environment requiring the need to redesign our directory services
- PLTW and programming classes. Plan to expand.

All of this has put a strain on a network that was designed for instructional purposes.

The future will take us to a “Cloud Computing” atmosphere. Based on the Horizon Report referenced in Appendix G:

*“The cloud refers to surplus computing resources available from specialized data centers, each often hosting thousands of servers that power the world’s largest websites and web services. Growing out of research in grid computing, cloud computing transforms once-expensive resources like disk storage and processing cycles into a readily available, cheap commodity. Development platforms layered onto the cloud infrastructure enable thin-client, web-based applications for image editing, word processing, social networking, and media creation. Many of us use the cloud, or cloud-based applications, without even being aware of it. In schools, use of cloud computing is progressing along a path that began with the adoption of collaborative tools for administrative tasks and that leads, eventually, to classroom adoption of cloud-based tools for learning.”*

Our virtual environment, use of web 2.0, the move to more web-based applications is the beginning of our goal to reach cloud computing. Our next steps will be to encourage mobile device use, work with teachers to leverage web enabled activities, collaboration should be on the forefront in planning, and build a wireless infrastructure to give us access to the cloud.

*Goal 2: Plan and implement effective professional development programs to infuse technology, create communities of inquiry and knowledge, target students accessibility, become embedded in current instructional initiatives and integrate NETS for students, teachers, and administrators.*

Teachers have been involved in technology training and have learned about and worked with technology throughout the district. Many teachers have begun to integrate and there are many that have gone beyond just integration – it is infused into their daily work whether it is through instruction in the classroom or an online Global Village environment to make learning accessible

at anytime. We are now migrating to a more formalized approach to what we expect students and teachers to know and be able to do in each grade level through a project based constructivist environment. This approach has required a change in actual instruction in the classroom. It is not the technology but the instructional strategies that we are aiming for. The shift has occurred in the following ways and we are customizing the professional development to accommodate our schools:

- K-5 – advent of IB (International Baccalereate) has welcomed the ISTE (Appendix B) and Intel standards (Appendix C) as the programs promote communities of learners. Teachers create planners that drive what they facilitate in the classroom and every lesson is approached with an intercultural perspective that technology plays a large role in through online instruction, video conferencing, web-enabled collaborative environments, and web 2.0 tools. Professional Development will be a part of the actual planning process for the teachers. We are also working with literacy and math liaisons as they create instructional experiences for the building. They will be the carrier of the strategies so it is a part of their initiatives.
- The Middle school is a teaming environment with looping and has just finished restructuring. There is a .6 professional developer in this building and her responsibility is to work with teachers individually and in teams to leverage the use of technology for learning.
- The High School is a small learning environment school. Teams work together as they plan in interdisciplinary groups. This building also has a fulltime staff developer that works with teams, administrators and teachers to effectively integrate.
- Our CDEP plan has identified the priorities for the district that we are to focus on. This has been determined based on data. We will focus our efforts in the following areas to support the goals in CDEP to be aligned to the identified initiatives and that all professional development will contribute to the overall needs in CDEP.
  - ELA
    - Writing – our PD has focused on the use of multi-media and social networking to improve writing
    - Develop teacher leaders – we work with Literacy Coaches to embed technology into their daily and instructional tasks and training with teachers
    - Assessments through rubrics – we are working with Intel to design essential rubrics for activities assigned along with a K-12 articulation

- Literacy Across the Content Areas – We work closely with teachers to create social projects that incorporate all content areas and promote literacy
- Math
  - Problem Solving – we have built the project lead the way program to work on pre-engineering skills for our students. We continue to expand the program.
  - Added TiNavigator carts
  - Math Concepts – The addition of Aegom and Gizmos on our smartboards
- School Climate and Culture
  - Web 2.0 is our focus to continue to improve all communication through our global village site, blogging, glogging, wikis, etc. Our programs are infused into bullying blog programs as an example.
  - We are working with BOCES as they create an internet safety curriculum

We have and will expand the use of online instruction for teachers as they need to access information as students do, at any time. We will accomplish that with webinars that can be archived for future use.

Instructional Strategies, pedagogy, and building inquiry based environments that embrace a connected classroom rather than an isolated one is what is necessary for our incoming students..

The US Department of Educations reports states that:

*“Just as leveraging technology can help us improve learning and assessment, the model of 21st century learning calls for using technology to help build the capacity of educators by enabling a shift to a model of connected teaching. In such a teaching model, teams of connected educators replace solo practitioners and classrooms are fully connected to provide educators with 24/7 access to data and analytic tools as well as to resources that help them act on the insights the data provide.”*

*Goal 3 – Provide Information Literacy strategies throughout the K-12 student’s population to be infused through classroom instruction and research and the library media centers.*

As we move to a digital world an education in information literacy, its impact on student learning, and how we access information and knowledge will need to be incorporated in every phase of planning. Our district will use the Big 6 model and will train our library media specialists as they

are the trainers for research. Students will learn to define their tasks, develop research strategies, locate and access the information, use it, synthesize and evaluate. We will also include appropriate and ethical behavior to contribute to internet safety. Student development of these skills will occur during library and any other curriculum and instructional activities that occur throughout the year.

The Library Media Centers will go through a change as they become a hub or portal for cloud computing. We are calling these “Communication Cays.” Literacy strategies will include what we have been practicing for years but will expand to the new literacies as students will have access to data anytime but more importantly will have storage anywhere.

## I. Curriculum and Instruction

A. Curriculum Integration: *Goals and strategies, aligned with state and national standards, for using telecommunications and technology to improve teaching and learning.*

All initiatives are tied to CDEP, ISTE, and IB. I have outlined the CDEP goals our department will focus on in the sections above. Our technology plan has also been informed by the National Educational Technology Plan through the Office of Educational Technology at the U.S.

Department of Education (*Summaries Appendix D*), The Horizon Report, (*Summary Appendix A*) and by the guidelines set by the New York State Education Department (SCALE in *Appendix E*).

This plan drives the state plans and the overall direction funding will be allocated for so it is critical to keep this in focus. The specific quotes will be cited in the areas of this report that its mention will be relevant. ISTE is embedded in our current structure as we create a K-12 articulation that will be based on the ISTE standards woven into the current content initiatives and the International Baccalaureate (IB).

Planning also occurs with the Directors and principals. All staff development is differentiated and customized to accommodate the teachers needs but is based on the curriculum mapping done for the particular content areas or the planners created through IB. All projects are driven by the NY State standards, data to support the need to enhance instructional strategies because students are failing or having difficulty, and to bring a social learning and connected opportunity for our students as we look at a global delivery rather than just classroom. I have attached a sample planning document that illustrates the planning process or Crosswalk for many of our projects.

(*Appendix F*).

B. Student Achievement: *Strategies that are based on research and that integrate technology into curricula and instruction for purposes of improving student academic achievement and a timeline for that integration.*

The research will be quoted throughout as we move through this document. I prefer to embed the research into the location where it best supports the planning. The timeline is constant. There is a cycle and process for planning that includes implementation and project planning that is not necessarily a “timeline.” The writer of this plan feels that “timeline” is an antiquated term and it is specific to a grant plan or perhaps a situation where a systemic process is not in place.

The outline of how we provide support is in the following table:

<b>Meeting</b>	<b>Standards Alignment</b>	<b>Projects</b>	<b>Instructional Delivery and Strategies</b>	<b>Best Practices</b>	<b>Support</b>
Administrators and also teachers Demos can be done during faculty and other planning meetings. Follow up is customized and embedded	CDEP, NY Standards, ISTE, 21 <sup>st</sup> Century Skills, Intel, K-12 articulation (being written now)	Implementation plans are put together for larger initiatives, classroom visits and follow up for projects	Appropriate strategies and support come out of the planning. 21 <sup>st</sup> Century skills is emphasized with distance learning included	Video taped or annotated to be used for K-12 articulation development	Equipment, time, PD, evaluation. Equipment is purchased based on project needs.

The process that is used is different based on building, staff members’ needs, student’s needs, and resources we can provide. It is critical to consider the personalized instructional methods that teachers use as we weave in the infusion of technology so it is relevant and seamless. An example would be the implementation of our smartboards. It is an interactive tool that supports the Essential Classrooms Technology recommendations for instruction and presentation based on the New York

State Department Educations recommendations, SCALE. They have 5 areas of focus for schools and this is the first one “Essential Classroom Technology for Student Centered Active Learning”. In this case we would customize tools and PD for the classrooms but also include a list of skills and benchmarks that teachers are expected to become proficient in as the tool has a skill component and an integration component. The skills would look similar across the teaching board but the implementation and instructional projects would look entirely different. This is the reason why PD needs to be customized and the “timeline” is a process because it is strategic to weave the two together to make sure it is relevant to the teacher.

C. Technology Delivery: *Strategies for the delivery of specialized or rigorous courses and curricula through the use of technology, including distance learning technologies*

Instructional delivery is based on the alignment to the standards as mentioned above. It is our intent to continue to work towards an atmosphere where the classroom becomes a collaborative venture by teacher and student as the teacher moves to a more collaborative partner with other educators and becomes less isolated in their teaching.

*“Technology provides access to more learning resources than are available in classrooms and connections to a wider set of “educators,” including teachers, parents, experts, and mentors outside the classroom. On-demand learning is now within reach, supporting learning that is life-long and life-wide.” (Bransford et al., 2006 as cited in the Transforming Education through Technology Report, (March 2010).*

*“Collaborative environments are online spaces where the focus is on making it easy to collaborate and work in groups, no matter where the participants may be. As the typical educator’s network of contacts has grown to include colleagues who might live and work across the county, or indeed anywhere on the globe, it has become common for people who are not physically located near each other to collaborate on projects. In classrooms as well, joint projects with students oat other schools or in other countries are more and more commonplace as strategies to expose learners to a variant of perspective. Collaborative environment can be off-the-shelf or assembled from a wide variety of simple, free tools- the key is the interaction they enable, not the technology they include.”(Horizon Report 2010 Appendix G)*

We also work towards a project based environment where technology is identified as an instructional strategy that now goes beyond its motivation and engagement for students. Research conducted by Giselle Martin-Kniep and Heidi Hayes Jacobs ([Active Literacy Across the Curriculum, 2006](#)) concludes that schools moving towards a more integrated curriculum and using effective pedagogy are witnessing an increase in student literacy. In that light, we are

working towards a K-12 articulation of necessary technology skills based on the standards and these units of study will be shared in Global Village. It has now become a necessity to include distance learning technologies as students have already begun to see the world globally in their personal lives so distance learning is a part of their everyday lives. According to the US Department of Education's report on "Transforming Education through Technology Report, (March 2010):"

*"The challenge for our education system is to leverage the learning sciences and modern technology to create engaging, relevant, and personalized learning experiences for all learners that mirror students' daily lives and the reality of their futures. In contrast to traditional classroom instruction, this requires that we put students at the center and empower them to take control of their own learning by providing flexibility on several dimensions"*

We have begun to build the technology resources to accommodate these needs. They both include a "cloud" computing model (addressed in the technical section) that both include an in-house and public model. (There are many websites that describe cloud computing to reference - <http://www.microsoft.com/presspass/presskits/cloud/> has video that will introduce the reader.) Our in-house web based resources include Global Village, College in the Classroom, Syracuse University programs, and teachers using Video Conferencing for remotely teaching students in other locations. We plan to expand this learning to include electronic portfolios, a cloud computing public model where students will have the ability to use multiple devices, different networks, and be responsible for their own storage. This will drive the distance learning and file management capabilities and assist in working towards a ubiquitous model where students are connected. (SCALE)

*"Ian Jukes supports the fact that we have created a digital divide that disconnects students and the world at large. It is for this reason we will cultivate and maintain an atmosphere where digital, interactive, and visual experiences abound. The internet links we will grow are in existence through cloud computing that include web 2.0 tools. Our students will share and collaborate as they research, read, and create content through various web 2.0 tools. Instructional Strategies, pedagogy, and building inquiry based environments that embrace a connected classroom rather than an isolated one."*

#### D. Parent Communications and Community Relations:

As we move to a more cloud computing environment for our students it is important to migrate to Web 2.0 tools for our forms of communication for our parents. Many of our families do not have internet access at home and if they do it is very limited because of multiple people using the same

computer. MCSD has the following communication systems in place to keep parents informed but again the intent is to build a system that will build overtime. We have worked with parents to ask them what the main areas are that they feel they want to know about and stay up to date on. Based on that feedback we have provided them and will continue to grow the following platforms:

- How are my students doing in school which translates to attendance, grades, assignments, discipline: Solution - Parent Portal
- What are my children doing in school on a daily basis which translates to publishing lessons, assignments, requirements, etc. in a web based environment: Solution - Global Village.
- How do I become informed if school is out or there is an emergency which translates to a quick communication protocol for school closings and emergencies: Solution - SNN
- How do I know about relevant topics concerning budget, school activities, schedules, calendars: Solution - School website and Superintendents blog
- If my child is at home can we stay connected to the classroom: Solution - Adobe Connect, video conferencing, Global Village, teacher websites, etc.

Areas to grow –

- As our students become more global it is important to have their work in a digital format. It will assist in showing progress and will give them feedback on who they are and how they want to demonstrate their skills and gifts. We will develop a web-based portfolio system. This development will occur with the instructional leaders in the district to develop protocols and procedures to ensure we have the technical infrastructure to support what is needed.
- More students publishing through various portals offered on the web.

E. Collaboration: *Strategies for developing the program, where applicable, with adult literacy providers*

The adult literacy we focus on is the use of technology for our students and families. The EPIC program (Every Person Influences Children) provides courses in Internet Safety and other technology related topics.

But as we move towards a more cloud computing model adults from the world can participate in our student's success. Monticello is not rich in adult literacy programs but if it is expanded to anyone adult literacy takes on a whole new meaning. Students are now and will expand to sharing their writing in voicethread, adobe buzzword, google docs, wikis and blogs. Adults have already been invited to be a part of the project construction that has contributed to their growth as formative assessment has become global and reflective for the student. Social media plays a large role in this as we have begun to use facebook, ning and moodle to communicate collaboratively.

#### F. Internet Safety:

We are working with Sullivan BOCES as they are working with other BOCES to design a K-12 Internet Safety curriculum. We have resources available for our staff in Global Village but we want to make the program more systemic and articulated per grade level. This program should be available to us in the school year 2010-2011 and we will revise it as needed to include a community and parent piece.

In all of the research and reporting there is little about internet safety as it sits as a separate leaned skill. It does however evolve as students become more involved in using these tools. They learn from each other and experience what works because they are motivated to have a positive impact and experience in this environment. We must be careful to weave the safety aspects of the Internet into just those skills that might not be easily know such as identity theft or giving out too much personal information. Ethics will evolve as work posted and collaborated on becomes of the utmost importance to them and their inclusion in its creation will empower them to protect it and not abuse it.

## II. Professional Development

*A. Strategies for providing ongoing, sustained professional development for teachers, principals, administrators and school library media personnel to ensure that staff know how to use the new technologies to improve education or library services.*

Professional development is actually one of our goals and much of it is articulated in the vision and goals section.

MCS D invests in Professional Development as a common practice. We are fortunate to have 2.6 professional developers on staff that works closely with our content specialists, administrators and teachers to offer embedded PD. They work in classrooms modeling lessons, designing opportunities that are customized for our teachers, and build projects through our planning processes with teachers, committees, and all initiatives. With this support our professional development infrastructure is strong.

Our embedded professional development model has been based on research since its inception 3 years ago. Workshops and other outside events are not as effective because of the transfer of knowledge difficulty and the broad way in which they are taught. As we have laid out our planning it is targeted and project based focusing on a specific student population that general professional developers cannot always incorporate into their trainings. We also know that the teachers need to be an active participant in planning and need in class follow through and support of any professional development. Unfortunately, "the demands posed by daily teaching and other aspects of the reform continue to absorb a bulk of teachers' energy, thought, and attention" (McDiarmid, 1995).

We have seen first hand here in the Monticello Central School System that the attempt to pull teachers from their classroom, show them an idea and then send them back into the classroom to implement this new concept, does not work. Studies have also shown that:

*“adults need to participate in small group activities during the learning to move them beyond understanding to application, analysis, synthesis, and evaluation. Small – group activities provide an opportunity to share, reflect, and generalize their learning experiences.” (Speck, 1996). “Adult learners need direct concrete experiences where they apply the real learning and work.” Adult learners need to see that the professional development learning and their day to day activities are related and relevant.” (Speck, 1996).*

*“Adults need to note why they should learn something. Under the more standard pedagogical model it is assumed that the student will learn what they are told. Adults however are used to understanding what they do in life, they want to know the reasons they need to learn something or how it will benefit them.” This may be accomplished before students engage in technology.” (Knowles, Holten, and Swanson 1998).*

In all schools we have different systems of planning which are based on the same concept. The IB schools require a different integration approach because of the use of planners whereas the MS and HS is assembling teams of teachers that do cross content project based learning. This planning is guided by current AAIS (American Alliance of Innovative Schools) infrastructure that has our teachers working in project based teams. Through the restructuring process we have put in a system to build capacity with our own staff that has deployed additional resources (professional developers such as instructional technology, literacy coach, college support in the classroom, ELA staff developer, and social workers). We have a CEP plan that drives all of our actions. The system is clearly defined where the causal analysis in the CEP plan drives instructional practice and resource allocation, the data administrator works closely with the staff to assist in evaluating programs, the Executive Director of Technology and Professional Development works closely in the planning to deploy the appropriate staff development and instructional technology support where needed. The district has made this commitment and will sustain this effort through their staff developers.

We have broken the professional development needs to two areas which are administrative computing and instructional computing. The following organizations and people assist in that planning and delivery.

Administrative computing: Executive Director, MHRIC, BOCES, building liaisons

Instructional computing: Executive Director, BOCES, embedded staff developers, library media specialists, literacy coaches, math coaches, Intel trainers, other IT leaders

The expectation of effective teaching and accountability for professional educators needs to be as connected as kids so they are accessing all of the learning worlds possible for everyone.

Connection replaces isolationism.

*B. Strategies and supporting resources such as services, software, other electronically delivered learning materials and print resources that will be acquired to ensure successful and effective uses of technology.*

Our school district has built a virtual environment to manage the multiple amounts of software we encourage our teachers to use to be effective. The virtual software program has given us the ability to use over 200 software programs to customize instruction. (*Appendix G*)

We also work through Sullivan BOCES, Capitol region BOCES, GST BOCES, and the Mid-Hudson Regional Information Center for the following services:

- GST BOCES: Activeworlds – virtual world (Horizon Report refers to this as Augmented Reality – Appendix A)
- Sullivan BOCES: Ensemble, Adobe Connect
- Capitol: Teacher webpages, district webpage
- MHRIC: Financial and student management system, IEP Direct, AISM Direct, Guidance software

We will continue to develop a K-12 articulation that will include digital literacy. The Horizon report says that we need to focus on digital media literacy as the norm. The professional development will focus on the thinking not the tools.

### III. Infrastructure, Hardware, Technical Support and Software

Our infrastructure planning is based on the instructional models we have identified above. To continue many of our students' lives today are filled with technology that gives them mobile access to information and resources 24/7, enables them to create multimedia content and share it with the world, and allows them to participate in online social networks where people from all over the world share ideas, collaborate, and learn new things. Outside school, students are free to pursue their passions in their own way and at their own pace. The opportunities are limitless, borderless, and instantaneous.

According to the US Department of Education's report:

*“The challenge for our education system is to leverage the learning sciences and modern technology to create engaging, relevant, and personalized learning experiences for all learners that mirror students’ daily lives and the reality of their futures. In contrast to traditional classroom instruction, this requires that we put students at the center and empower them to take control of their own learning by providing flexibility on several dimensions. A core set of standards-based concepts and competencies should form the basis of what all students should learn, but beyond that students and educators should have options for engaging in learning: large groups, small groups, and work tailored to individual goals, needs, interests, and prior experience of each learner. By supporting student learning in areas that are of real concern or particular interest to them it becomes personalized.”*

In addition, technology provides access to more learning resources than are available in classrooms and connections to a wider set of “educators,” including teachers, parents, experts, and mentors outside the classroom. On-demand learning is now within reach, supporting learning that is life-long and life-wide (Bransford et al., 2006)

How we need to learn includes using the technology that professionals in various disciplines use. Professionals routinely use the web and tools such as wikis, blogs, and digital content for the research, collaboration, and communication demanded in their jobs. They gather data and analyze it using inquiry and visualization tools. They use graphical and 3D modeling tools for design. For students, using these real-world tools creates learning opportunities that allow them to grapple with real-world problems – opportunities that prepare them to be more productive members of a globally competitive workforce.

The future growth will take on a different feel as we begin to think and design with a global perspective as we expect our students to. No longer will we see the walls as a barrier for collaboration. Those walls are now transparent and the district is building transport systems to access the “Cloud” where the world resides.

Cloud computing is a concept that is responsible for the need to do a few things based on consumer drive. It is an environment where resources can be purchased or accessed in a shared space that is not onsite but in another location and it is totally scalable. The access to these resources is through web servers and the like that act as a conduit to access these services. The design of our future network will need to keep the new technical specifications in mind as we change from an environment that is sustained by only us and is closed to one that is shared with everyone. As consumers our demands have increased exponentially and it has become impossible to ramp up for all of the possibilities. We also don't have the ability to necessarily build the infrastructures required to move our students and staff to a full virtual environment where access is the key. In our current networks we provide the access to what we see as being important. Cloud computing connects us to everyone and everything.

There are multiple principals it is built on:

1. New opportunities for everyone: Years ago if you wanted to be an author you would have to write, edit, contact a publisher and perhaps get positive or negative feedback after the full manuscript was written. If it was accepted it was then published, marketed, and well you take your chances. It was someone else that decided you were an “author.” It could take years for one story. In a cloud computing model everyone can be whatever they want and in an instant with constant feedback that will lead to constant revision. The consumer is in control of everything and they decide. Their connections to a worldwide network keep them working towards a goal that has the makings of “formative assessments” as work is revised and reposted. There is a collaborative and constant self-reflection to their writing as it can take on others perspectives and ideas in an instant.
2. Scalable – by purchasing or connecting to new services that are already out there we can be up and running with new technology instantly without having to rebuild the infrastructure to get there.
3. Reliability and back up- storage is centralized and organizations such as google and Amazon do the heavy lifting.
4. Maintenance – since applications and all resources are accessed in the cloud there are no installations to be made on individual machines. But we will always need to differentiate so specialized software will be necessary.
5. Load balancing – centralized computing systems can adjust loads based on usage.
5. Dimension – in the UK their TV system is called SKY. It integrates xbox, live and archived TV, video and it allows for feedback. It is very interactive.
6. The cloud learns as we do. Cloud computing is developing the ability for consumers to have information brought to them based on their needs rather than spending hours and hours searching for something that takes so much time.
7. There will be more development to create even smarter mobile devices that will access everything.
8. This technology gives our clients full and constant access to data which will have built in redundancy and back up.
9. It is the next business model: People can design any product and ramp up for its marketing and distribution in a moments notice. Inventors have an avenue to gain acceptance for their ideas and distribution. Businesses will find the more global they are the more successful and that

can only be done by building hyperconnected marketing to reach every market not just the one down the street or the one based on a flat website created. Our students are posting their work to web-enabled sites and soon will be able to perform live in interactive sites such as SecondLife and Activeworlds.

In this model our students need to be hyperconnected. Our students and staff will need access to our network and others as they connect to and have access to everything described above. We will build a wireless infrastructure, allow access to other networks and modify our file servers to access intercloud environments.

The following initiatives will work towards the intended outcomes as listed in this plan:

- Our future desktop configuration will change to engineer a solution that gives us the connections we need to the cloud so it can be a virtual desktop. It will be strategic as we need to still customize for special situations such as high end graphics programs that require a lot of bandwidth and data transfer or adaptive software.
- The cloud services companies such as google are pushing for cloud based desktops. The desktops can be personalized and virtualized depending on the cloud they are accessing.
- We will expand our transport to the cloud by continuing to expand Moodle, attach virtual desktops to the network, build in wireless, and allow personal devices for computing.
- Increased data leads to a need to back up data more efficiently and cut down time for the process.
- Wireless MS and HS.

A. The US Department of Education Report says that:

*“An essential component of the 21st century learning model is a comprehensive infrastructure for learning that provides every student, educator, and level of our education system with the resources they need when and where they are needed. The underlying principle is that infrastructure includes people, processes, learning resources, policies, and sustainable models for continuous improvement in addition to broadband connectivity, servers, software, management systems, and administration tools. Building this infrastructure is a far-reaching project that will demand concerted and coordinated effort.”*

All of our infrastructure planning is based on instructional and administrative computing needs. The Executive Director of IT/PD is expected to keep up to date on the new technologies that will improve both student performances, preparing our students to be global, and to improve

productivity. This knowledge is woven into planning at every stage and infrastructure are built to accommodate the needs established.

We are planning to grow the following areas as we continue to prepare our students for the future and provide a secure, stable, reliable, and productive environment for support staff.

- Bandwidth distribution and management – Most of the resources are now migrating to a “cloud” environment which incorporates the web. Students and staff have more access to live video conferencing and video. We need to build a strategic solution for managing bandwidth to ensure a consistently positive experience while on the web. The US Dept. of Education's report says that adequate bandwidth is necessary for a successful deployment of a multi-media connected environment for our students.
  - Plan: Lightspeed to control and allocate appropriate bandwidth.
  - Continue to purchase more bandwidth as costs go down.
  - Improve infrastructure in the future to accommodate more traffic (we are stable).
- Security – this continues to be a top priority. As technology grows so do the threats. We have integrated products to ensure a safe and secure environment.
- Infrastructure replacement cycles – these are in place. The district is now informed when new projects are recommended with a 3 – 5 year projection of cost implications when purchasing through a grant or other funding source.
- Upgrading of phones – The summer of 2010 will be the upgrade to our phone systems core. We have also begun learning how to fix phones as they go into disrepair.
- Building redundancy – it has become apparent that staff and students are becoming more and more reliant on technology. With this in mind we are building a system to allow us to switch to an alternate system for necessary repair work and if something fails there is a way to still be operational. In the future the cloud will accommodate some of these needs.
- SAN integration – Storage becomes more critical as students and staffs use the current tools such as video editing, music production and electronic portfolios. Projects have become more media intensive so storage needs to be strategic. The security cameras are a large draw on storage.

- Growing our virtualized system – Our server and software environment are virtualized. We will research the desktop.
- Edirectory/Active directory communication – We have begun to leverage the use of Microsoft’s Active Directory structure to manage our users. New software along with the Macs requires these directory services to operate. These systems manage all of the user profiles and permissions for access to the various systems installed. We are a Novel network which is the network of choice when running a program as large as ours. Microsoft has made many agreements with software and hardware environments and developed products that don’t seamlessly share services with a Novel edirectory solution. It is now necessary to work with both to communicate effectively so we can keep the enterprise network solution we have that will cooperate with other technical requirements made by Microsoft.
- Wireless implementation – in order to move towards a totally ubiquitous environment it will be necessary to build a wireless infrastructure. At this juncture little growth can occur without it. We will continue to try and fund a wireless program and will phase it in slowly if necessary.
- Improve access- in order to improve access for staff and students we need to build a wireless environment that has public capabilities so students can access cloud computing options as they become mobile.

## B. Inventory (*Appendix H*)

## C. Strategies to improve access to all students

- Public wireless network – Staff and students will be able to bring in their own devices that will communicate, collaborate, access cloud options, and give them the flexibility to use their devices for all work. Laptop carts and other mobile devices will still be available for students during the day for more intensive computing and for those that do not have mobile devices.

#### IV.Funding and Budget

A. The budget for MCSD’s technology comes from multiple sources depending on need. The district provides the technical services department with a budget but it is not enough to fund a full implementation of much needed hardware, software, professional development and services. We have built this environment to be very responsive to our users which is unlike many environments. It is our intent to give our staff and students’ access to what they need based on the standards outlined above. We have adopted the approach that one size does not fit all and that instructional technology needs to also be differentiated and flexible to respond to needs. We cannot always anticipate security issues, hardware failure, new technologies and/or looming demands on the environment. The budget needs to be reflective of a 6 month window of change that makes it difficult to always plan for. We have the experience to anticipate and plan with replacement cycles and knowledge that new programs will place more demands on our system. It is incumbent upon us to be in constant communication with our clients to ensure an effective design for all. The following funding sources are outlined in the following table:

#### Budget

Funding Source	Break out
District Funds	\$14,500 – Computer Software \$12,750 – Equipment support staff/administrators \$49,500 – Supplies \$17,900 – Purchased Services Staff Developers for PD \$14,000 – Compass Learning
AIDE	\$128,000 – Hardware/Software
BOCES	\$200,000 – Instructional Computing
Model Schools	\$20,000 per year for Model Schools
Entitlements – Title 1, Title 2-D, SIG - Equipment	Based on need - \$50,000 on average
Entitlements – Title 1, Title 2-D,	IT staff developers participate in ELA and Math summer

SIG – PD – Most PD includes technology	work - \$7,000 for them
Competitive Grants – E2T2, Library grant	Just applied for – if granted would be over \$200,000
Title 2-D - PD	\$10,000
Other – IDEA, EXCEL	Depends on need

When reading this budget it is necessary to keep in mind that all PD is imbedded. Our Staff Developers work with all of the staff developers in the district to infuse technology into all of the instructional initiatives. Most of the PD is not “separate.”

The district has budgeted an adequate amount for personnel and our department is able to respond to the demands of our users.

*B. Strategies that will be employed to coordinate available state and local resources to implement activities and acquisitions prescribed in the technology plan*

This is illustrated in the chart above. All of our planning is again done collaboratively so technology is seen as a seamless partner.

## V. Monitoring and Evaluation

A. *Strategies that the district will use to evaluate the extent to which activities are effective in integrating technology into curricula and instruction, increasing the ability of teachers to teach, and enabling students to reach State and National standards*

Although it is tough to tease out the specifics of whether technology has really improved student achievement vs. the instructional practice that has changed we are focused on research telling us it improves student engagement, time on task but more importantly prepares students to be global thinkers and doers. To this end all of the projects planned have the ISTE standards tied to them. We are also writing a K-12 articulation that will incorporate all of the standard areas listed above in planning which will be evaluated via rubrics and testing as the state begins to settle on a testing system for instructional technology. This will evaluate specific technology skills.

Guides are going to be developed during the tenure of this tech plan that will include the ISTE standard profiles (*Appendix F*), crosswalks for planning and IB planners. Intel will also assist as they have a full complement of rubrics that can be customized (*Appendix C*).

A. *Strategies are in place to develop and monitor district's policy's for faculty, staff and student use of the technologies including Acceptable Use Policy*

The district's Acceptable Use Policy is available online. Before logging in all staff and students need to click the AUP box in order to gain access to the network. There is a video available that outlines the AUP and provides examples.

## Resources

Horizon Report Summary

Summary and Key Points

### **Horizon Report 2010**

The New Media Consortium in collaboration with COSN (Consortium of School Networking)  
<http://www.cosn.org/>

The Horizon Project is an ongoing research effort to identify and describe emerging technologies likely to have a large impact on teaching, learning, research, or creative expression within education around the globe. There is an advisory board that represents a range of perspectives in K-12 education that put together the research. <http://www.nmc.org/pdf/2010-Horizon-Report.pdf>

It is a very comprehensive report and in order to really grasp the technology plan please read it in its entirety. We have many examples of the recommendations already in Monticello which is something to very proud of. Based on the research the Executive Director has been involved in for the past 7 years along with the technical staff we have been working towards these identified goals already and it is reflected in this technology plan.

#### Key Trends in Technology

- Technology is increasingly a means for empowering students, a method for communication and socializing, and a ubiquitous, transparent part of their lives.
- Technology continues to profoundly affect the way we work, collaborate, communicate, and succeed.
- The perceived value of innovation and creativity is increasing.
- There is increasing interest in just-in-time alternate or non-formal avenues of education, such as online learning, mentoring, and independent study.
- The way we think of learning environments is changing.

#### Challenges

- Digital media literacy continues its rise in importance as a key skill in every discipline and profession. As we all agree to this notion the adoption and actual classroom experience for students is lacking.
- Students are different, but educational practice and the materials that support it are changing only slowly.
- Many policy makers and educators believe that deep reform is needed, but at the same time, there is little agreement as to what a new model of education might look like.
- A key challenge is the fundamental structure of the K-12 education establishment.
- Many activities related to learning and education take place outside the walls of the classroom – but these experiences are often undervalued or unacknowledged.

#### Technology to watch

- Cloud Computing

- Game based learning
- Mobile devices vary in type and increase
- Augmented Reality – virtual reality worlds

## ISTE Standards



### **1. Creativity and Innovation**

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students:

- a. apply existing knowledge to generate new ideas, products, or processes.
- b. create original works as a means of personal or group expression.
- c. use models and simulations to explore complex systems and issues.
- d. identify trends and forecast possibilities.

### **2. Communication and Collaboration**

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students:

- a. interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
- b. communicate information and ideas effectively to multiple audiences using a variety of media and formats.
- c. develop cultural understanding and global awareness by engaging with learners of other cultures.
- d. contribute to project teams to produce original works or solve problems.

### **3. Research and Information Fluency**

Students apply digital tools to gather, evaluate, and use information. Students:

- a. plan strategies to guide inquiry.
- b. locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
- c. evaluate and select information sources and digital tools based on the appropriateness to specific tasks.

d. process data and report results.

#### **4. Critical Thinking, Problem Solving, and Decision Making**

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students:

- a. identify and define authentic problems and significant questions for investigation.
- b. plan and manage activities to develop a solution or complete a project.
- c. collect and analyze data to identify solutions and/or make informed decisions.
- d. use multiple processes and diverse perspectives to explore alternative solutions.

#### **5. Digital Citizenship**

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students:

- a. advocate and practice safe, legal, and responsible use of information and technology.
- b. exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.
- c. demonstrate personal responsibility for lifelong learning.
- d. exhibit leadership for digital citizenship.

#### **6. Technology Operations and Concepts**

Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:

- a. understand and use technology systems.
- b. select and use applications effectively and productively.
- c. troubleshoot systems and applications.
- d. transfer current knowledge to learning of new technologies.

## **INTEL Standards**

### **Summary of Main Points**

## **Intel® Teach Program Essentials Course**

The goal of the Intel® Teach Program Essentials Course is to help classroom teachers develop student-centered learning through technology integration and project-based approaches.

The Essentials Course consists of instruction delivered through 8 curricular modules. The course curriculum supports:

- Instructional design, project approaches, multiple methods of assessment, and promotion of 21st century skills
- Effective use of technology in the classroom
- Instructional uses of new communication and collaborative learning technologies
- Research and productivity strategies and tools
- Problem-solving and working in teams

### **Intel® Teach Essentials Course curriculum**

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- [Module 1: Teaching with Projects](#)
- [Module 2: Planning My Unit](#)
- [Module 3: Making Connections](#)
- [Module 4: Creating Samples of Learning](#)
- [Module 5: Assessing Student Projects](#)
- [Module 6: Planning for Student Success](#)
- [Module 7: Facilitating with Technology](#)
- [Module 8: Showcasing Unit Portfolios](#)

### **Transforming America in Education**

#### **Summary of Main Points**

# Transforming American Education:

Please visit the website where Arnie Duncan from the US Department of Education addresses the plan and copies of the executive summary and full plan can be found.

<http://www.ed.gov/technology/netp-2010?page=1>

March 5, 2010 Draft

## **National Educational Technology Plan 2010**

Office of Educational Technology U.S. Department of Education

This plan is calling for educators to leverage technology to engage and provide powerful learning experiences, content, resources, and assessments. They are recommending technology based assessments to gather data.

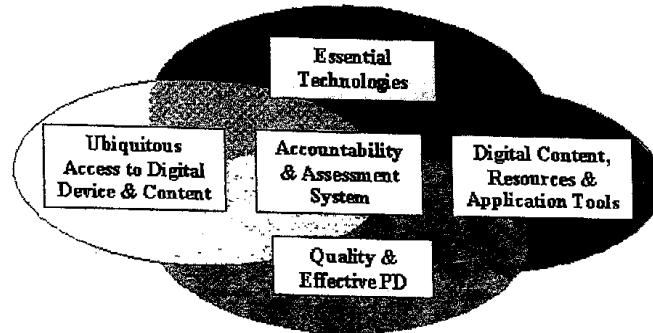
The report breaks up its recommendations into the following areas:

1. Learning: *“The model of 21st century learning described in this plan calls for engaging and empowering learning experiences for all learners. The model asks that we focus what and how we teach to match what people need to know, how they learn, where and when they will learn, and who needs to learn. It brings state-of-the art technology into learning to enable, motivate, and inspire all students, regardless of background, languages, or disabilities, to achieve. It leverages the power of technology to provide personalized learning instead of a one-size-fits-all curriculum, pace of teaching, and instructional practices.”*
2. Assessment: *“The model of 21st century learning requires new and better ways to measure what matters, diagnose strengths and weaknesses in the course of learning when there is still time to improve student performance, and involve multiple stakeholders in the process of designing, conducting, and using assessment. In all these activities, technology-based assessments can provide data to drive decisions on the basis of what is best for each and every student and that in aggregate will lead to continuous improvement across our entire education system”*
3. Teaching: *“Just as leveraging technology can help us improve learning and assessment, the model of 21st century learning calls for using technology to help build the capacity of educators by enabling a shift to a model of connected teaching. In such a teaching model, teams of connected educators replace solo practitioners and classrooms are fully connected to provide educators with 24/7 access to data and analytic tools as well as to resources that help them act on the insights the data provide.”*
4. Infrastructure: *“An essential component of the 21st century learning model is a comprehensive infrastructure for learning that provides every student, educator, and level of our education system with the resources they need when and where they are needed. The underlying principle is that infrastructure includes people, processes, learning resources, policies, and sustainable models for continuous improvement in addition to broadband connectivity, servers, software, management systems, and administration tools. Building this infrastructure is a far-reaching project that will demand concerted and coordinated effort”*.
5. Production: *“To achieve our goal of transforming American education, we must rethink basic assumptions and redesign our education system. We must apply technology to implement personalized learning and ensure that students are making appropriate progress through our K-16 system so they graduate. These and other initiatives require investment, but tight economic times and basic fiscal responsibility*

*demand that we get more out of each dollar we spend. We must leverage technology to plan, manage, monitor, and report spending to provide decision-makers with a reliable, accurate, and complete view of the financial performance of our education system at all levels. Such visibility is essential to meeting our goals for educational attainment within the budgets we can afford.”*

## APPENDIX E

### Five Essential Modules of the 21<sup>st</sup> Century Student-Centered Active Learning Environment (SCALE 21)



#### Module 1. Essential Classroom Technology for Student-centered Active Learning

For each of the high-need school buildings included in the project, five classrooms must be selected to form a cluster of the Student-Centered Active Learning Environment (SCALE). The selection of the cluster of the classrooms must be based on the specific area(s) of academic needs as identified in 'need for improvement'. Each of the five classrooms in the school building will be adequately equipped and supported with essential technologies for effective teaching and learning. Below is a list of essential technologies adopted from some of the most successful programs in the country. Applicants for the SCALE grants are expected to use the following list as a reference point and develop their own configuration based on the identified academic needs and existing technology capacity in the identified school buildings to ensure a student-centered active learning environment.

##### Core Technology for Classrooms

- Teacher Laptop & Productivity Tools
- Presentation Device - Collaborative Learning System (Interactive Whiteboard, LCD or Plasma TV)
- Projector (if needed for the presentation device or collaborative learning system)
- Learner Response Devices for active Participation, Formative Assessment & Individualized Instruction
- Audio System
- Document Camera
- Color Printer
- Digital Camera
- Video Camera

##### Additional Elements to Consider Based Upon Location and Curricular Goals

- Mobile Learning Lab Carts (must ensure one device per student in the classroom with available swapouts to eliminate downtime for any student and must ensure battery capacity and re-charging protocol to eliminate down time)
- Webcam for Teacher Computers
- Flashdrives for each Student

With the short-term funding, funded districts/consortia should consider strong maintenance contracts and warranties to ensure the technologies' longevity. Funded districts are also strongly urged to

integrate existing technology equipment, digital resources and support capacity with the new project initiatives funded by this grant for cost-effectiveness and greater impact. More importantly, coordination and collaboration with other programs and leveraging resources from existing, local and other NCLB/ARRA funding sources would be highly valued.

### **Module 2. Digital Content, Application Tools, Resources and Solutions**

The focus of the SCALE is *classroom transformation*. The project focuses on the classrooms as the fundamental units of school change initiatives. District-wide or region-wide support system(s) are expected to be in place to support the implementation of the initiative. Such district-wide, city-wide or region-wide support systems may include data-driven decision-making and/or learning management systems, educational resource portals, online learning, etc. The following are identified as common systems in supporting successful implementation of the SCALE initiative.

- **Student Performance Data System**
- **Student-centric Learning Management Systems**
- **Education Portals** – with quality and rich digital content and resources
- **Web 2.0 Tools** – for engaging and interactive learning experiences
- **Digital Tools and Software** – for active learning and “real” problem solving
- **Virtual Learning** – for expanding learning opportunities with online learning courses and support resources

### **Module 3. Professional development for integration of proficiencies and skills in core content, pedagogy and technology application**

As the objective of the program is to systemically transform schools, funded projects must focus on systemic change in the belief system, learning materials as well as teaching and learning process and engage professional learning/development for not only classroom teachers, but also, as importantly, school building administrators, curriculum leaders, and student leaders to promote common understanding and coherent efforts to transform the learning environment. As professional development is an essential key to the success of a technology-integration program, a comprehensive framework of professional development for technology integration by Mishra & Koehler (*TPACK, 2006*) must be used as the guiding framework for mapping and developing professional development strategies and activities in support of the creation of the SCALE classrooms.

The following list of professional learning focuses and requirements is provided as a reference for consideration in the module development and implementation.

#### **Guide for Required Core Professional Learning and Development**

- 80-100 hours participation in professional learning activities and 5 – 7 classroom visits/observations over 15 months (including Intel Teach Program 15-30 hours).
- Standards-aligned curriculum and instructional materials and resources
- Access and use of student-centric learning management system and assessment reporting tools
- Essential proficiency and skills in using provided technologies, following ISTE's National Education Technology Standards for Teachers (NETS-T, 2007)
- Communication and collaboration tools (email, blog, wikispace, collaboration, social networking, etc)
- Professional learning activities on technology integration proficiency and knowledge which includes the intersected areas of technology, core content, and pedagogy
- One online course on technology integration
- Digital authoring and publishing tools

- Other (0.5 FTE education technology integration specialist per SCALE building...)

In support of teachers' professional and growth and meaningful technology integration for new modalities of teaching and learning, corresponding professional development activities and experiences should be provided to school building administrators and student leaders to foster long-lasting change in culture, accountability and support system.

**Module 4. Ubiquitous access to technology and resources for equitable and expanded learning opportunities.**

Ubiquitous access to technology is defined in four areas:

- Texas' [Technology Immersion Pilot \(TIP\) Program](#) <sup>CS</sup> uninterrupted access to the Internet with adequate bandwidth by students and teachers in schools and beyond in order to acquire media rich digital resources for learning.
- Uninterrupted access to technology equipment and/or devices by teachers and students to engage in effective learning in classrooms, school buildings and/or beyond.
- Access to high quality and engaging digital content and resources for teachers and students to enhance teaching, enrich and expand learning opportunities through district's enterprise/virtualized network.
- Access to quality online courses and digital resources for both teachers and students to expand learning opportunities; for teachers to engage in professional learning and for students to enrich their learning experiences and earn credits towards graduation at any time, any place and any pace.

Given specific needs, capacity and resources, technology configuration for ubiquitous access to technology and expanding learning opportunities in classroom and beyond, funded district's equipment and/or devices may vary in form from a one-to-one student laptop/netbook implementation to a ubiquitous access scenario where students use mobile labs, digital devices and digital resources in class and shared technology resources in school, community and/or home. Each strategy must address the goal of promoting students' ubiquitous access to technology and digital resources. It is important for funded projects to base their strategies on evidence-based promising practices and proven effective implementation strategies.

**Module 5. Accountability and Assessment System for Student-centered Active Learning**

The component of accountability and assessment looks at the alignment between vision, goals, strategies, practices, assessments, and results. It establishes logical connections among the vision, goals, selected strategies and activities; ensures the objectives are tangible and measurable; assessment instruments are appropriate and reliable; and progress, results and impact are properly gauged and adequately documented. It is also an important mechanism to provide timely information on progress and identify needs for adjustment and improvement. It has the following qualities:

- Accountability system aligned to the vision
- Clarity, transparency, and consequences
- Comprehensive, prioritized funding
- Decision making informed by data, research, and results.

Some resources for consideration in program development:

- [Partnership for the 21st Century Skills: the 21st Century Learning Environment](#) <sup>CS</sup>
- [SETDA's 21st Century Learning Environment Models](#) <sup>CS</sup>
- Missouri's [eMINTS Model](#) <sup>CS</sup>
- Texas' [Technology Immersion Project \(TIP\)](#) <sup>CS</sup>

FULL HORIZON REPORT

# THE HORIZON REPORT

2010 EDITION

a collaboration between  
**The New Media Consortium**  
and the  
**eduCause Learning initiative**  
*an eduCause Program*

**The 2010 Horizon Report is  
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an eduCause Program**

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# eXeCuTiVe suMMaRy

The annual *Horizon Report* describes the continuing work of the New Media Consortium's Horizon Project, a qualitative research project established in 2002 that identifies and describes emerging technologies likely to have a large impact on teaching, learning, or creative inquiry on college and university campuses within the next five years. The *2010 Horizon Report* is the seventh in the series and is produced as part of an ongoing collaboration between the New Media Consortium (NMC) and the EDUCAUSE Learning Initiative (ELI), an EDUCAUSE program.

In each edition of the *Horizon Report*, six emerging technologies or practices are described that are likely to enter mainstream use on campuses within three adoption horizons spread over the next one to five years. Each report also presents critical trends and challenges that will affect teaching and learning over the same time frame. In the seven years that the Horizon Project has been underway, more than 400 leaders in the fields of business, industry, technology, and education have contributed to this long-running primary research effort. They have drawn on a comprehensive body of published resources, current research and practice, their own considerable expertise, and the expertise of the NMC and ELI communities to identify technologies and practices that are beginning to appear on campuses or are likely to be adopted in the next few years. The 2010 Advisory Board, like those before it, considered a broad picture of emerging technology and its intersection with the academic world through a close examination of primary sources as well as through the lens of their own experiences and perspectives. The research methodology employed in producing the report is detailed in a special section that follows the body of the report.

The report's format is consistent from year to year, opening with a discussion of the trends and challenges identified by the Advisory Board as most critical for the next five years. The format of the main section closely reflects the focus of the Horizon Project itself, centering on the applications

of emerging technologies to teaching, learning, and creative inquiry. Each topic is introduced with an overview that describes what it is, followed by a discussion of the particular relevance of the topic to education, creativity, or research. Examples of how the technology is being, or could be applied to those activities are given. Finally, each section closes with an annotated list of suggested readings and additional examples that expand on the discussion in the report and a link to the tagged resources collected during the research process by project staff, the Advisory Board, and others in the growing Horizon Project community.

## Key Trends

The technologies featured in each edition of the *Horizon Report* are embedded within a contemporary context that reflects the realities of the time, both in the sphere of academia and in the world at large. To assure this perspective, each Advisory Board researches, identifies, and ranks key trends that are currently affecting the practice of teaching, learning, and creative inquiry, and uses these as a lens for its later work. These trends are surfaced through an extensive review of current articles, interviews, papers, and new research. Once identified, the list of trends is ranked according to how significant an impact they are likely to have on education in the next five years. The following four trends have been identified as key drivers of technology adoptions for the period 2010 through 2015; they are listed here in the order they were ranked by the Advisory Board.

- *The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators in sense-making, coaching, and credentialing.* Institutions must consider the unique value that each adds to a world in which information is everywhere. In such a world, sense-making and the ability to assess the credibility of information are paramount. Mentoring and preparing students for the world in which they will live, the central role of the university when it



achieved its modern form in the 14th century, is again at the forefront. Universities have always been seen as the gold standard for educational credentialing, but emerging certification programs from other sources are eroding the value of that mission daily.

- *People expect to be able to work, learn, and study whenever and wherever they want to.* Life in an increasingly busy world where learners must balance demands from home, work, school, and family poses a host of logistical challenges with which today's ever more mobile students must cope. A faster approach is often perceived as a better approach, and as such people want easy and timely access not only to the information on the network, but to their social networks that can help them to interpret it and maximize its value. The implications for informal learning are profound, as are the notions of "just-in-time" learning and "found" learning, both ways of maximizing the impact of learning by ensuring it is timely and efficient.
- *The technologies we use are increasingly cloud-based, and our notions of IT support are decentralized.* The continuing acceptance and adoption of cloud-based applications and services is changing not only the ways we configure and use software and file storage, but even how we conceptualize those functions. It does not matter where our work is stored; what matters is that our information is accessible no matter where we are or what device we choose to use. Globally, in huge numbers, we are growing used to a model of browser-based software that is device-independent. While some challenges still remain, specifically with notions of privacy and control, the promise of significant cost savings is an important driver in the search for solutions.
- *The work of students is increasingly seen as collaborative by nature, and there is more cross-campus collaboration between departments.* While this trend is not as widespread as the others listed here, where schools have created

a climate in which students, their peers, and their teachers are all working towards the same goals, where research is something open even to first year students, the results have shown tantalizing promise. Increasingly, both students and their professors see the challenges facing the world as multidisciplinary, and the need for collaboration great. Over the past few years, the emergence of a raft of new (and often free) tools has made collaboration easier than at any other point in history.

## Critical Challenges

Along with current trends, the Advisory Board notes critical challenges that face learning organizations, especially those that are likely to continue to affect education over the five-year time period covered by this report. Like the trends, these are drawn from a careful analysis of current events, papers, articles, and similar sources, as well as from the personal experience of the Advisory Board members in their roles as leaders in education and technology. Those challenges ranked as most significant in terms of their impact on teaching, learning, and creative inquiry in the coming years are listed here, in the order of importance assigned them by the Advisory Board.

- *The role of the academy — and the way we prepare students for their future lives — is changing.* In a 2007 report, the American Association of Colleges and Universities recommended strongly that emerging technologies be employed by students in order for them to gain experience in "research, experimentation, problem-based learning, and other forms of creative work," particularly in their chosen fields of study. It is incumbent upon the academy to adapt teaching and learning practices to meet the needs of today's learners; to emphasize critical inquiry and mental flexibility, and provide students with necessary tools for those tasks; to connect learners to broad social issues through civic engagement; and to encourage them to apply their learning to solve large-scale complex problems.

- *New scholarly forms of authoring, publishing, and researching continue to emerge but appropriate metrics for evaluating them increasingly and far too often lag behind.* Citation-based metrics, to pick one example, are hard to apply to research based in social media. New forms of peer review and approval, such as reader ratings, inclusion in and mention by influential blogs, tagging, incoming links, and retweeting, are arising from the natural actions of the global community of educators, with increasingly relevant and interesting results. These forms of scholarly corroboration are not yet well understood by mainstream faculty and academic decision makers, creating a gap between what is possible and what is acceptable.
- *Digital media literacy continues its rise in importance as a key skill in every discipline and profession.* The challenge is due to the fact that despite the widespread agreement on its importance, training in digital literacy skills and techniques is rare in any discipline, and especially rare in teacher education programs. As faculty and instructors begin to realize that they are limiting their students by not helping them to develop and use digital media literacy skills across the curriculum, the lack of formal training is being offset through professional development or informal learning, but we are far from seeing digital media literacy as a norm. This reality is exacerbated by the fact that as technology continues to evolve, digital literacy must necessarily be less about tools and more about ways of thinking and seeing, and of crafting narrative. That is why skills and standards based on tools and platforms have proven to be somewhat ephemeral and difficult to sustain.
- *Institutions increasingly focus more narrowly on key goals, as a result of shrinking budgets in the present economic climate.* Across the board, institutions are looking for ways to control costs while still providing a high quality of service. Schools are challenged by the need to support a steady — or growing — number of students with fewer resources and staff than before. In

this atmosphere, it is critical for information and media professionals to emphasize the importance of continuing research into emerging technologies as a means to achieve key institutional goals. As one example, knowing the facts about shifting server- and network-intensive infrastructure, such as email or media streaming, off campus in the current climate might present the opportunity to generate considerable annual savings.

These trends and challenges are having a profound effect on the way we experiment with, adopt, and use emerging technologies. These aspects of the world that surround and permeate academia serve as a frame for considering the probable impacts of the emerging technologies listed in the sections that follow.

## Technologies to watch

The six technologies featured in each *Horizon Report* are placed along three adoption horizons that indicate likely time frames for their entrance into mainstream use for teaching, learning, or creative inquiry. The near-term horizon assumes the likelihood of entry into the mainstream for institutions within the next twelve months; the mid-term horizon, within two to three years; and the far-term, within four to five years. It should be noted that the *Horizon Report* is not a predictive tool. It is meant, rather, to highlight emerging technologies with considerable potential for our focus areas of teaching, learning, and creative inquiry. Each of them is already the focus of work at a number of innovative institutions around the world, and the work we showcase here reveals the promise of a wider impact.

**on the near-term horizon** — that is, within the next 12 months — are *mobile computing* and *open content*.

**Mobile computing**, by which we mean use of the network-capable devices students are already carrying, is already established on many campuses, although before we see widespread use, concerns about privacy, classroom management, and access will need to be



addressed. At the same time, the opportunity is great; virtually all higher education students carry some form of mobile device, and the cellular network that supports their connectivity continues to grow. An increasing number of faculty and instructional technology staff are experimenting with the possibilities for collaboration and communication offered by mobile computing. Devices from smart phones to netbooks are portable tools for productivity, learning, and communication, offering an increasing range of activities fully supported by applications designed especially for mobiles.

**Open content**, also expected to reach mainstream use in the next twelve months, is the current form of a movement that began nearly a decade ago, when schools like MIT began to make their course content freely available. Today, there is a tremendous variety of open content, and in many parts of the world, open content represents a profound shift in the way students study and learn. Far more than a collection of free online course materials, the open content movement is a response to the rising costs of education, the desire for access to learning in areas where such access is difficult, and an expression of student choice about when and how to learn.

**The second adoption horizon** is set two to three years out, where we will begin to see widespread adoptions of two well-established technologies that have taken off by making use of the global cellular networks — *electronic books* and *simple augmented reality*. Both of these technologies are entering the mainstream of popular culture; both are already used in practice at a surprising number of campuses; and both are expected to see much broader use across academia over the next two to three years.

**Electronic books** have been available in some form for nearly four decades, but the past twelve months have seen a dramatic upswing in their acceptance and use. Convenient and capable electronic reading devices combine the activities of acquiring, storing, reading, and annotating

digital books, making it very easy to collect and carry hundreds of volumes in a space smaller than a single paperback book. Already in the mainstream of consumer use, electronic books are appearing on campuses with increasing frequency. Thanks to a number of pilot programs, much is already known about student preferences with regards to the various platforms available. Electronic books promise to reduce costs, save students from carrying pounds of textbooks, and contribute to the environmental efforts of paper-conscious campuses.

**Simple augmented reality** refers to the shift that has made augmented reality accessible to almost anyone. Augmented reality used to require specialized equipment, none of which was very portable. Today, applications for laptops and smart phones overlay digital information onto the physical world quickly and easily. While still two to three years away from widespread use on campuses, augmented reality is establishing a foothold in the consumer sector, and in a form much easier to access than originally envisioned.

**on the far-term horizon**, set at four to five years away for widespread adoption, but clearly already in use in some quarters, are *gesture-based computing* and *visual data analysis*. Neither of these two technologies is yet commonly found in campus settings, but the high level of interest and the tremendous amounts of research in both areas indicates that they are worth following closely.

**Gesture-based computing** is already strong in the consumer market and we are seeing a growing number of prototypical applications for training, research, and study, though this technology is still some time away from common educational use. Devices that are controlled by natural movements of the finger, hand, arm, and body are becoming more common. Game companies in particular are exploring the potential offered by consoles that require no handheld controller, but instead recognize and interpret body motions. As we work with devices that react to

us instead of requiring us to learn to work with them, our understanding of what it means to interact with computers is beginning to change.

**Visual data analysis**, a way of discovering and understanding patterns in large data sets via visual interpretation, is currently used in the scientific analysis of complex processes. As the tools to interpret and display data have become more sophisticated, models can be manipulated in real time and researchers are able to navigate and explore data in ways that were not possible previously. Visual data analysis is an emerging field, a blend of statistics, data mining, and visualization, that promises to make it possible for anyone to sift through, display, and understand complex concepts and relationships.

Each of these technologies is described in detail in the body of the report. These sections open with a discussion of what the technology is and why it is relevant to teaching, learning, and creative inquiry. Examples of the technology in practice, especially in academia, are listed there to illustrate how it is being adopted at the current time. Our research indicates that all six of these technologies, taken together, will have a significant impact on learning-focused organizations within the next five years.

Regular readers of the *Horizon Report* will note that some topics have strong ties to topics that were featured in past editions. Mobile computing, in particular, is the latest aspect of a trend toward smaller, more powerful computing devices that has grown over the past three years. We have watched mobile phones become increasingly capable and flexible. As described here, the topic of mobile computing encompasses handheld devices with the ability to access the Internet, a group of devices that includes the mobile phones most people carry as well as other often specialized devices that are increasingly powerful. The significance of mobile computing is not so much in the device used, but in the ability to easily access an expanding cellular network and fully-featured tools from the palm of your hand.

Simple augmented reality and gesture-based computing also have roots in previous editions.

Augmented reality first appeared in the 2005 *Horizon Report* on the far-term horizon, returning in 2006 with a focus on its applications for visualizing large data sets, a use that is now common in many research labs. Today, augmented reality has become simple and available on the computers and mobile devices we already own. Gesture-based computing is one offshoot of a group of technologies that was noted in the first *Horizon Report*, published in 2004; multimodal interfaces, as this group was called, included gestural as well as other types of input. Gesture-based computing also has ties to context-aware computing, featured in 2005 and as context-aware devices in 2006.

## The Horizon Project

Since March 2002, under the banner of the Horizon Project, the New Media Consortium has held an ongoing series of conversations and dialogs with hundreds of technology professionals, campus technologists, faculty leaders from colleges and universities, and representatives of leading corporations from more than two dozen countries. In each of the past six years, these conversations have resulted in the publication each January of a report focused on emerging technologies relevant to higher education. As the report is produced, an Advisory Board engages in lively dialogs using a wide range of articles, published and unpublished research, papers, scholarly blogs, and websites. The result of these dialogs is a list of the key technologies, trends, challenges, and issues that knowledgeable people in technology industries, higher education, and learning-focused organizations are thinking about.

In 2008 and 2009, the NMC convened additional advisory boards to engage in a new series of regional and sector-based companion editions of the *Horizon Report*, with the dual goals of understanding how technology is being absorbed using a smaller lens, and also noting the contrasts between technology use in one area compared with another. To date, companion editions have been prepared that center on Australia and New Zealand, on the K-12 sector, and on small- to medium-sized businesses.



Each time a report is undertaken, the NMC uses qualitative research methods to identify the technologies selected for inclusion in that report, beginning with a survey of the work of other organizations and a review of the literature with an eye to spotting interesting emerging technologies. When the cycle starts, little is known, or even can be known, about the appropriateness or efficacy of many of the emerging technologies for these purposes, as the Horizon Project expressly focuses on technologies not currently in widespread use in academe. In a typical year, 75 or more of these technologies may be identified for further investigation; for the 2010 report, more than 110 were considered.

By engaging a wide community of interested parties, and diligently searching the Internet and other sources, enough information is gathered early in the process to allow the members of the Advisory Board to form an understanding of how each of the discovered technologies might be in use in settings outside of academe, to develop a sense of the potential the technology may have for higher education settings, and to envision applications of the technology for teaching, learning, and creative inquiry. The findings are discussed in a variety of settings — with faculty, industry experts, campus technologists, and of course, the Horizon Advisory Board. Of particular interest to the Advisory Board every year is finding educational applications for these technologies that may not be intuitive or obvious.

Increasingly the Horizon Project is a global effort. Each year at least a third of the members of the advisory board represent countries outside of North

America. Since 2007, with the aid of the Universitat Oberta de Catalunya, the *Horizon Report* has been translated into Spanish and Catalan. In 2008, the Horizon Project expanded with the publication of its first-ever regional report, the *2008 Horizon Report: Australia-New Zealand Edition*. The *2009 Horizon Report* was also translated into Japanese, German, and Chinese, as well as Spanish and Catalan, and plans are in place to add to those translations for the current report. In 2010, in partnership with the Universitat Oberta de Catalunya, a new Spanish-language report is planned especially for Ibero-America that will look at the entire body of work from the project.

Each *Horizon Report* is produced over a period of just a few months so that the information is timely and relevant. This year, the effort to produce the report began in September 2009, and concluded when the report was released in January 2010, a period of just over four months. The six technologies and applications that emerged at the top of the final rankings — two per adoption horizon — are detailed in the chapters that follow.

Each of those chapters includes detailed descriptions, links to active demonstration projects, and a wide array of additional resources related to the six profiled technologies. Those profiles are the heart of the *2010 Horizon Report*, and will fuel the work of the Horizon Project throughout 2010-11. For those wanting to know more about the processes used to generate the *Horizon Report*, many of which are ongoing and extend the work in the report, we refer you to the report's final section on the research methodology.

# MOBILE COMPUTING

## Time-to-adoption Horizon: one Year or Less

*The available choices for staying connected while on the go are many — smart phones, netbooks, laptops, and a wide range of other devices access the Internet using cellular-based portable hotspots and mobile broadband cards, in addition to wi-fi that is increasingly available wherever people congregate. At the same time, the devices we carry are becoming ever more capable, and the boundaries between them more and more blurred. In the developed world, mobile computing has become an indispensable part of day-to-day life in the workforce, and a key driver is the increasing ease and speed with which it is possible to access the Internet from virtually anywhere in the world via the ever-expanding cellular network.*

### overview

Mobiles as a category have proven more interesting and more capable with each passing year, and continue to be a technology with new surprises. The mobile market today has nearly 4 billion subscribers, more than two-thirds of whom live in developing countries. Well over a billion new phones are produced each year, a flow of continuous enhancement and innovation that is unprecedented in modern times. The fastest-growing sales segment belongs to smart phones — which means that a massive and increasing number of people all over the world now own and use a computer that fits in their hand and is able to connect to the network wirelessly from virtually anywhere. Thousands of applications designed to support a wide range of tasks on virtually any smart-phone operating system are readily available, with more entering the market all the time. These mobile computing tools have become accepted aids in daily life, giving us on-the-go access to tools for business, video/audio capture and basic editing, sensing and measurement, geolocation, social networking, personal productivity, references, just-in-time learning — indeed, virtually anything that can be done on a desktop.

Users increasingly expect anytime, anywhere access to data and services that not very long ago were available only while sitting in front of a computer linked to the network via a cable. In addition to the typical software for email, communication, and calendaring, new tools allow users to manage personal information (such as Evernote, Nozbe,

Wesabe, and Triplt), collaborate and easily access and share files (Dropbox and CalenGoo are two of many possible examples), or keep abreast of social networks (Limbo, Facebook, Foursquare, Whrrl), and generally make checking and updating work, school, or personal information flows something easily done on the fly.

For many people all over the world, but especially in developing countries, mobiles are increasingly the access point not only for common tools and communications, but also for information of all kinds, training materials, and more. An ever more common pattern is for people to look to mobile computing platforms as their device of choice, as they are often far cheaper than desktop or laptop computers. For this group, mobile computing devices are more affordable, more accessible, and easier to use than desktop computers, and provide more than enough functionality to serve as their primary computing device.

A middle ground for those who need a little more flexibility and power from a mobile platform includes netbooks, smartbooks, or other specialized devices. Smaller and lighter than a laptop, this category of devices can access the Internet via multiple networks. Netbooks run typical productivity and communications applications, using a standard keyboard and a compact laptop-like design. More specialized devices, like ebooks, email readers, and others are customized for a single purpose. The advantages they offer are storage and portability; the Kindle, for instance, makes it easy to carry a library

full of reading material, while the Peek email reader delivers email access on a very compact device.

less time

## relevance for Teaching, Learning, or Creative inquiry

The portability of mobile devices and their ability to connect to the Internet almost anywhere makes them ideal as a store of reference materials and learning experiences, as well as general-use tools for fieldwork, where they can be used to record observations via voice, text, or multimedia, and access reference sources in real time. At Ball State University, students gather meteorological data around campus, using Twitter on mobile devices to aggregate and disseminate their findings. At the University of Kansas, geology labs are being augmented by carefully designed field experiments that students can complete in blocks of three hours.

As faculty use of mobile computing has grown, studies have begun to emerge documenting the efficacy of both the tools and the techniques used to employ them. At Abilene Christian University, for example, all incoming freshmen were issued an iPhone or iPod Touch in 2009, providing a broad canvas upon which to explore the use of mobiles for instruction. One section of a chemistry course received laboratory preparation and safety lectures via podcast for mobile devices rather than in the classroom; performance scores for these students indicated that the mobile lectures were equally effective. At Franklin & Marshall College, sixteen faculty in the year-long mLearning Pilot Project are using iPod Touches to explore ways mobile computing can be used in teaching, learning, and research in disciplines like history, psychology, religious studies, world languages, government, classics, and more.

A Houston Community College pilot held in spring 2009 compared study habits of two groups of students enrolled in the same anatomy course. One group, issued mobile devices, was found to work on the course during spare moments such as while waiting for appointments. The other group, using only desktop computers, appeared to spend

overall working with the course content online. At the Open University of Catalunya (UOC), where many students commute or attend classes around full-time work schedules, course materials are made available not only in paper format, but also in audio, video, and text formats designed for mobile access. The University of Waterloo, another campus with a large commuter population, piloted delivery of materials for online courses to the BlackBerry platform. The response was very positive, and students noted increased time spent accessing course materials as well as higher levels of collaboration with classmates.

The potential of mobile computing is being demonstrated in hundreds of projects at higher education institutions. Students in the University of Alabama's Computer-Based Honors program, for example, are developing an application for the iPhone and iPod Touch that will deliver blood-sugar check reminders to patients with type 2 diabetes and provide resources about diabetes management, as well as collect information on how patients using the tool are succeeding in keeping their blood sugar under control. These data will be used in a research project comparing the effects of standard patient-care practices with self-management practices as facilitated by the mobile application. A custom tool developed at Purdue University, Hotseat (<http://purdue.edu/hotseat>), allows students to use their mobile devices to contribute to discussions, ask and answer questions, and respond to teacher prompts through any of several channels, including Facebook, Twitter, the Hotseat mobile application, or a web application. Students in a history course at the University of Texas-Dallas used Twitter to discuss course topics during class; the tweets were displayed on a large screen to encourage cross-group communication.

A sampling of other applications of mobile computing across a variety of disciplines includes the following:

- **Chemistry.** At Bluegrass Community & Technical

College, outdoor fieldwork has replaced many "cookbook" chemistry labs. Students use tablet

PCs to record and analyze field research, present their findings, and compare results in real time.

- **History.** The Edinburgh College of Art, the University of Edinburgh, and the EDINA Data Centre collaboratively developed a mobile app called Walking Through Time. The app overlays historical maps onto current maps of the viewer's location, showing street views and areas of interest from prior times.
- **information Technology.** Students at the University of Michigan developed an application for Google's Android platform that measures power consumption on mobiles. The app, called PowerTutor, is designed to help software developers create more efficient applications.
- **Medicine.** Harvard Medical School has released an iPhone app about the H1N1 virus, including maps of outbreaks, a symptom checker, and tips for avoiding infection or dealing with illness. The app is the first in a planned series of mobile applications developed at HMS in collaboration with medical school scientists and doctors.

## Mobile Computing in Practice

The following links provide examples of mobile computing.

### Cellular Colleges: The Next small Thing

<http://www.universitybusiness.com/viewarticle.aspx?articleid=1233>

(James Martin and James E. Samels, *University Business*, February 2009.) Following the lead of Japan's Fukuoka-based Cyber University, several colleges in the United States are now planning full, media-rich courses delivered via smart phone.

### CMu students, Professors find benefits with iPod Technology in Classroom

<http://www.news.cmich.edu/2009/10/cmu-students-professors-find-b/>

(*The News @ Central*, 28 October 2009.) Students in Central Michigan University's

Introduction to Teaching Course — which serves nearly 650 freshmen and transfer students — use mobile devices to access reference material, respond to professors' questions, and take polls during class.

### iPhone the body electric

<http://www.unews.utah.edu/p/?r=092409-2>

At the University of Utah, researchers have developed a suite of mobile apps to allow scientists, students, doctors, and patients to study human anatomy, visualize large data sets in 3D, manipulate and analyze large numbers of high-resolution images, and evaluate medical problems.

### Mobile Libraries

<http://www.lib.ncsu.edu/m/about.html>

The North Carolina State University library now offers a mobile application that provides a catalog search, information about computer availability in labs, and access to a reference librarian.

### san francisco Museum of Modern art Mobile Tours

<http://www.sfmoma.org/events/1556>

The San Francisco Museum of Modern Art is offering two new mobile applications: Making Sense of Modern Art Mobile and the Rooftop Garden iPhone Tour. MSOMA Mobile is available on iPod Touches that may be borrowed by museum visitors and includes interviews with architects, artists, and curators; video footage; and music and poetry related to the collection. The Rooftop Garden tour is available at no cost as an application in the iTunes Store.

### smartphones fill Med school Prescription

<http://www.allbusiness.com/health-care/health-care-professionals-physicians-surgeons/13161277-1.html>

At the University of Louisville School of Medicine, residents use smartphones instead of prescription pads and multiple reference books. Patients and residents alike approve of the new system.

## for further reading

The following articles and resources are recommended for those who wish to learn more about mobile computing.

### gsm Coverage Maps

<http://www.gsmworld.com/Roaming/Gsminfo/Index.Shtml>

GSM World provides detailed information about cellular network operators worldwide, as well as up-to-date coverage maps for countries around the globe. Specific details included are network, roaming, services (including broadband), and coverage information for over 860 networks in 220 countries or areas of the world.

### The Mobile Campus

<http://www.insidehighered.com/news/2009/09/21/iphones>

(Steve Kolowich, *Inside Higher Ed*, 21 September 2009.) One year after implementing its campus-wide policy of issuing each freshman an iPhone or iPod Touch, Abilene Christian University challenged instructors to integrate mobile learning into their classes and surveyed the campus community about the results.

### MoCa: gathering instant student feedback on Mobile devices

<http://www.utexas.edu/academic/dia/about/postcards>

This case study from the University of Texas at Austin describes the Mobile Ongoing Course Assessment (MOCA) tool developed by the Division of Instructional Innovation and Assessment. MOCA is used to assess student learning and engage students in discussion. MOCA may be accessed from any web-capable mobile device.

### Teaching with Technology face-off: iPhones vs. PCs

<https://chronicle.com/blogPost/Teaching-With-Technology/4547>

(Jeffrey R. Young, *The Chronicle of Higher Education*, 25 February 2009.) One professor found that students with access to an iPhone studied more than those who used only a PC.

### Delicious: Mobile Computing

<http://delicious.com/tag/hz10+mobile>

Follow this link to find additional resources tagged for this topic and this edition of the *Horizon Report*. To add to this list, simply tag resources with “hz10” and “mobile” when you save them to *Delicious*.

# oPeN CoNTeNT

## Time-to-adoption Horizon: one Year or Less

*The movement toward open content reflects a growing shift in the way academics in many parts of the world are conceptualizing education to a view that is more about the process of learning than the information conveyed in their courses. Information is everywhere; the challenge is to make effective use of it. Part of the appeal of open content is that it is also a response to both the rising costs of traditionally published resources and the lack of educational resources in some regions, and a cost-effective alternative to textbooks and other materials. As customizable educational content is made increasingly available for free over the Internet, students are learning not only the material, but also skills related to finding, evaluating, interpreting, and repurposing the resources they are studying in partnership with their teachers.*

### overview

A new educational perspective, focused on collective knowledge and the sharing and reuse of learning and scholarly content, has been gaining ground across the globe for nearly a decade. Open content has now come to the point that it is rapidly driving change in both the materials we use and the process of education. At its core, the notion of open content is to take advantage of the Internet as a global dissemination platform for collective knowledge and wisdom, and to design learning experiences that maximize the use of it.

Open content, as described here, has its roots in a number of seminal efforts, including the Open Content Project, MIT's Open Courseware Initiative (OCW), the Open Knowledge Foundation, and work by the William and Flora Hewlett Foundation and others. Many of these projects focused on creating collections of sharable resources and on devising licenses and metadata schemata. The groundswell of interest in open content described here is differentiated from early work by its primary focus on the use of open content and its place in the curriculum. The role of open content producers has evolved as well, away from the idea of authoritative repositories of content and towards the broader notion of content being both free and ubiquitous. Building on the trailblazing models of institutions like MIT, schools like Tufts University (and many others) now consider making their course materials available to the public a social responsibility.

An outgrowth of that perspective is the emergence of open-content textbooks that can be “remixed” — that is, customized, modified, or combined with other materials — and a number of publishers are finding ways to support authors of such materials. One such publisher, Flat World Knowledge, provides access to textbooks authored for open use, making it very easy for faculty to individually tailor a text for use in their own class. Flat World Knowledge operates as a publisher, reviewing book submissions and using a traditional editing process before release; however, electronic copies of the textbooks are free. Students only pay for print copies, and authors receive royalties for these purchases whether the book has been customized or not.

At the center of many discussions of open content are the challenges of sharing, repurposing, and reusing scholarly works; related to those discussions are concerns about intellectual property, copyright, and student-to-student collaboration, and solid work has been done by groups such as Creative Commons, the Academic Commons, Science Commons, and others to address many of the concerns commonly voiced. Many believe that reward structures that support the sharing of work in progress, ongoing research, highly collaborative projects, and a broad view of what constitutes scholarly publication are key challenges that institutions need to solve. Also to be addressed are reputation systems, peer review processes, and new models for citation of the new



forms of content that are likely outgrowths of open content initiatives.

While a number of highly structured projects exist to provide access to open content, in general, the open content community is diffuse and distributed; learning to find useful resources within a given discipline, assess the quality of content available, and repurpose them in support of a learning or research objective are in and of themselves valuable skills for any emerging scholar, and many adherents of open content list that aspect among the reasons they support the use of shareable materials.

### relevance for Teaching, Learning, or Creative inquiry

Open content shifts the learning equation in a number of interesting ways; the most important is that its use promotes a set of skills that are critical in maintaining currency in any discipline — the ability to find, evaluate, and put new information to use. Almost as important is that the same set of materials, once placed online and made sharable via the appropriate licensing, can inform a wide variety of learning modalities, not the least of which is learning for the sheer joy of discovery.

Communities of practice and learning communities have formed around open content in a great many disciplines, and provide practitioners and independent learners alike an avenue for continuing education. OpenLearn (<http://openlearn.open.ac.uk>), a project of the Open University in the U.K., offers anyone the opportunity to join a study group while working through their open course content. OpenLearn practices a method known as “supported open learning,” in which students work through content at their own pace with help and guidance from a tutor. Faculty communities of practice are flourishing as well; at Trinity University, for example, faculty endorsed an Open Access policy that enables them to place copies of their scholarly works in an open-access repository shared by several liberal arts colleges.

Many sources of open content can easily be found in Creative Commons (<http://creativecommons.org>),

Teachers Without Borders (<http://www.teacherswithoutborders.org>), and other online communities, while portals like Folksemantic (<http://www.folksemantic.com>) offer a single point of entry to many open content offerings. Learning communities associated with services like Diigo or Twine can point educators in the right direction via the social networking equivalent of “word of mouth.”

A sampling of other open content projects across disciplines includes the following:

- **art History.** Smarthistory, an open educational resource dedicated to the study of art, seeks to replace traditional art history textbooks with an interactive, well-organized website. Search by time period, style, or artist (<http://smarthistory.org>).
- **graduate studies.** The Tokyo Institute of Technology offers 35 graduate level courses, open and free of charge, in the schools of science and engineering, bioscience and biotechnology, innovation management, and others.
- **Health sciences.** The Johns Hopkins Bloomberg School of Public Health provides open-access classes to further the goal of improving global understanding of health-related issues. Courses include the school’s most popular subjects, including adolescent health, infectious disease, genetics, and aging.
- **Literature.** *Looking for Whitman* (<http://lookingforwhitman.org>) is an open-access, multi-institutional experiment, dedicated to the study of the life and works of Walt Whitman.

### open Content in Practice

The following links provide examples of open content.

#### american Literature before 1860 <http://enh241.wetpaint.com>

Students in this course, held at Mesa Community College, contribute to the open course material as part of their research. MCC also features a number of lectures on YouTube (see <http://www.youtube.com/user/mesacc#p/p>).

## Carnegie Mellon university's open Learning initiative

<http://oli.web.cmu.edu/openlearning>

The Open Learning Initiative offers instructor-led and self-paced courses; any instructor may teach with the materials, regardless of affiliation. In addition, the courses include student assessment and intelligent tutoring capability.

## Connexions

<http://cnx.org>

Connexions offers small modules of information and encourages users to piece together these chunks to meet their individual needs.

## escholarship: university of California

[http://escholarship.org/about\\_escholarship.html](http://escholarship.org/about_escholarship.html)

eScholarship provides peer review and publishing for scholarly articles, books, and papers, using an open content model. The service also includes tools for dissemination and research.

## MiT openCourseware

<http://ocw.mit.edu>

The Massachusetts Institute of Technology publishes lectures and materials from most of its undergraduate and graduate courses online, where they are freely available for self-study.

## open.Michigan's dscribe Project

<https://open.umich.edu/projects/oer.php>

The University of Michigan's Open.Michigan initiative houses several open content projects. One, dScribe, is a student-centered approach to creating open content. Students work with faculty to select and vet resources, easing the staffing and cost burden of content creation while involving the students in developing materials for themselves and their peers.

## oTter

<http://www.le.ac.uk/otter>

The University of Leicester's OTTER project (Open, Transferable and Technology-enabled Educational Resources) pilots and evaluates systems for releasing educational content under an open license.

## for further reading

The following articles and resources are recommended for those who wish to learn more about open content.

### Center for social Media Publishes New Code of best Practices in oCw

<http://criticalcommons.org/blog/content/center-for-social-media-publishes-new-code-of-best-practices-in-ocw>

(Critical Commons, 25 October 2009.) The advocacy group Critical Commons seeks to promote the use of media in open educational resources. Their *Code of Best Practices in Fair Use for Open-CourseWare* is a guide for content developers who want to include fair-use material in their offerings.

### Countries offer different Takes to open online Learning

<http://chronicle.com/article/Countries-Offer-Different/48775>

(Simmi Aujla and Ben Terris, *The Chronicle of Higher Education*, 11 October 2009.) Many countries are using open educational resources to reach students who would otherwise be unable to attend university.

### Creative Commons

<http://www.creativecommons.org>

Creative Commons has created a set of legal tools consistent with the rules of copyright that make it not only possible but easy for people to share and build upon the work of others. The organization provides free licenses that allow anyone to create, share, and use open content.

### flat world Knowledge: a disruptive business Model

<http://industry.bnet.com/media/10003790/flat-world-knowledge-a-disruptive-business-model>

(David Weir, *BNET*, 20 August 2009.) Flat World Knowledge is enjoying rapid growth, from 1,000 students in the spring of 2009 to 40,000 in the fall semester using their materials. The company's business model pays a higher royalty percentage to textbook authors and charges students a great deal less than traditional publishers.

**open Content and the emerging global Meta-university**

**<http://www.educause.edu/EDUCAUSE+Review/EDUCAUSEReviewMagazineVolume41/>**

**[OpenContentandtheEmergingGlobo/158053](#)**

In this article drawn from his 2005 Clair Maple Memorial Address at the Seminars on Academic Computing, MIT President Emeritus Charles Vest discusses open content and outlines the promise and opportunity that drove the creation of MIT OpenCourseWare.

***Delicious: open Content***

**<http://delicious.com/tag/hz10+opened>**

Follow this link to find additional resources tagged for this topic and this edition of the *Horizon Report*. To add to this list, simply tag resources with “hz10” and “opened” when you save them to *Delicious*.

# eLeCTroNiC books

## Time-to-adoption Horizon: Two to Three Years

*As the technology underlying electronic readers has improved and as more titles have become available, electronic books are quickly reaching the point where their advantages over the printed book are compelling to almost any observer. The convenience of carrying an entire library in a purse, pocket, or book bag appeals to readers who find time for a few pages in between appointments or while commuting. Already firmly established in the public sector, electronic books are gaining a foothold on campuses as well, where they serve as a cost-effective and portable alternative to heavy textbooks and supplemental reading selections.*

### overview

Electronic books have reached mainstream adoption in the consumer sector; in 2009, the Kindle was Amazon.com's best selling product, with more than

390,000 titles available. The very first electronic versions of books were those digitized by Project Gutenberg in the 1970s. Electronic books were meant to be read using a computer until the late

1990s; at that time, special devices for reading electronic books, known as e-readers or simply readers, began to appear on the market. The latest readers offer a high fidelity reading experience that offers most of the affordances of the printed book, with enhancements like wireless connectivity and ample storage that allow the typical device to hold more than 1,000 titles.

This ready availability of a selection of capable readers is one of the factors contributing to the success of electronic books. Not only are there many models available to please a variety of tastes — besides the Amazon Kindle, the Sony Reader, the new Barnes & Noble Nook, and a number of reader applications for iPhones, Android phones, and other smartphones have entered the market — but the capabilities of readers have advanced to the point where the experience truly rivals that of reading a paper book. Paper and ink color, font, type size, even the way pages are turned, are all customizable. Text is clear and crisp, with enough contrast to make it easy to read, and the devices are comfortable to hold for long periods of time.

Supported by such a wide variety of readers, electronic books have enjoyed a dramatic rise in popularity over the last year — Kindle editions, for

example, now account for half of Amazon's sales of books available both in print and for the Kindle. Readers of electronic books may be reading more, as well. Kindle owners, according to Amazon, buy three times as many books as they did before they had Kindles; Sony reports that Reader owners download about eight books per month — as compared to fewer than seven books per year purchased by the average American book buyer in 2008<sup>1</sup>.

The list of available titles, already broad and growing rapidly, is spurring that interest. Virtually all new books are available in electronic form, as well as classics, and popular books from the last 50 years. Collections of copyright-free texts, including great works of literature, are available at little or no cost. Publishers are releasing more titles in electronic formats as the popularity grows, leading to a wider selection of current books and new releases. Cost is generally a little lower than buying a paperback edition.

Wirelessly connected readers make purchasing an electronic book a simple matter, often delivering a new volume in less than a minute. Purchases can be made at any time, from virtually any location, at no additional cost, and with no subscription or access fee. The convenience of having an entire library of books, magazines, and newspapers — each remembering exactly where you left off the last time you looked at them — and all in a single, small device is one of the most compelling aspects driving electronic reader sales.

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<sup>1</sup> See *E-Book Fans Are Proving to be Enthusiastic Readers*, NYTimes.com, 20 October 2009 ([http://www.nytimes.com/2009/10/21/technology/21books.html?\\_r=2](http://www.nytimes.com/2009/10/21/technology/21books.html?_r=2)).



## relevance for Teaching, Learning, or Creative Inquiry

While the typical electronic reader could conceivably hold the entire sum of textbooks and readings for the entirety of one's academic experience, campuses have been slower to adopt electronic books than the general public for three primary reasons, but all of them are becoming less of a constraint.

The primary obstacle was simply availability. While a great variety of consumer titles are available electronically, textbooks or academic works have been published in electronic formats far less frequently. Secondly, as the reader technology developed, the ability to easily render high quality illustrations was initially limited. The last obstacle was related to the publishing model. Where electronic versions were available, they were most commonly viewed as ancillary to the printed version, which had to be purchased before the electronic version could be accessed — and the early versions were not in formats compatible with most readers.

Over the past year or so, however, those obstacles have each started to fall away. Many academic titles are now available, and many more are in the pipeline. Amazon, for example, now lists some 30,000 academic titles; all of the major textbook publishers have electronic versions in the Amazon education catalog. Advances in electronic reader technology have brought electronic versions of academic texts to a level with printed ones. The newest readers can display graphics of all kinds and make it easy to bookmark and annotate pages and passages. Annotations can be exported, viewed online, shared, and archived. In addition, electronic readers offer keyword searching, instant dictionary lookups and, in some cases, wireless Internet access. The experience of reading and note taking is becoming as easy in electronic form as it is in paper. Major publishers have largely uncoupled print and electronic sales of academic texts as well.

An encouraging number of colleges and universities are running pilot programs with electronic books.

The Kindle DX, a larger format version of the device expressly built for academic texts, newspapers, and journals, is being piloted at Arizona State University, Ball State University, Case Western Reserve University, Pace University, Princeton, Reed College, Syracuse University, and the University of Virginia Darden School of Business. Northwest Missouri State University and Penn State have embarked on pilots using the Sony Reader. Johns Hopkins is piloting the enTourage eDGe, which combines the functions of an e-reader, a netbook, a notepad, and an audio/video recorder and player in one handheld device. Many other similar projects could be listed here, as the number of campus-based evaluation pilots is large and growing rapidly.

An obvious draw for students is the advantage of having a single handheld reading device that can easily accommodate the entirety of readings involved in one's study, as well as all the essential reference texts. In a pilot program, Seton Hall University's Teaching, Learning & Technology Center found that students appreciated the ability to store and review a semester's worth of material in electronic form.

A survey of current projects shows that electronic books are being explored in virtually every discipline, although full-scale movement to electronic books is still two to three years away. A sampling of projects includes the following:

- **extracurricular reading.** The library at Fairleigh Dickinson University offers a selection of electronic readers that students may check out, including Amazon Kindles, Sony Readers, and iPod Touches. Each reader includes a selection of reference books, popular titles, literature, and more.
- **foreign Language.** First-year French students at the University of Texas at Austin use an online interactive textbook with a print-on-demand component, available in color or black-and-white. The online portion includes audio clips of each part of the text and video clips to explore the culture of France (<http://www.laits.utexas.edu/fi>).

■ **Humanities.** The Humanities E-Book (HEB), offered to institutions on a subscription basis by the American Council of Learned Societies, is a digital collection of 2,200 humanities texts. Students at subscribing institutions may browse and read the collection online or order printed copies on demand.

■ **Physics.** MIT, in conjunction with Ball State University, produced an electronic book to visually demonstrate the principles of electricity and magnetism. ([http://web.mit.edu/viz/EM/flash/E&M\\_Master/E&M.swf](http://web.mit.edu/viz/EM/flash/E&M_Master/E&M.swf)).

## electronic books in Practice

The following links provide examples of the use of electronic books for educational purposes.

### arden students Test the amazon Kindle dX

<http://www.virginia.edu/uvatoday/newsRelease.php?id=9509>

The University of Virginia's Darden School of Business is participating in an Amazon-sponsored program to test the Kindle DX. The pilot aims to assess the effect of electronic books on teaching and learning, determine whether the school can reduce its carbon footprint by employing the devices, and explore potential cost savings for students and the university.

### deepdyve

<http://www.deepdyve.com>

DeepDyve is an extensive online collection of scientific, technical, and medical research. Articles are either open access or premium; premium articles may be rented and read online for twenty-four hours at a cost of \$0.99.

### sony reader Project at The Penn state university Libraries

[http://libraries.psu.edu/psul/ils/sony\\_reader.html](http://libraries.psu.edu/psul/ils/sony_reader.html)

Students may check out a Sony Reader from the library, complete with leisure reading titles including both fiction and non-fiction.

### sophie

<http://sophiecommons.org>

Sophie is an open source tool, maintained by the University of Southern California's School of Cinematic Arts, for creating and reading rich media documents in a networked environment. Sophie authors can easily combine a variety of media — text, images, video, and audio — to develop sophisticated multimedia works.

### swapping Textbooks for e-books

<http://www.edtechmag.com/higher/march-april-2009/swapping-textbooks-for-e-books.html>

(Lee Copeland, *EDTECH*, March-April 2009.)

In a pilot program at Northwest Missouri State University, 500 of the school's 6,500 students will receive electronic textbooks instead of, or in some cases in addition to, printed copies.

## for further reading

The following articles and resources are recommended for those who want to learn more about electronic books.

### 7 Things You Need To Know about sony readers in a Higher ed environment

[http://libraries.psu.edu/etc/medialib/psulpublicmedialibrary/ils/documents.Par.53256.File.dat/7things\\_SonyReader.pdf](http://libraries.psu.edu/etc/medialib/psulpublicmedialibrary/ils/documents.Par.53256.File.dat/7things_SonyReader.pdf)

This white paper from the Penn State University Libraries describes relevant uses of Sony's Reader in the classroom, in the library, and as a tool for the visually disabled. Pros and cons of using e-books are discussed.

### Clive Thompson on the future of reading in a digital world

[http://www.wired.com/techbiz/people/magazine/17-06/st\\_thompson](http://www.wired.com/techbiz/people/magazine/17-06/st_thompson)

(Clive Thompson, *Wired Magazine*, 22 May 2009.) Thompson makes a case for digitizing books: in addition to enhancing sales of the printed book, e-books enable ongoing reader dialogs.

### devices to Take Textbooks beyond Text

<http://www.nytimes.com/2009/12/06/business/06novel.html>

(Anne Eisenberg, *The New York Times*, 5 December 2009.) New e-book readers, in addition to displaying standard text, offer liquid-crystal displays to better show graphics and other items found in color in textbooks.

### e-book fans are Proving to be enthusiastic readers

<http://www.nytimes.com/2009/10/21/technology/21books.html>

(Brad Stone, *The New York Times*, 20 October 2009.) Fans of e-readers suggest that the convenience of using these products, which offer a sense of control and customization that consumers have come to expect from all their media gadgets, has created a greater interest in books.

### How the e-book will Change the way we read and write

<http://online.wsj.com/article/SB123980920727621353.html>

(Steven Johnson, *The Wall Street Journal*, 20 April 2009.) While electronic readers satisfy our desire for instant gratification, they may compromise the sanctity of an author, a reader, and a book. The author predicts that electronic books will fundamentally change the way we interact with the printed word.

### Kindle for the academic

<http://www.insidehighered.com/views/2009/11/03/golub>

(Alex Golub, *Inside Higher Ed*, 3 November 2009.) The author discusses the pros and cons of electronic readers, particularly the Kindle, from the point of view of a reader of academic works (as opposed to textbooks or leisure reading).

### students give e-readers the old College Try

<http://www.columbiatribune.com/news/2009/oct/20/students-give-ereaders-old-college-try>

(*Columbia Daily Tribune*, 20 October 2009.) Students weigh in on the Kindle. Included are benefits and drawbacks from a number of participants in this year's Kindle pilot program.

### Delicious: electronic books

<http://delicious.com/tag/hz10+ebooks>

Follow this link to find additional resources tagged for this topic and this edition of the *Horizon Report*. To add to this list, simply tag resources with "hz10" and "ebooks" when you save them to *Delicious*.

# siMPLe augMentEd reaLiTY

## Time-to-adoption Horizon: Two to Three Years

*While the capability to deliver augmented reality experiences has been around for decades, it is only very recently that those experiences have become easy and portable. Advances in mobile devices as well as in the different technologies that combine the real world with virtual information have led to augmented reality applications that are as near to hand as any other application on a laptop or a smart phone. New uses for augmented reality are being explored and new experiments undertaken now that it is easy to do so. Emerging augmented reality tools to date have been mainly designed for marketing, social purposes, amusement, or location-based information, but new ones continue to appear as the technology becomes more popular. Augmented reality has become simple, and is now poised to enter the mainstream in the consumer sector.*

### overview

The expression *augmented reality* (AR) is credited to former Boeing researcher Tom Caudell, who is believed to have coined the term in 1990. The concept of blending (augmenting) virtual data — information, rich media, and even live action — with what we see in the real world, for the purpose of enhancing the information we can perceive with our senses is a powerful one. Augmented reality itself is older than the term; the first applications of AR appeared in the late 1960s and 1970s. By the

1990s, augmented reality was being put to use by a number of major companies for visualization, training, and other purposes. Now, the technologies that make augmented reality possible are powerful and compact enough to deliver AR experiences to personal computers and mobile devices. Early mobile applications began to appear in 2008, and several augmented reality mapping and social tools are now on the market.

Wireless mobile devices are increasingly driving this technology into the mobile space where the applications offer a great deal of promise. Initially, AR required unwieldy headsets and kept users largely tethered to their desktop computers. The camera and screen embedded in smart phones and other mobile devices now serve as the means to combine real world data with virtual data; using GPS capability, image recognition, and a compass, AR applications can pinpoint where the mobile's camera is pointing and overlay relevant information at appropriate points on the screen.

Augmented reality applications can either be marker-based, which means that the camera must perceive a specific visual cue in order for the software to call up the correct information, or markerless. Markerless applications use positional data, such as a mobile's GPS and compass, or image recognition, where input to the camera is compared against a library of images to find a match. Markerless applications have wider applicability since they function anywhere without the need for special labeling or supplemental reference points.

Currently, many augmented reality efforts are focused on entertainment and marketing, but these will spill into other areas as the technology matures and becomes even more simplified. Layar (<http://layar.com>) has been a leader in this space with AR applications for Android and iPhones. Layar's mobile application features content layers that may include ratings, reviews, advertising, or other such information to assist consumers on location in shopping or dining areas. Other mobile applications that make use of AR for social or commercial purposes include Yelp, another review and rating service; Wikitude, which overlays information from Wikipedia and other sources onto a view of the real world; and a handful of Twitter clients. The mobile media company Ogmento develops AR games for mobiles.

The improvement in technology allows more streamlined approaches and wider user adoption.



Market projections for augmented reality on mobile devices predict revenues of \$2 million in 2010, rising to several hundred million by 2014 (\$350 million, according to ABI Research; Juniper Research's projections are even higher). Augmented reality is poised to enter the mainstream in the consumer sector, and the social, gaming, and location-based applications that are emerging point to a strong potential for educational applications in the next few years.

### relevance for Teaching, Learning, or Creative inquiry

Augmented reality has strong potential to provide both powerful contextual, *in situ* learning experiences and serendipitous exploration and discovery of the connected nature of information in the real world. Mechanics in the military and at companies like Boeing already use AR goggles while they work on vehicles; the goggles demonstrate each step in a repair, identify the tools needed, and include textual instructions as well. This kind of augmented experience especially lends itself to training for specific tasks.

Applications that convey information about a place open the door to discovery-based learning. Visitors to historic sites can access AR applications that overlay maps and information about how the location looked at different points of history. An application currently in development by the EU-funded iTacitus project (<http://itacitus.org/>) will allow visitors to pan across a location — the Coliseum, say — and see what it looked like during an historical event, complete with cheering spectators and competing athletes. People, too, will soon be explored through augmented reality. The TAT Augmented ID application, still in development, uses facial recognition technology to display certain, pre-approved information about a person when he or she is viewed through the camera of a mobile device. SREngine is another augmented reality application, also in development, that will use object recognition to display information about everyday things one encounters in the real world —

comparing prices in a shopping center, for instance, or identifying trees.

Of particular relevance to education is augmented reality gaming. Games that are based in the real world and augmented with networked data can give educators powerful new ways to show relationships and connections. Games using marker technology often include a flat game board or map which becomes a 3D setting when viewed with a mobile device or a webcam. This kind of game could easily be applied to a range of disciplines, including archaeology, history, anthropology, or geography, to name a few. Another approach to AR gaming allows players or game masters to create virtual people and objects, tying them to a specific location in the real world. Players interact with these constructs, which appear when the player approaches a linked location in the real world.

Augmented reality can also be used to model objects, allowing learners to envision how a given item would look in different settings. Models can be generated rapidly, manipulated, and rotated. Students receive immediate visual feedback about their designs and ideas in a way that allows them to spot inconsistencies or problems that need to be addressed. Researchers in the Human Interface Technology Laboratory at the University of Canterbury in New Zealand have created a tool that translates sketches into 3D objects and uses augmented reality to allow students to explore the physical properties and interactions between objects. Simple controls, drawn on slips of paper, are used to alter the properties of the sketched objects (see a demonstration video at [http://www.youtube.com/watch?v=M4qZ0GLO5\\_A](http://www.youtube.com/watch?v=M4qZ0GLO5_A)). At Mauricio De Nassau College in Brazil, architecture students are exploring the possibilities of using augmented reality to project scale models of buildings, cutting down on the time required to construct and present architectural proposals. For another idea of how augmented reality could be applied to the study of architecture, see the concept video *Realtà Aumentata* (<http://vimeo.com/2341387>), created as a thesis project by

a student at the Valle Giulia Faculty of Architecture in Italy.

Augmented books, now just beginning to enter the market, are another interesting application of this technology. The German company Metaio is developing books that include AR elements, such as globes that pop up on the pages. The books are printed normally; after purchase, consumers install special software on their computers and point a webcam at the book to see the visualizations. The technology allows any existing book to be developed into an augmented reality edition after publication; an atlas featuring 3D views of geographic locations is currently in development.

A sampling of applications of simple augmented reality across disciplines includes the following:

- **astronomy.** Google's SkyMap is an augmented reality application that overlays information about the stars and constellations as a user views the sky through the camera on his or her mobile phone. Other astronomy applications, such as pUniverse, key detailed (and precisely oriented) maps of the sky to a user's location and orientation.
- **architecture.** ARSights is a website and tool that allows users to visualize 3D models created in Google's SketchUp. Pointing a webcam at a 2D printout causes a 3D model to appear on the screen. It can be turned and manipulated by moving the sheet of paper (see [http://www.inglobetechnologies.com/en/products/arplugin\\_su/info.php](http://www.inglobetechnologies.com/en/products/arplugin_su/info.php)).
- **Computer science.** The FourEyes Lab at the University of California Santa Barbara is creating a finger-sensing augmented reality program. The software determines the finger positions of the user's hand (spread out, close-fisted, etc.) and moves an illustration on the screen accordingly (causing a rabbit to crouch or jump, for example).

- **student guides.** Graz University of Technology, Austria, has developed campus and museum tours using augmented reality. Looking through the camera on a mobile phone while walking the campus, students see tagged classrooms inside the buildings. At the museum, a virtual tour guide accompanies users through the halls.

## simple augmented reality in Practice

The following links provide examples of simple augmented reality.

### arhrrrr - an augmented reality shooter

[http://www.youtube.com/watch?v=cNu4CluFOcw&feature=player\\_embedded](http://www.youtube.com/watch?v=cNu4CluFOcw&feature=player_embedded)

This video demonstrates an augmented reality game created at Georgia Tech Augmented Environments Lab and the Savannah College of Art and Design Atlanta. The dynamic, interactive game uses a handheld mobile device and a table map — and Skittles.

### aris Mobile Media Learning games

<http://arisgames.org>

ARIS is an alternate reality gaming engine created by the University of Wisconsin's Games, Learning and Society research group. Virtual objects and characters can be placed at certain locations in the physical world; players can interact with them using their mobile devices.

### Mirror worlds

<http://www.augmentedenvironments.org/lab/2009/10>

Students at Georgia Tech have created a tour of campus that switches between a view of an avatar in a virtual world and augmented reality superimposed on the real world. Users choose their view and can move back and forth between the two.

### Video: TaT's augmented reality Concept unveiled

<http://www.engadget.com/2009/07/09/video-tats-augmented-reality-concept-unveiled/>

(Joseph L. Flatley, *Engadget*, 9 July 2009.)  
Swedish company The Astonishing Tribe (TAT)



is developing augmented reality software for mobiles that allows users to tag themselves with their Facebook page, Twitter account, a business card, and more. When a tagged person is viewed through others' mobiles, these tags appear and, when selected, open specific links.

### **wikitude world browser**

[http://www.wikitude.org/world\\_browser](http://www.wikitude.org/world_browser)

With the Wikitude World Browser, users can view their surroundings through the camera on a mobile device, seeing historical information, nearby landmarks, and points of interest. Content is drawn from Wikipedia, Qype, and Wikitude, and users can add information of their own.

### **wimbledon seer app serves augmented reality on a grass Court**

<http://www.fastcompany.com/blog/kit-eaton/technomix/augmented-reality-hits-wimbledon-tennis-championship>

(Kit Eaton, *Fast Company*, 22 June 2009.) An augmented reality app assisted the 500,000 ticket holders at Wimbledon this year. Fans saw information about each match, news feeds, menus of local restaurants, and more superimposed on a view of the venue on their mobiles.

### **for further reading**

The following articles and resources are recommended for those who wish to learn more about simple augmented reality.

### **augmented Learning: an interview with eric Klopfer (Part one)**

[http://henryjenkins.org/2008/07/an\\_interview\\_with\\_eric\\_klopfer.html](http://henryjenkins.org/2008/07/an_interview_with_eric_klopfer.html)

(Henry Jenkins, *Confessions of an Aca-Fan*, 7 July 2008.) Henry Jenkins interviews AR game developer Eric Klopfer, who gives insights into why this area of AR has promise in education and beyond. A link to part two is available on the above page.

### **augmented reality in a Contact Lens**

<http://spectrum.ieee.org/biomedical/bionics/augmented-reality-in-a-contact-lens/0>

(Babak Parviz, *IEEE Spectrum Feature*, September 2009.) Developers at the University of Washington in Seattle have created a contact lens that features augmented reality. They are also exploring the use of contact lenses to measure blood glucose, cholesterol, and more.

### **if You are Not seeing data, You are Not seeing**

<http://www.wired.com/gadgetlab/2009/08/augmented-reality/>

(Brian Chen, *Wired Gadget Lab*, 25 August 2009.) This *Wired* article gives a good overview of augmented reality, including where it currently is situated and what to expect in the future.

### **Map/Territory: augmented reality without the Phone**

<http://radar.oreilly.com/2009/08/mapterritory-augmented-reality.html>

(Brady Forrest, *O'Reilly Radar*, 17 August 2009.) This brief interview discusses what forms augmented reality might take beyond its application for mobile devices.

### **Visual Time Machine offers Tourists a glimpse of the Past**

<http://www.sciencedaily.com/releases/2009/08/090812104219.htm>

(*ScienceDaily*, 17 August 2009.) New apps for smartphones offer augmented reality on the go. While on location, users view historical sites as they were hundreds of years ago.

### **Delicious: simple augmented reality**

<http://delicious.com/tag/hz10+augmentedreality>

Follow this link to find additional resources tagged for this topic and this edition of the *Horizon Report*. To add to this list, simply tag resources with “hz10” and “augmentedreality” when you save them to *Delicious*.

# gesture-based CoMPuTiNg

## Time-to-adoption Horizon: four to five Years

*For nearly forty years, the keyboard and mouse have been the primary means to interact with computers. The Nintendo Wii in 2006 and the Apple iPhone in 2007 signaled the beginning of widespread consumer interest in — and acceptance of — interfaces based on natural human gestures. Now, new devices are appearing on the market that take advantage of motions that are easy and intuitive to make, allowing us an unprecedented level of control over the devices around us. Cameras and sensors pick up the movements of our bodies without the need of remotes or handheld tracking tools. The full realization of the potential of gesture-based computing is still several years away, especially for education; but we are moving ever closer to a time when our gestures will speak for us, even to our machines.*

### overview

It is already common to interact with a new class of devices entirely by using natural gestures. The Microsoft Surface, the iPhone and iPod Touch, the Nintendo Wii, and other gesture-based systems accept input in the form of taps, swipes, and other ways of touching, hand and arm motions, or body movement. These are the first in a growing array of alternative input devices that allow computers to recognize and interpret natural physical gestures as a means of control. We are seeing a gradual shift towards interfaces that adapt to — or are built for — humans and human movements. Gestural interfaces allow users to engage in virtual activities with motion and movement similar to what they would use in the real world, manipulating content intuitively. The idea that natural, comfortable motions can be used to control computers is opening the way to a host of input devices that look and feel very different from the keyboard and mouse.

As the underlying technologies evolve, a variety of approaches to gesture-based input are being explored. The screens of the iPhone and the Surface, for instance, react to pressure, motion, and the number of fingers touching the devices. The iPhone additionally can react to manipulation of the device itself — shaking, rotating, tilting, or moving the device in space. The Wii and other emerging gaming systems use a combination of a handheld, accelerometer-based controller and stationary infrared sensor to determine position, acceleration,

and direction. The technology to detect gestural movement and to display its results is improving very rapidly, increasing the opportunities for this kind of interaction. Two new gaming systems are expected to be released in 2010 — a Sony platform based on a motion sensor code-named Gem, and the Microsoft Natal system. Both of these systems take a step closer to stripping the gesture-based interface of anything beyond the gesture and the machine, at least in terms of how it is experienced by the user.

Gesture-based interfaces are changing the way we interact with computers, giving us a more intuitive way to control devices. They are increasingly built into things we can already use; Logitech and Apple have brought gesture-based mice to market, and Microsoft is developing several models. Smart phones, remote controls, and touch-screen computers accept gesture input. As more of these devices are developed and released, our options for controlling a host of electronic devices are expanding. We can make music louder or softer by moving a hand, or skip a track with the flick of a finger. Apple's Remote app for the iPhone turns the mobile device into a remote control for the Apple TV; users can search, play, pause, rewind, and so on, just by gliding a finger over the iPhone's surface. Instead of learning where to point and click and how to type, we are beginning to be able to expect our computers to respond to natural movements that make sense to us.



Currently, the most common applications of gesture-based computing are for computer games, file and media browsing, and simulation and training. A number of simple mobile applications use gestures. *Mover* lets users “flick” photos and files from one phone to another; *Shut Up*, an app from Nokia, silences the phone when the user turns it upside down; *nAlertme*, an anti-theft app, sounds an alarm if the phone isn’t shaken in a specific, preset way when it is switched on. Some companies are exploring further possibilities; for instance, Softkinetic (<http://www.softkinetic.net>) develops platforms that support gesture-based technology, as well as designing custom applications for clients, including interactive marketing and consumer electronics as well as games and entertainment.

Because it changes not only the physical and mechanical aspects of interacting with computers, but also our perception of what it means to work with a computer, gesture-based computing is a potentially transformative technology. The distance between the user and the machine decreases and the sense of power and control increases when the machine responds to movements that feel natural. Unlike a keyboard and mouse, gestural interfaces can often be used by more than one person at a time, making it possible to engage in truly collaborative activities and games. Our perception of the kinds of activities that computers are good for is also altered by gestural interaction — activities that require sweeping movements, such as many sports or exercises, are suited to gestural interfaces.

### relevance for Teaching, Learning, or Creative inquiry

The kinesthetic nature of gesture-based computing will very likely lead to new kinds of teaching or training simulations that look, feel, and operate almost exactly like their real-world counterparts. The very ease and intuitiveness of a gestural interface makes the experience seem very natural, and even fun. Already, medical students benefit from simulations that teach the use of specific tools through gesture-based interfaces, and it is easy to see how such

interfaces could be applied in the visual arts and other fields where fine motor skills come into play. When combined with haptic (touch or motion-based) feedback, the overall effect is very compelling.

Larger multi-touch displays support collaborative work, allowing multiple users to interact with content simultaneously. In schools where the Microsoft Surface has been installed in study areas, staff report that students naturally gravitate to the devices when they want to work together to study collaboratively. The promotional video for Microsoft’s Natal system shows a family taking on different roles in a racing game — driver, pit crew — and suggests that role-playing activities where several students work together to perform different but related tasks will be a scenario made common by tools that use gesture-based computing.

Pranav Mistry, while at the MIT Media Lab, developed a gesture-based system called Sixth Sense that uses markers to allow interaction with all sorts of real-time information and data in extremely intuitive ways. He recently announced the release of the platform into open source (<http://www.youtube.com/watch?v=YrtANPtHyg>), which is likely to stimulate a raft of new ideas. Mgestyk’s gesture-based system of control uses a 3-dimensional camera to capture user movements. The system has been demonstrated with Microsoft Flight Simulator, and allows players to fly a simulated plane by simply moving their hands — without any joystick or remote (see <http://www.youtube.com/watch?v=FZyErkPJOR8>). The system is expected to release to market in late spring 2010 at a cost comparable to that of a high-end webcam. It is not difficult to picture similar applications, a little further down the road, that could be used to simulate many kinds of experiences.

A sampling of applications for gesture-based computing across disciplines includes the following:

- **Kinesiology.** Dutch company Silverfit uses a gesture-based system to deliver fitness games designed for the elderly. Used in elder care organizations, the games provide gentle

exercise and “activity of daily life” practice.

■ **Medicine.** Digital Lightbox by BrainLAB is a multi-touch screen that allows doctors and surgeons to view and manipulate data from MRI, CT, x-ray, and other scan images. The system integrates with hospital data sources to enable health professionals to collaborate throughout the cycle of treatment.

■ **sign Language.** Researchers at Georgia Tech University have developed gesture-based games designed to help deaf children learn sign language. Deaf children of hearing parents often lack opportunities to pick up language serendipitously in the way hearing children do; the game provides an opportunity for incidental learning.

■ **surgical Training.** After discovering the significant improvement in dexterity that surgeons-in-training gained from interacting with the Wii (in one study, those who warmed up with the Wii scored an average of 48% higher on tool tests and simulated surgical procedures than those who did not), researchers are developing a set of Wii-based medical training materials for students in developing countries.

## gesture-based Computing in Practice

The following links provide examples of gesture-based computing.

**CMu grad students build 3-d snowball fight**  
<http://www.post-gazette.com/pg/09308/1010559-96.stm>

(Ann Belser, *Pittsburgh Post-Gazette*, 4 November 2009.) As an assignment, several graduate students at Carnegie Mellon University created a gesture-based snowball fight game using PC software and components from the Nintendo Wii.

**Microsoft's finally got game**  
<http://blog.newsweek.com/blogs/techtonicshifts/archive/2009/11/05/microsoft-s-finally-got-game.aspx>  
(Nick Summers, *Newsweek*, 5 November

2009.) Microsoft's Project Natal engages full-body movement to interact with this game console — without any kind of controller or remote. The product, still in development, uses an infrared light and camera to sense the users' movements, eliminating the need for hand-held equipment and placing the user's own silhouette in the game world.

**Parkinson's Patients go to wii-hab**  
<http://www.livescience.com/technology/090611-wii-parkinsons.html>

(*LiveScience*, 11 June 2009.) In a study undertaken at the Medical College of Georgia's School of Allied Health Sciences, Parkinson's patients showed significant improvement when playing games on the Wii was added to their therapy.

**university offers New Technology to Help students study**  
<http://www.unr.edu/nevadaneews/templates/details.aspx?articleid=5194&zoneid=14>

(Skyler Dillon, *Nevada News*, 1 October 2009.) The Mathewson-IGT Knowledge Center at the University of Nevada in Reno has installed two Microsoft Surfaces in its study area and developed a custom anatomy study guide. Placing a coded lab assignment or tagged model on the screen calls up diagrams related to the material. Students can manipulate the diagrams using hand and finger gestures while they study independently or collaboratively.

**The Virtual autopsy Table**  
<http://www.visualiseringenrcenter.se/1/1.0.1.0/230/2/>

Researchers at Norrköping Visualization Center and the Center for Medical Image Science and Visualization in Sweden have created a virtual autopsy using a multi-touch table. Detailed CT scans are created from a living or dead person and transferred to the table where they are manipulated with the hands, allowing forensic scientists to examine a body, make virtual cross-sections, and view layers including skin, muscle, blood vessels, and bone.

## for further reading

The following articles and resources are recommended for those who wish to learn more about gesture-based computing.

### The best Computer interfaces: Past, Present, and future

<http://www.technologyreview.com/computing/22393/page1>

(Duncan Graham-Rowe, *Technology Review*, 6 April 2009.) This article discusses a variety of human-computer interfaces, including gesture-sensing, voice recognition, and multi-touch surfaces.

### a better, Cheaper Multitouch interface

<http://www.technologyreview.com/computing/22358/?a=f>

(Kate Greene, *Technology Review*, 30 March 2009.) New York University is developing a new multi-touch interface that accepts gesture-based input on a specially designed pad. The Inexpensive Multi-touch Pressure Acquisition Device (IMPAD) is a very thin surface that can be used on a desktop, a wall, a mobile device, or a touch screen.

### sony Motion Controller demo: dueling domino snakes

<http://www.shacknews.com/onearticle.x/60518>

(Nick Breckon, *ShackNews*, 18 September 2009.) Sony is developing a motion controller to be released in 2010. This article includes a

video demonstration of some of the system's capabilities. The system is characterized as somewhere in between the Nintendo Wii and the unreleased Microsoft Natal system in terms of how it is controlled.

### Touching: all rumors Point To The end of Keys/buttons

<http://www.techcrunch.com/2009/09/29/touching-all-rumors-point-to-the-end-of-keysbuttons/>

(MG Siegler, *TechCrunch*, 29 September 2009.)

This article describes a number of touch- and gesture-based devices from Apple and speculates on what might be forthcoming.

### why desktop Touch screens don't really work well for Humans

<http://www.washingtonpost.com/wp-dyn/content/article/2009/10/13/AR2009101300113.html>

(Michael Arrington, *The Washington Post*, 12 October 2009.) Desktop touch screens are available (like the HP TouchSmart line), but they are difficult to use over long periods. This article suggests another design approach.

### Delicious: gesture-based Computing

<http://delicious.com/tag/hz10+altinput>

Follow this link to find additional resources tagged for this topic and this edition of the *Horizon Report*. To add to this list, simply tag resources with "hz10" and "altinput" when you save them to *Delicious*.

# Visual data analysis

## Time-to-adoption Horizon: four to five Years

*Visual data analysis blends highly advanced computational methods with sophisticated graphics engines to tap the extraordinary ability of humans to see patterns and structure in even the most complex visual presentations. Currently applied to massive, heterogeneous, and dynamic datasets, such as those generated in studies of astrophysical, fluidic, biological, and other complex processes, the techniques have become sophisticated enough to allow the interactive manipulation of variables in real time. Ultra high-resolution displays allow teams of researchers to zoom in to examine specific aspects of the renderings, or to navigate along interesting visual pathways, following their intuitions and even hunches to see where they may lead. New research is now beginning to apply these sorts of tools to the social sciences and humanities as well, and the techniques offer considerable promise in helping us understand complex social processes like learning, political and organizational change, and the diffusion of knowledge.*

### overview

Over the past century, data collection, storage, transmission, and display has changed dramatically, and scholars have undergone a profound transformation in the way they approach data-related tasks. Data collection and compilation is no longer the tedious, manual process it once was, and tools to analyze, interpret, and display data are increasingly sophisticated, and their use routine in many disciplines. The options for illustrating trends, relationships, and cause and effect have exploded, and it is now a relatively simple matter for anyone to do the sorts of analyses that were once only the province of statisticians and engineers.

In advanced research settings, scientists and others studying massively complex systems generate mountains of data, and have developed a wide variety of new tools and techniques to allow those data to be interpreted holistically, and to expose meaningful patterns and structure, trends and exceptions, and more. Researchers that work with data sets from experiments or simulations, such as computational fluid dynamics, astrophysics, climate study, or medicine draw on techniques from the study of visualization, data mining, and statistics to create useful ways to investigate and understand what they have found.

The blending of these disciplines has given rise to the new field of visual data analysis, which is not

only characterized by its focus on making use of the pattern matching skills that seem to be hard-wired into the human brain, but also in the way in which it facilitates the work of teams working in concert to tease out meaning from complex sets of information. While the most sophisticated tools are still mostly found in research settings, a variety of tools are emerging that make it possible for almost anyone with an analytical bent to easily interpret all sorts of data.

Self-organizing maps are an approach that mimics the way our brains organize multi-faceted relationships; they create a grid of “neuronal units” such that neighboring units recognize similar data, reinforcing important patterns so that they can be seen. Cluster analysis is a set of mathematical techniques for partitioning a series of data objects into a smaller amount of groups, or clusters, so that the data objects within one cluster are more similar to each other than to those in other clusters. Visual, interactive principal components analysis is a technique once only available to statisticians that is now commonly used to identify hidden trends and data correlations in multidimensional data sets. Gapminder (<http://www.gapminder.org/>), for example, uses this approach in its analysis of multivariate datasets over time.

These sorts of tools are now finding their way into common use in many other disciplines, where the



analytical needs are not necessarily computational; visualization techniques have even begun to emerge for textual analysis and basic observation. Many are free or very inexpensive, bringing the ability to engage in rich visual interpretation to virtually anyone.

Online services such as Many Eyes, Wordle, Flowing Data, and Gapminder accept uploaded data and allow the user to configure the output to varying degrees. Many Eyes, for instance, allows people to learn how to create visualizations, to share and visualize their own data, and to create new visualizations from data contributed by others. Some, like Roambi, have mobile counterparts, making it easy to carry interactive, visual representations of data wherever one goes. Even quite public data, such as the posts made in Twitter, can be rendered visually to reveal creative insights. For instance, New Political Interfaces (<http://newpoliticalinterfaces.org>) created a visualization examining political topics as expressed on Twitter, charting which topics are — and are not — being discussed by politicians, news outlets, and other sources.

### relevance for Teaching, Learning, or Creative inquiry

As stated previously, one of the most compelling aspects of visual data analysis is in the ways it augments the natural abilities humans have to seek and find patterns in what they see. By manipulating variables, or simply seeing them change over time (as Gapminder has done so famously) if patterns exist (or if they don't), that fact is easily discoverable. Such tools have applicability in nearly every field.

As the tools, their capabilities, and their variety continue to expand, their use is already making its way out of scientific and engineering labs and into business and social research. Creative inquiry is benefiting from a wide range of new tools that are exposing trends and relationships among both qualitative and quantitative variables in real time, and making longitudinal relationships easier to find and interpret than ever. Textual analysis is an area that

tools like Wordle have revealed as especially suited to visual techniques.

The promise for teaching and learning is further afield, but because of the intuitive ways in which it can expose intricate relationships to even the uninitiated, there is tremendous opportunity to integrate visual data analysis into undergraduate research, even in survey courses. Models of complex processes in quantum physics, organic chemistry, medicine, or economics are just a few of the ways in which the outcomes of visual data analysis can be applied to learning situations.

Visual data analysis may help expand our understanding of learning itself. Learning is one of the most complex of social processes, with a myriad of variables interacting in ways that are not well understood, making it an ideal focus for the search for patterns. Related to this is the opportunity to understand the variables influencing informal learning and the social networking processes at work in the formation of learning communities. The tools for such analyses exist today; what is needed are ways to balance privacy with the kinds of data capture that can inform such work.

A sampling of visual data analysis applications for a variety of purposes includes the following:

- **astrophysics.** Harvard scientists are using data visualization from the Chandra X-Ray Observatory to measure the expansion velocity of supernova remnants. Visual data analysis has also enabled scientists to more fully understand the effects of multiple points of explosion in a supernova.
- **fluid dynamics and Human Physiology.** Researchers working with Amira, a visual data analysis tool created originally at the Zuse Institute in Berlin, have created a range of models of biological processes from MRI data, fluid flows, and other complex datasets. Insights from the study of fluid dynamics over complex surfaces informed work that models blood flows and arterial mapping.

■ **Marine geology.** Published by the Lamont-Doherty Earth Observatory at Columbia University, the Virtual Ocean, similar to Google Earth, offers students a three-dimensional view of the Earth's oceans (<http://www.virtualocean.org>).

■ **Composition and rhetoric.** Using tools like Many Eyes and Wordle, students can easily analyze the contents of their papers visually for insights into what points might need further development, and whether or not certain language has been overused.

## Visual data analysis in Practice

The following links provide examples of visual data analysis.

### 28 rich data Visualization Tools

<http://www.insideria.com/2009/12/28-rich-data-visualization-too.html>

(Theresa Neil, *O'Reilly's Inside RIA*, 10 December 2009.) This article contains visual examples of dozens of data analysis displays. Listed are twenty-eight tools for creating charts, graphs, and other data displays for use by developers.

### best science Visualization Videos of 2009

<http://www.wired.com/wiredscience/2009/08/visualizations/all/1>

(Hadley Legget, *Wired*, 19 August 2009.) From simulating the way waves break against a ship to visualizing seasonal carbon dioxide accumulation in North America, these videos demonstrate the diversity of data visualization.

### brain structure assists in immune response, according to Penn Vet study

<http://www.upenn.edu/pennnews/article.php?id=1531>

(Jordan Reese, Media Contact, Office of University Communications, University of Pennsylvania, 28 January 2009.) Analytics and data visualization allowed researchers at the University of Pennsylvania to visually model (in

real time) the response of the body's immune system to a parasitic infection.

### gapminder

<http://www.gapminder.org>

Gapminder, a Swedish-based nonprofit organization, seeks to promote sustainable global development using data visualization as a major tool.

### Visual Complexity

<http://www.visualcomplexity.com/vc>

A wide variety of data visualization projects are featured on this site. Browse everything from changes in the text from one edition of *The Origin of the Species* to the next, to *Cymatics*, a visualization of the study of sound vibrations on matter.

### worldmapper

<http://www.worldmapper.org>

Worldmapper is a visualization tool that re-draws maps based on the data being displayed. For instance, on a world map showing population, countries with more people swell while those with fewer people shrink.

## for further reading

The following articles and resources are recommended for those who wish to learn more about visual data analysis.

### 7 Things You should Know about data Visualization ii

<http://net.educause.edu/ir/library/pdf/ELI7052.pdf>

(*Educause*, August 2009.) This article discusses data visualization as it relates to higher education: who's using it, why they're using it, and what to expect in the future.

### New Visualization Techniques Yield star formation insights: gravity Plays Larger role Than Thought

<http://www.sciencedaily.com/releases/2008/12/081231152305.htm>

(*Science Daily*, 4 January 2009.) Early in 2009, a new computer algorithm developed at

the Harvard Initiative in Innovative Computing demonstrated that data visualization is critical in the discovery of new information, not just in the final presentation of data.

**The Technologies of g21: How government Can become a Platform for innovation**

**[http://www.huffingtonpost.com/gadi-benyehuda/the-technologies-of-g21-h\\_b\\_266532.html](http://www.huffingtonpost.com/gadi-benyehuda/the-technologies-of-g21-h_b_266532.html)**

(Gadi Ben-Yehuda, *Huffington Post*, 24 August 2009.) The author discusses the changes in data collection, storage, transmission, and display over the past century, noting that data visualization is now in the hands of the people for the first time.

**Visualization and Knowledge discovery: report from the doe/asCr workshop on Visual analysis and data exploration at extreme scale**

**<http://www.sci.utah.edu/vaw2007/DOE-Visualization-Report-2007.pdf>**

This report from the Department of Energy describes fundamental research in visualization and analysis that is enabling knowledge discovery from computational science applications at extreme scale.

**Delicious: Visual data analysis**

**<http://delicious.com/tag/hz10+analytics>**

Follow this link to find additional resources tagged for this topic and this edition of the *Horizon Report*. To add to this list, simply tag resources with “hz10” and “analytics” when you save them to *Delicious*.

# MeTHoDoLogY

The *Horizon Report* is produced each fall using a carefully constructed process that is informed by both primary and secondary research. Nearly a hundred technologies, as well as dozens of meaningful trends and challenges are examined for possible inclusion in the report each year; an internationally renowned Advisory Board examines each topic in progressively more detail, reducing the set until the final listing of technologies, trends, and challenges is selected. The entire process takes place online and is fully documented at [horizon.wiki.nmc.org](http://horizon.wiki.nmc.org).

The process of selection, a modified Delphi process now refined over several years of producing *Horizon Reports*, begins each summer as the Advisory Board is convened. About half of the forty or so members are newly chosen each year, and the board as a whole is intended to represent a wide range of backgrounds, nationalities, and interests. By design, at least one-third of the Advisory Board represent countries outside of North America. To date, more than 400 internationally recognized practitioners and experts have participated. Once the Advisory Board is constituted, their work begins with a systematic review of the literature — press clippings, reports, essays, and other materials — that pertain to emerging technology. Advisory Board members are provided with an extensive set of background materials when the project begins, and then are asked to comment on them, identify those which seem especially worthwhile, and also add to the set. A carefully selected set of RSS feeds from nearly 50 leading publications ensures that these resources stay current as the project progresses, and they are used to inform the thinking of the participants through the process.

Following the review of the literature, the Advisory Board engages in the process of addressing the five research questions that are at the core of the Horizon Project. These questions are the same each year, and are designed to elicit a comprehensive

listing of interesting technologies, challenges, and trends from the Advisory Board:

- 1 *What would you list among the established technologies that learning-focused institutions should all be using broadly today to support or enhance teaching, learning, or creative inquiry?*
- 2 *What technologies that have a solid user base in consumer, entertainment, or other industries should learning-focused institutions be actively looking for ways to apply?*
- 3 *What are the key emerging technologies you see developing to the point that learning-focused institutions should begin to take notice during the next three to five years? What organizations or companies are the leaders in these technologies?*
- 4 *What do you see as the key challenges related to teaching, learning, or creative inquiry that learning-focused institutions will face during the next five years?*
- 5 *What trends do you expect to have a significant impact on the ways in which learning-focused institutions approach our core missions of teaching, research, and service?*

One of the Advisory Board's most important tasks is to answer these five questions as systematically and broadly as possible, so as to generate a large number of potential topics to consider. As the last step in this process, past *Horizon Reports* are revisited and the Advisory Board is asked to comment on the current state of technologies, challenges, and trends identified in previous years, and to look for metatrends that may be evident only across the results of multiple years.

To create the *2010 Horizon Report*, the 47 members of this year's Advisory Board engaged in a comprehensive review and analysis of research, articles, papers, blogs, and interviews; discussed existing applications; and brainstormed new ones. A



key criterion was the potential relevance of the topics to teaching, learning, research, or creative inquiry.

Once this foundational work was completed, the Advisory Board moved to a unique consensus-building process that uses an iterative Delphi-based methodology. In the first step, the responses to the research questions were systematically ranked and placed into adoption horizons by each Advisory Board member in a multi-vote system that allowed members to weight their selections. These rankings were compiled into a collective set of responses. From the more than 110 technologies originally considered, the twelve that emerged at the top of the initial ranking process — four per adoption horizon — were further researched. Once this “short list” was identified, the potential applications of these important technologies were further explored by higher education practitioners who were either knowledgeable about them, or interested in thinking about how they might be used. A significant amount of time was spent researching applications or potential applications for each of the areas that would be of interest to practitioners.

Each of these twelve was written up in the format of the *Horizon Report*. With the benefit of knowing how each topic would look in the report, the “short list” was then ranked yet again, this time with a reverse ranking approach. The six technologies and applications that emerged at the top of the rankings

— two per adoption horizon — are detailed in the preceding sections, and those descriptions are the final results of this process.

An ongoing component of the project involves a special set of *Delicious* links that have been established to help extend the findings of the project and allow new information to be shared within the community. These *Delicious* tags are listed under the “Further Reading” section of each of the six topic areas, and readers are invited to view the hundreds of resources used in producing the report. These links are enhanced by a vibrant community that contributes new information daily. Readers are encouraged to be part of this community and add their own examples and readings to these dynamic lists by tagging them for inclusion in each category.

# 2010 Horizon Project advisory board

**bryan alexander, Chair**

National Institute for Technology in  
Liberal Education

**Larry Johnson, co-Pi**

The New Media Consortium

**Malcolm brown, co-Pi**

EDUCAUSE Learning Initiative

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**Kumiko aoki**

The Open University of Japan

**Helga bechmann**

Multimedia Kontor Hamburg GmbH  
(Germany)

**Michael berman**

CSU Channel Islands

**danah boyd**

Microsoft Research/Harvard Berkman  
Center

**Todd bryant**

Dickinson College

**gardner Campbell**

Baylor University

**Cole Camplese**

The Pennsylvania State University

**dan Cohen**

George Mason University

**douglas darby**

Austin College

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**Timmo dugdale**

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**gavin dykes**

Future Lab (K-12)

**Julie evans**

Project Tomorrow (K-12)

**Jonathan finkelstein**

Learning Times

**Joan getman**

Cornell University

**Lev gonick**

Case Western Reserve University

**Keene Haywood**

University of Texas at Austin

**Jean Paul Jacob**

IBM Almaden Research Center

**Vijay Kumar**

Massachusetts Institute of Technology

**Paul Lefrere**

Open University (UK)

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Universitat Oberta de Catalunya (Spain)

**scott Leslie**

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**Joan Lippincott**

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University of Lagos (Nigeria)

**david Parkes**

Staffordshire University (UK)

**Nancy Proctor**

Smithsonian American Art Museum

**ruben Puentedura**

Hippasus

**Jason rosenblum**

St. Edward's University

**wendy shapiro**

Case Western Reserve University

**bill shewbridge**

University of Maryland,  
Baltimore County

**george siemens**

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# NoTes



**The New Media CoNsorTiuM**

sparkling innovative learning & creativity

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**Crosswalk representing multiple instructional and curriculum strategies  
aligned to technology**

**What does it look like – How should we think about it – What should we look for – What  
does it really mean**

NY State Learning Standard	ISTE - Teacher	Actions	ISTE - Administrator	Actions	ISTE – Web 2.0 Student	Blooms
<p>ELA <a href="#">Standard 4</a> Students will read, write, listen, and speak for social interaction.</p> <p>Students will use oral and written language for effective social communication with a wide variety of people. As readers and listeners, they will use the social communications of others to enrich their understanding of people and their views.</p>	<p>1. Facilitate and inspire creativity 2. Design and develop digital learning experiences 3. Model 4. Promote digital citizenship 5. Personal Growth</p>	<p>What is effective communication? In what medium – digital, classroom, society – digital fluency. Define the “social learning of others” – how do we get there – through perspective – how do we get there – through communications amongst others to solve problems <u>together</u> and create meaningful content together</p>	<p>1. Visionary 2. Culture 3. Professional Practice 4. Systemic Improvement 5. Digital Citizenship</p> <p>CDEP – define the role of these goals and how they assume different identities when presented with a global vision ELA Literacy across content School climate</p>	<p>Set the vision and expectations for staff through collaborative planning sessions and goal setting. Use the tools Work to create curriculum that promote digital citizenship</p>	<p>1 – Creativity 2 – Communication and Collaboration 3. Research and Information Fluency 4. Critical Thinking, Problem Solving, and Decision Making 5. Digital Citizenship 6. Technology Operations</p>	<p>Analysis, Synthesis, Evaluation</p> <p>Compose Compare Conclude Defend Describe Evaluate Support</p>



- A** Acronis True Image Echo Workstation
  - Acronis True Image Workstation - Universal Restore
  - Adobe Acrobat Professional
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  - Adobe Photoshop Elements
  - Adobe Photoshop Elements
  - Adobe premiere
  - Adobe Web Standard CS 3.0
  - Adobe Web Standard CS 4
  - ADVENTURES IN PROBLEM SOLVING
  - Adventures of Edison
  - Apple Remote Desktop
  - Auralia
- B** Baby sitters clube 4th grade
  - Band in a Box Pro Version
  - Barbie Storymaker
  - Blue Tortoise
  - Bryce
- C** Captain Kangaroo Life First Lesson
  - Career Zone
  - Chitty Chitty Bang Bang
  - Chitty Chitty Bang Bangs Adventure in Tinker Town
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  - Clicker 5
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  - Dr. Seuss Kindergarten
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  - Elroy Hits the pavement
  - Elroy's Costume Closet
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**G** Garage Band Jam Pack  
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 Glencoe Accounting Electronic Learning Center  
 Go Fish  
 Go West The Homesteader's Challenge  
 GradeQuick 8  
 Graph Master  
 Great Adventures Castel  
 Gus goes to Cybertown  
**H** HyperStudio  
 HyperStudio  
**I** iLife '09  
 Inspiration  
 Interwrite Workspace  
 Intuos 3  
 Iomea Ditto Tools  
**J** Jack's House  
 Jumpstart Artist  
 Just Think  
**K** Kanaka  
 Karen's Kid  
 Keynote  
 Kid Phonics 2  
 Kid Smarts  
 Kidspiration



- L** LanSchool
- Larson Pre-Algebra and Pre- Algebra Bundle
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- Learn Word
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- Musition 2
- My very first software
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- Nikolai's Trains
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- Numbers Undercover
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- Orion Network Performance Monitor
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- P** Pagis ScanWorks
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- PAIR-IT STAGE 5
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PIGS

Practica Musica

Pre-Algebra

Preschool

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Print Shop Pro Publisher Deluxe

ProTools

**Q** Quia Subscription (2/5/08-2/5/09)

QuickBooks Pro 2001

QuickOffice

**R** Reading for Meaning

RescueLink 8.1

Retrospect

Retrospect for Macintosh

Reveal

Rosetta Stone Level 1 Classroom Edition

Rosetta Stone Level 2 Classroom Edition

Rosetta Stone Level 3 Classroom Edition

Roxio Toast Titanium 5

**S** School House Rock!

Solaris 10

SolarWinds Engineers Edition Toolset

Sorry

Sounds Great

SplashID

Steck-Vaughn

Student Writing &amp; Reseach

SuccessMaker

SUNBURST A to Zap

Sunburst First Phonics

Sunburst Reading Who? Reading you?

SUNBurst Word Building

Sunburst/Hyperstudio

Super Putt

Suse Linux Professional

SUSE Linux Enterprise Desktop

**T** TechWorks

TextBridge Pro 98

The Baby Sitters Clube

The case of the Counterfeit collaborator

The Friends of Emily Culpepper

The Louvre: Museums of the World for Kids

The Sailor Dog

The Secret of the Castle

The Ultimate Voyage

The Ultimate Word Attack



The Universe According to Virgil Reality  
THE WAY WE LIVE  
The World of Physics  
ThumbsPlus  
TI Navigator  
TIMELINER 5.0  
TI-SmartView  
Toast 8 Titanium  
Toons Works  
Transcender Cer  
Type to Learn 3  
TypeTool 2  
Tyrannosaurs  
Tyrannosaurs Trying on Pants in My Bedroom  
**U** Ungaria  
**V** VectorWorks  
VideoStudio 10 SE  
Virgil Reality  
VMWare Fusion 3  
VMWare Workstation 6 - Linux  
VMWare Workstation 6 - Windows  
**W** What's Up Gold  
Where in the World is Carmen Sandiego  
Wild Ride  
With Open Eyes: Great Art For Kids  
Word City  
World of Physics  
Write out loud  
**X** X-Port Palm OS Student Info System

