MID-WESTERN EDUCATIONAL RESEARCHER

Volume 20, Number 1 · Winter 2007 ISSN 1056-3997

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2006 MWERA Keynote Address

The World Wide Web Revisited

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Nearly a decade ago I wrote in *Educational Researcher* one of the first widely cited academic articles about the educational role of the Web (Owston, 1997). I argued that before educators rush into adopting it we must be able to demonstrate that the Web (1) can increase access to learning, (2) must not result in higher costs for learning, and (3) can lead to improved learning. These criteria seemed to make sense in 1996 when I wrote the article and the Web was new to most of our educational institutions. Where are we today with respect to meeting these criteria? What progress have we made toward achieving them? Are they still relevant? What new research does the educational community need about the Web? These are the questions that I am going to address today. Before doing so, I think it would be helpful to look back briefly at the history of the Web as it relates to teaching and learning.

The Rise of the Web

While working at the European Particle Physics Laboratory at Geneva, Switzerland, Sir Tim Berners-Lee came up with the idea of the Web. He wrote the protocols for it in 1989, circulated them among colleagues for comment, and launched his first Web site in August, 1991, (a copy of which can still be viewed at http://www.w3.org/History/19921103-hypertext/hypertext/WWW/TheProject.html). Berners-Lee's goal was to develop a tool that would allow the laboratory "to much more efficiently use people who came and went, use student work, and use people working remotely." Interestingly, Berners-Lee felt that the Web should not be "a big browsing medium," nor "a glorified television channel." Instead, his vision was that it would be "an information space through which people can communicate…by sharing their knowledge in a pool" (Berners-Lee, 1999). Therefore, it is encouraging to look back and see that he first conceived of the Web as a learning tool.

The Web caught on very quickly in the academic world as a tool for sharing information; however, it was not until the development of the Web browser *Mosaic* in 1993, which permitted the display of graphics that a significant number of educators began to see its possibilities for teaching and learning. A year later the soon-to-be popular Netscape browser emerged, and by the mid 1990s Web-based courses aimed at university, college, and high school students began to spring up around the world almost overnight. Early courses were largely text-based with a limited amount of graphical images because dial-up connections to the Internet were slow. As the dial up technology improved and high speed access became more prevalent around the turn of the century course developers began integrating more graphics, animation, sound, and video into their courses. Growth was aided by the development of course management systems—WebCT being one of the first—that simplify the process of putting course materials online. According to a recent survey by the Sloan Consortium (2005), nearly two thirds of undergraduate and over a quarter of graduate degree programs in institutions of higher education in the U.S. now offer Web-based courses. Numerous courses are available on the Web for public school students as well, offered by school districts, state educational authorities, and non-profit and for-profit organizations.

The impact the Web is having on young people today was totally unanticipated by Berners-Lee. The Web and digital technology more generally spawned a new generation of youth and young adults—those who do not know a world without this technology as they were born into it. Referred to as the Net Generation (Tapscott, 1998; Oblinger and Oblinger, 2005) or Digital Natives (Prensky, 2006), this generation is in our public schools today and they are now entering our colleges and universities. Prensky draws a distinction between this generation and those born before the digital revolution, a group he calls Digital Immigrants that includes the vast majority of teachers. He describes how Digital Natives do so many things differently: communicate, share, buy and sell, exchange, create, meet, coordinate, evaluate, play games, learn, evolve, search, analyze, report, program digital devices, socialize, and grow up. Digital Immigrants can—and do well—many of the same things as Digital Natives, but what distinguishes Digital Natives is that they do all of these things so intuitively and are constantly inventing new ways of using technology for almost every activity in their lives. Prensky goes as far as to suggest that Digital Natives actually *think differently* based on his observation of young people and on what recent research says about the brain continually reorganizing itself in response to various kinds of stimuli, a process called neuroplasticity. Others have reported the same phenomenon as well. For example, John Seely-Brown, Chief Scientist at Xerox and director of its Palo Alto Research Center, who hired young students to design future work and learning environments, observed how students think in ways alien to his own generation in designing projects (Seely-Brown, 2002). The implications of Prensky's hypothesis are immense if it is borne out by further research. Schools will have to fundamentally change the way learning is organized or risk alienating an entire generation of students.

The mainstream educational research community took some time to recognize the potential of the Web as a learning tool and its impact on learners. My article in *Educational Researcher* published in March 1997 was the first in a journal

sponsored by the American Educational Research Association to deal specifically with the Web. An earlier article by Burbules and Bruce (1995) discussed publishing on the Web and another by Blumenfeld, Marx, Soloway, and Krajcik (1996) mentioned the Web in passing as a tool to support collaborative communities. Because of its newness, the editor of my article asked me to give a definition of the Web as well as illustrate what a Web address is like! The topic did not appear at all in AERA's flagship journal, the *American Educational Research Journal,* until 2000. That is not to say that other researchers were not studying or discussing the potential of the Web: a full text search of ERIC up until the end of 1996 revealed that "World Wide Web" was mentioned 471 times in various contexts either as a central focus or in passing. To set this in context, the terms computers or microcomputers appeared nearly 30,000 times during the same period. I do not wish to belabor this, but merely want to emphasize that when discussing the Web we are talking about a rapidly evolving phenomenon that has been researched from the perspective of teaching and learning for only about ten years. Therefore, it is not surprising that we know so little about the Web's educational value.

Access to Learning

Now let us take a look at my first criterion about access to learning. My intention here was to ask whether the Web could provide people with opportunities to learn which they otherwise would not have. That is, does the Web allow people to access learning who could not attend face-to-face classes due to work, finances, distance, or other barriers? I think the case is very clear here: the Web has opened the door to learning in the last ten years for people to study any time and in any place. There are close to 3 million people in the U.S. taking Web courses in a wide range of subjects in higher education today, which accounts for about one-fifth of the total student population in higher education in the country. Moreover, online enrolment appears to be growing 20% annually whereas the total annual population growth in the higher education system is about 1.5% (Sloan, 2005).

Up-to-date surveys of high school enrolments are harder to come by. The most recent statistics showed that in 2002–03 there were an estimated 328,000 enrollments in distance education courses among students regularly enrolled in U.S. public schools (Setzer and Lewis, 2005). Undoubtedly, these enrolments are significantly higher today, possibly doubled, and they do not include adults taking high school equivalency courses nor private schools. I will give three examples to illustrate the scope of what is happening in K-12. First, perhaps the best known and most studied is the Virtual High School (http://www.govhs.org) which enrolls over 7500 students per year. Students can take accredited courses in most high school subject areas and the school offers Advanced Placement and Pre-Advanced Placement courses. A second example is the Florida Virtual School (http://www.flvs.net/) that offers over 80 courses for grades 6 to 12 and enrolled more than 31,000 students during the 2005-06 school year. Third is the Michigan Virtual High School (http://www.mivhs.org/), one of the largest online high schools in the U.S., which since its inception in 2000 has had over 23,000 course enrolments and served more than 125,000 students. This school does not grant credit directly but works in conjunction with school districts to award credit and diplomas.

At the time of writing my article the issue of technology *haves* and *have nots* or what is now called the *digital divide* did not receive much attention. In fact, the term digital divide appears only once in the ERIC database prior to 1997. This occurrence was in the report *Connecting Children to the Future: A Telecommunications Policy Guide for Child Advocates* (1996) which drew attention to the widening gap of access to technology by children based on parental income. Subsequent research has explored various other socio-economic dimension of the problem such as age, education level, gender, race, and area of residence. In addition, comparisons have been made between developed versus less developed countries, on quality of technology available to users, and on the speed of Internet access. Some of the gaps identified earlier on appear to have closed. For instance, access to the Internet in schools and universities is now nearly universal in North America. Across the population more generally, a 2006 survey from the Pew Internet and American Life Project (2006) shows that 73% of American adults (age 18+) go online to use the Internet or email, which suggests that the Web is on its way to becoming as ubiquitous as the telephone and television. (The figures for Canada are slightly lower: see http://www.statcan.ca/Daily/English/060815/d060815b.htm.) The study also found that 74% of white adults go online, compared to 61% of African American adults, and 76% of English-speaking Hispanics. These statistics suggest that the digital divide based on race does not seem to be as serious a problem as it once was, although there is some cause for concern for non-English speaking Hispanics who may not be accessing the Internet at the same rate as English-speaking ones are. The access gap based on income is much larger and still a cause for concern: only 53% of adults living in households with less than $30,000 in annual income go online compared to 91% of adults living in households earning more than $75,000. Therefore, my criterion of access needs to be defined not about the notion of simply access to learning, but it needs to ask the question "What are the inequalities of access to learning and how can each one be overcome?" This is a challenge that public policymakers need to address. One way to address this problem may be to set up programs that provide subsidized Internet access for low income citizens as is done now with telephone service in some jurisdictions.

Costs of the Web

Ten years ago few educational institutions included costs for faculty or student computers in their base budgets let alone budgeting for online learning technology infrastructure costs. They tended to rely on one time only budget allocations or donations. Hence, I raised the issue of whether we can introduce Web-based learning without substantially

increasing our budgets. Much has changed since then with budgets for technology routinely included and seen as essential expenditures in almost all educational organizations. Without a doubt, expenditures on technology for online learning have increased in the last decade, but equally as important is that more and more institutions see online learning as part of their mission. Sloan reports that in 2005, 56% of higher education institutions considered online learning to be a critical long-term strategy; this is up from 46% in 2003 (Sloan, 2005). Additionally, according to a survey done by EDUCAUSE of 890 higher education institutions over 90% of those institutions reported that they use a course management system (http://www.educause.edu/ir/library/pdf/pub8002e.pdf). Only 1.2% said that they do not use one and have no plans to do so while the remaining 8.8% are in the process of reviewing their options or adopting one. Therefore, the basic infrastructure for Web-based learning appears to be in place in higher education at least.

Studies on cost effectiveness of online learning compared to face-to-face classes have not yielded very convincing results because of the complexity in gathering costing data. The exception to this is the work of Carol Twigg who has advocated that the most cost effective approach in higher education is to put online the dozen or two large undergraduate courses that typically make up about one percent of an institution's enrolment (Twigg, 2003). Twigg's Program in Course Redesign (http://www.center.rpi.edu/PCR.htm) studied the outcomes of 30 colleges and universities that received funding to restructure their courses using technology in a variety of ways. The restructuring ranged from using technology to supplement lectures with some out-of-class technology activity through to making courses fully online. The research showed that per student cost savings averaged 41% when comparing the traditional format of the course to the redesigned format incorporating technology. Institutions realized cost savings by freeing up faculty to teach other courses, eliminating adjunct faculty, serving more students with the course, or decreasing faculty workload for the course. Important to note was that the project only compared costs before and after redesign and the study did not include development costs, nor infrastructure and equipment costs as they were already in place. While generalizations cannot be made from this research, it nonetheless illustrates that online learning can reduce costs compared to face-to-face delivery, depending upon what assumptions you are willing to make.

During the last ten years the cost of computers has dropped significantly and their capabilities have increased dramatically. The $1000 computer remained an elusive goal for many years, but now that barrier has been broken and it is now possible to purchase powerful computers for $500. The new hurdle is now the $100 computer. Nicholas Negroponte and colleagues at the MIT Media Lab are in the process of developing a laptop computer for this price to "revolutionize how we educate the world's children… [and] … to provide children around the world with new opportunities to explore, experiment, and express themselves." (http://wiki.laptop.org/go/Home). The project is aimed particularly at less developed countries (LDCs) and the expectation is that governments and foundations would purchase large quantities of the machines for students. Large corporate donations are funding development costs and the United Nations Development Program will work with LDCs to implement extensive field trials.

Learning with the Web

I first began to investigate how Web-based learning affects achievement the year after publication of my article. My university, which traditionally offered a large number of undergraduate correspondence courses, began offering most of the same courses in Web-based format. Enrolment in the Web courses increased rapidly in the mid to late 1990s and faculty started raising questions about their academic rigor. I received funding by the university administration to do a study of achievement in these courses. My senior researcher and I compared final grades of students enrolled in all courses that were offered in three formats: (1) face-to-face lectures; (2) traditional correspondence courses that used mail, telephone, and print materials; and (3) fully online courses. Our findings were quite surprising. Students in Web courses (N = 1099) and face-to-face courses (N = 2467) scored significantly higher than their counterparts in correspondence courses (N = 2318) ($p < .001$ and $p < .01$ respectively), although no significant difference was found between Internet and in-class students. We decided to re-analyze the data by comparing only students with passing grades because according to the registrar's office, students rarely failed a course, they just did not complete the final exam and got an F grade. When we did the analysis we found that Web students achieved significantly higher than their face-to-face counterparts ($p < .001$), who in turn scored significantly higher grades than correspondence students ($p < .001$). Drop out rates were slightly higher for Web courses (11%) compared to face-to-face and correspondence (both 8%). Students also reported that taking a Web course was generally a very satisfying experience, with 73 percent saying they would recommend the course to their friends and 68 percent feeling that the course stimulated their interest in taking further courses in the discipline. (See Wideman and Owston, 1999, for details.)

Our study had a very small effect size of +.08. The effect size specifies the number of standard deviation units separating the outcome scores of treatment and control groups in a study. Generally effect sizes should be +.25 or more for the treatment to be considered educationally meaningful. Therefore, the strongest statement that we could make was that there was no educational difference between achievement of Web students and their face-to-face counterparts. Nevertheless, our findings were convincing enough to demonstrate to faculty who opposed Web courses that students were not suffering academically when they took them and as a result, debate on campus quieted down.

The findings of our study are consistent with most other studies that compare technology-based learning to traditional methods, namely that technology offers very none to modest improvements in student performance. For example, Kulick (2003) summarized the effect sizes of technology in various subject areas reported in studies since 1990 and in reviews of studies published before then. He concluded that integrated learning systems (ILS) to teach reading make little or no difference in reading outcomes, but they produce small effects on math skills (+.40); word processors produced small effects on writing (+.30). Similarly, Kimitta and Davis (2004) who synthesized many of the meta-analyses in the literature conclude:

Computer technologies generally have a positive effect on academic achievement. Within this finding there is great variance. On average, the strength of the correlation between computer technologies and student achievement varies from low to moderate. Most of the effect sizes range from .10 to .40. Rarely in the literature are there overtly strong relationships.

Robert Bernard and colleagues at Concordia University carried out an exhaustive meta-analysis of 232 studies on distance education (DE) between 1985 and 2002 to compare the effectiveness of DE and classroom instruction on student achievement as well as other variables (Bernard et al., 2004). There was a wide range of technologies and media used in the DE studies they examined, although many of them included the Web, discussion groups, or email. The authors concluded that there is a very small yet statistically significant effect favoring DE conditions (effect size = .01) on overall achievement outcomes, however the variability across studies was wide and significant. When they compared synchronous and asynchronous DE achievement to in-class environments, achievement results favored asynchronous DE slightly more (effect size = .05).

All of the studies cited above examined course grades or other traditional outcome measures. Thus, there seems to be mounting evidence that when assessing Web-based learning in general with these kinds of measures we are unlikely to see any educationally significant advantage of the Web over traditional ways of teaching and learning. Undoubtedly, there will be specific implementations of Web-based learning that work exceptionally well and those that do not, so our goal should be to identify these and discontinue simple comparative studies.

Future Research Directions

So where does that leave us today with respect to my three criteria? First, I would surmise that the Web has met expectations in terms of providing more opportunities to access learning than before. However, we still need to address the issue of the digital divide, not so much by more general research, but by implementing and assessing specific programs designed to close the access gap particularly across income levels. I do not think that we need more studies on the cost effectiveness of the Web as a teaching and learning tool. The Web is here with us and is ubiquitous; the justification for using it will likely not be on cost, but on educational grounds (except perhaps in corporate training where travel costs to attend courses is a significant factor for physically diversified companies). As for improved learning, the third issue, we saw above that the Web cannot be strongly rationalized on that basis either, so continued research comparing Web-based courses to traditional face-to-face classes is no longer productive. I believe what is now needed is a research agenda that examines various ways of organizing instruction using the Web and how the many new technologies that the Web has given rise to can be used for teaching and learning with the net savvy generation in our schools. I will summarize some of my thoughts on these topics next.

Blended Learning. A trend that has become popular in the last several years is to integrate traditional face-to-face instruction with Web-based learning. Known as blended or sometimes hybrid learning, this method of organizing courses is gaining ground on many campuses due to disenchantment with the lack of personal interaction among faculty and students in fully online courses. Moreover, it appeals to faculty because blended learning courses require less expertise and resources to mount than fully online courses, and students like the approach because of the flexibility it provides in their study schedules. Blended learning is not seen by most scholars in the field as something added on to an existing course, but as a thoughtful restructuring of a course that moves tasks and activities to the Web that may be more effectively handled there, and retaining those activities for the classroom that require interaction and dialogue. (See Bonk and Graham, 2006, for a recent thorough discussion of blended learning and how it is being implemented around the world.)

Most outcomes research on blended learning has been carried out at the undergraduate level, where it tends to show that blended learning has some distinct advantages for students over traditional lectures and fully online courses. Twigg (2003) reported that student learning improved in 20 of the 30 courses she studied compared to the former versions of the courses, while the rest showed no significant difference. The University of Central Florida's extensive experience with blended learning suggests that on average, blended courses consistently have higher success rates and lower withdrawal rates than their comparable face-to-face courses and fully online courses (Dziuban, Hartman, Juge, Moskal, and Sorg, 2006), a finding also supported by Twigg (2003). Additionally, the majority of faculty teaching in those courses at the University of Central Florida indicated that more and higher quality interaction occurred in their blended courses than in their comparable face-to-face sections. In a study I led of eight Canadian universities using blended learning, students reported that they liked blended learning because it provides scheduling flexibility and varied learning opportunities, while maintaining traditional classroom experiences such as in-class discussion (Owston, Garrison, and Cook, 2006). Both faculty and students in the study felt that the online component of blended learning encouraged the develop-

ment of critical thinking skills, and faculty found that they got to know their students better as individuals in blended courses than they would have in traditional lectures. Additionally, we found high levels of student and faculty satisfaction with their blended course experiences. What we need now is research that focuses on the pedagogy of blended learning and the technology employed. Pedagogical research needs to consider such issues as the nature of the activities best suited for online and face-to-face interaction, the appropriate balance between the two instructional modes for particular kinds of courses, creation and maintenance of a sense of community among students, and whether there are some course subject areas where blended learning is more appropriate than others. As for the technology itself, research is needed to look at how existing tools such as course management systems, with what many consider to have serious pedagogical limitations, can be adapted to blended learning, and studies need to be done on how new tools such as the ones I describe next can be integrated into the blended learning experience.

Participatory Web Tools. A new generation of Web-based tools has emerged over the past few years that allow people to create, share, modify, augment, and comment on content as well as socialize with others having the same interests. Some use the term Web 2.0 to set apart this generation of tools with those that preceded them; others call it the Read/Write Web or the social Web. I prefer the term Participatory Web as I believe it has more of an intuitive meaning. Simply put the previous generation of Websites was passive, but this generation allows users to actively participate with others and contribute to the Web. The tools that are part of the Participatory Web are already well known to students in our schools, but not so well know by the rest of us. They include *wikis* (a collaborative Webspace where users can create and edit content, *blogs* (easily updateable Websites used for personal diaries), and *audio/video casting* (downloading and uploading audio or video files). The Web sites that represent the Participatory Web include:

- *Flickr* which allows sharing photos publicly, privately, or in special interest groups; commenting on your own or other's photos; and organizing photos.
- *MySpace* which is the most popular Website in the U.S and one of the most visited in the world—a place for people to meet, make friends, share photos, chat, download music, and join discussion forms, to name only some of the activities at the site.
- *Del.icio.us* which is a site where people share bookmarks to their favorite Website and add commentary about the sites.
- *Wikipedia* which is a wiki-based encyclopedia where anyone can make an entry on any topic or edit anyone else's entry.

There are far too many potential uses of these tools for teaching and learning for me to attempt a discussion here, so I refer you to the recent book *Blogs, wikis, podcasts, and other powerful tools for the classroom* (Richardson, 2006) that has a good description of these tools and their educational applications. Because of their newness, there is almost no research available on the pedagogical uses of these tools. Nevertheless, as Richardson points out, educators should understand and learn to use them because our students are using them outside of school and their underlying concepts define a significant new direction for the Web.

Serious Games. Although it might seem like an oxymoron, a new field of study is emerging that is usually referred to as serious game research. Two leaders in this field are Marc Prensky and James Paul Gee. Prensky, a game developer himself, presents a very compelling argument of why games are an engaging way for students to learn (Prensky, 2006). He makes the point that by the time students graduate from college they will have spent about 5000 hours reading but 10,000 hours playing games. Games can be an engaging and challenging tool that help young people learn successfully states Prensky, and it behooves us to bring gaming design principles into the classroom in the design of learning activities. Gee is an accomplished linguist who discovered the impact of games on learning later on in his career by observing his own child play commercial games and then playing them himself. In his book *What video games have to teach us about learning and literacy* (Gee, 2003), Gee documents 36 learning principles found in good games that are a far cry from the skill-drill-test routine prevalent in many classrooms today. Gee argues that educators need to give serious attention to these learning principles as they fit better with the needs of today's generation of students.

My colleagues and I are also involved in research on serious games. Several years ago we received funding from Canada's Social Sciences and Humanities Research Council to develop a research network to develop prototype games and simulations for learning and to study their impact on learners. Called Simulation and Advanced Gaming Environments (SAGE) for Learning, our network is making significant progress in developing this field of research. I am leading a team in SAGE that is developing the Virtual Usability Laboratory (http://VULab.ca), which we can use to record screen interactions and audio of students playing games on our server when they are in remote locations such as classrooms or laboratories. The tool also pops up pre- and post-game questions that the researcher sets up in advance. The videos and question answers obtained from the tool are then available for qualitative coding and analysis to discover design problems and usability issues. Another study I am leading is examining the effects on grade 4 students' literacy skill development when they do curriculum-related research and develop games to test their fellow students' skills (see http://www.gamestudy.ca). Students use a Web-based *game shell* that provides them with templates of popular board games such as Tic-Tac-Toe and Trivia into which they can enter questions based on their research on the curriculum topics. A SAGE researcher developed this shell which can be accessed at http://www.savie.qc.ca/carrefourjeux/an/accueil.htm/.

The field of serious game research is in its still in its infancy; so we need to do much work to understand better how existing commercial games can be successfully used in the classroom and how the principles of game design can be incorporated into designing other kinds of Web-based learning activities.

Conclusion

The Web is one of the most extraordinary developments of modern society. Before our eyes, it is literally transforming the way we work, communicate, socialize, shop, do business, play, entertain ourselves, and learn. At the same time the Web is creating a myriad of research opportunities for both new researchers and those already established. I hope that my remarks will stimulate your interest in pursuing research on Web-based learning in some of the most promising areas that I outlined.

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