Writing the Digital Economy: A Summary of Research and Perspectives

Thinking Differently about Digital Literacies and the Digital Economy

An important foundational step for Canadian policy makers to ensure that Canada becomes a world leader in the digital economy will be a continued commitment to funding research that explores the links between the digital economy and digital literacies. Ongoing investigation of these links is important as society moves beyond a traditional approach to texts. Canadian policy makers have an opportunity to support Canadians as they generate financial, social, and personal value through their participation as producers and consumers in a global economy.

Innovation requires new thinking about literacies, and simply replacing the current literacies with digital approaches is not sufficient. Models of conventional writing, publishing, and feedback are shifting, the structures of classrooms are changing, the writing process is evolving, and new digital media are impacting the way many Canadian citizens live, learn, and write. These changes not only affect education, but our society and economy at large.

Why Our Study Focused on Writing and the Digital Economy

Today's students view digital technologies very differently than their teachers (and parents) as they seamlessly integrate them into all aspects of their lives outside the walls of the classroom. The word "writing" now includes an assortment of purposes, skills, and audiences that have become intertwined with a technological existence that permeates all facets of students' lives. These new literacy practices are also defining the workplace in the knowledge economy and carry dramatic implications for teaching and learning, so much so that the essential foundations of education—learners, literacy, and knowledge—are continually being transformed.

> *"The great digital divide is between those that can read and write with media and those who can't"- Elizabeth Day*

For example, a search of the writing tag on the Flickr photo sharing site nets an array of photos from all corners of the world that the photographers see as connected to writing. The diversity of medium, form, and choice illustrates the changing nature and definition of writing.

As writers explore digital media, what text is and how it functions is changing. This changing dynamic of text is bringing new challenges and opportunities to education to embrace, explore, research, and enhance learning.

Further, changes in communication and connectivity are accelerating the pace of production and widening the audience for writers. Writers are not tethered to a desktop. Almost anywhere, anytime, a sophisticated message can be created, edited, and published in a public, easily accessible internet space in a matter of minutes. Regardless of ability, being connected means being able to instantly publish to an audience of millions. Many more citizens than ever before need the combined skill set of critical thinking and digital message creation.

A thriving digital economy depends on more than just accessibility, but on its citizens having the the ability to contribute, respond, remix, and become part of the conversation. Influencing that "conversation" is part of how goods and services are being exchanged. Writing has always been a critical element of the economy, but in earlier times text on a printed page was static and final. Consumers used to be able to respond, by traditional mail, to an article in the newspaper, and several days later, one's response might have been printed; the conversation and process was disjointed and had no continuity. Today, whether an editorial, a novel, a 140 character thought, or a video clip, a digital message can be annotated, revised, and commented on instantly and in the meaningful context of a wide public audience. Much like the Greek agora, today's public space is collaborative and socially/economically connected. Writers are producers and consumers, building a community of exchange.

A Snapshot of our Methods

Qualitative Literature Review

The qualitative literature review was conducted with questions from the initial research proposal:

- How will increased adoption of digital technologies in schools change understandings, practices, and the development of writing as a communication skill? As new technologies change the disciplinary identity of writing, what are the relationships among writing inside/outside the classroom and student agency as global citizens?

- What are the institutional and discipline-related power and structural controls which legitimize some forms of writing at the expense of digital opportunities? To what extent do these controls influence students' and teachers' perceptions of writing quality, classroom expectations regarding the use of technology, and beliefs about the purpose of writing within the tension of academic success, employment, and active citizenship?
- In an age where the dissemination of ideas can be instant and worldwide, how does growth in the digital economy produce knowledge, shape thought, shift economies, develop citizenship, and generally alter what it means to be globally literate?

Initially the search was started with the terms writing, composition, web 2.0, internet, and technology. As the search continued terms such as blogging, storytelling, higher education, wiki, digital, collaboration, and text were added to both broaden and lead the search more towards specific writing and online publishing platforms. The search often led to older publications from the late 1990s or early 2000s, but through checking references and searching relevant recent journal indexes, more up to date publications were located.

Articles which focused on technologies that were not internet based, or that focused on technology used in non literacy based contexts, were discarded from search results. Initial reading centered around specific examples of using technology to instruct or support writing, but papers with trends, emerging technologies, and larger scale impacts and implications were also included. More than 100 studies were identified, and the 53 articles that best matched the research questions were reviewed.

The review process was a detailed analytical reading of the selected materials. The articles were read, summarized, and compared and contrasted with each new paper read. Throughout the process team members coded the papers for themes, highlighted for salient quotations, and annotated and commented on the emerging ideas. During this time, the team held four face-to-face and online meetings (one team member was working from Scotland) to assess the data, which included identifying links, exploring trends, and constructing possible models. Leading up to the knowledge exchange forum, team members synthesized the data for presentation to stakeholders working in the field of education. The knowledge exchange forum added a level of authenticity to our research as participants interacted with our findings from the perspective of their various classroom and administrative positions.

Current studies on the changing nature of writing and the new ways that writing can be taught are scarce. Also scarce are studies which investigate how new writing processes (such as collaborations and multi-modal constructions) are influencing what it means to publish, to have authorship, and to have influence in a vast public. Educational institutions have been slow to adjust to the shifting nature of writing and examples of innovative uses of digital technology in the classroom are rare. Much more research is needed in how multimodal writing genres, collaboration, instant publishing and feedback are changing and influencing writing, and how the resulting digital literacies can be part of education.

Quantitative Meta-analysis

There have been meta-analyses on distance learning (Cavanaugh et al., 2004; Shachar & Neumann, 2010) and online learning (Means et al., 2009) but there have not been meta-analyses on how using Web 2.0 may affect student writing and learning in general. This meta-analysis compares levels of learning and quality of writing when students used traditional versus Web 2.0 tools.

Area of inquiry

As the qualitative literature review continued (see above), the question of whether web-based tools could result in higher levels of learning outcomes and writing came to the fore for the quantitative meta-analysis. It was surmised that if web-based tools bring about higher levels of learning as well as contribute to better writing, then these skills would enable persons to be better able to interact and work in a digital economy.

The quantitative team considered two main questions: 1. Is there a significant difference in students' learning when using Web 2.0 tools compared to traditional, face-to-face learning contexts? 2. Is there a significant difference in students' writing quality when using Web 2.0 tools compared to traditional, face-to-face learning contexts?

Effect Size

Meta-analyses quantitatively integrate findings from extant research studies. Individual effect size measures from each study (in our case Cohen's *d*) are used to build an overall effect

size. This overall effect size compares the difference between the mean of the control (without using Web 2.0 tools) and the intervention (using Web 2.0 tools) divided by the pooled standard deviation. *STATA* software was used to calculate the overall effect size. For studies that reported more than one measure for particular qualities of writing (e.g. writing content and writing management in Meyer, et al, 2010) a pooled mean and standard deviation was used to calculate one Cohen's *d* measure.

Four highly regarded meta-analyses on similar topics guided our procedure (Cavanaugh et al., 2004; Goldberg et al., 2003; Means, et al.,2009; Shachar & Neumann, 2010).

Criteria for Inclusion/Exclusion of Studies

1. Time period: Since this meta-analysis focused on Web 2.0 and learning, we only considered studies undertaken after 2004.
2. Design of the study: Studies that followed an experimental design and had a control and an experimental group were selected. Therefore no correlational, qualitative or single-subject design studies were included in the meta-analysis.
3. Participant age and educational institution: We did not exclude studies based on age-range or type of educational institution.
4. Tool used or mode of delivery: Studies which used Web 2.0 tools such as Moodle, Blackboard, etc. were selected. Studies with computer aided or computer assisted tools and learning modes were not included.
5. Objective measure of learning and writing outcomes: The results in these studies presented objective measures of learning and writing quality outcomes.
6. Quantitative necessities: To determine effect sizes, the results of included studies required sufficient quantitative data to determine sample size, mean, and standard deviation. That is, mean, standard deviation, *t*-scores, and/or *ANOVA* for the control and experimental group were necessary.
7. Source of measure: Studies which used self-report as a measure of difference between control and experimental group were not included.
8. Language of study: Studies written in English were chosen.

Searching for Studies

The search for study materials was carried out mainly online. The electronic library and inter-library data bases and services of University of Prince Edward Island were employed. Search engines, such as Science Direct, ERIC, Academic Search Premier, Pro-Quest, Google Scholar, and MedLine, were used. Reference Lists of selected studies were consulted. Online journals were screened. When studies presented incomplete statistical data, direct email requests were sent out to the study authors for additional data.

Selection of Final Set of Studies

All studies were compiled into a master database. Studies were reviewed for relevant information pertinent to this study. Data on variables of interest were extracted, recorded and then coded by the research team.

The initial search resulted in a large number of topic-related studies (N > 300). Applying the exclusion criteria 1 and 2, this number was reduced to 145 experimental and quasi-experimental studies which examined Web 2.0 and student learning or student writing from 2004 onwards. Further reduction resulted after applying the other criteria. For example, some studies ($N = 5$) were excluded as they employed online modes for both the control and experimental group while considering other variables. Some studies reported results in terms of student's' self perceived level of learning. These too did not fit the inclusion criteria. The application of all criteria resulted in a total of 30 studies and 55 individual Cohen's *d* measures (Table 1 in Appendix 1). These studies covered a total of 5727 participants.

Key Findings from our Research

Findings from our study suggest:

1. A gap exists between what is possible in using technology for teaching and learning and what actually happens in most classrooms. Both students and teachers need to be better informed of what is possible in innovative teaching and learning strategies, not just for the classroom, but in how learned skills can then be implemented in teachers' and students' lives. The literature clearly

shows that personal use of social media—specifically blogs, wikis, podcasts and virtual environments—does not of itself result in new approaches to pedagogy. As Senior points out, "...although digital technologies can be used to support constructivist educational approaches, they can also be used to support traditional transmission of behaviourist approaches" (p. 138). This has been observed in elementary, secondary and tertiary education repeatedly.

We recommend that educational institutions be encouraged to adopt an approach to literacy that draws upon the constructivist possibilities presented by actively engaging students' use of social media and other web 2.0 tools. Some of these constructivist possibilities are as follows:

- Learning is enhanced when teachers make use of the online environment to give more immediate and context relevant feedback. Qualitative indicators suggest that process feedback works best in a closed environment, while content feedback works best in an open environment.
- When working in online environments, teachers need to consider thoughtfully when to have students collaborate and when to have them work independently.
- Regarding the social dynamics of Web 2.0, students are consuming more information, but their participation in content creation lags behind. Thus, broader application of learning is enhanced when students' writing matters beyond classroom evaluation.
- Online writing, such as tweets, texts, blog comments, and facebook updates reflect a trend of instant publication that is devoid of the traditional writing processes of reflection and revision. Thus, broader application of learning is enhanced when students are still required to complete specific writing tasks as part of a set of processes before publishing to the global, online audience.

These recommendations come with the caveat that any adoption of technology needs to be seamless and seen as a tool, not the focus of instruction. Technology must support instruction, learning, pedagogy, and content, not dictate it. We also recommend research which outlines the effective ways of supporting learners' use of social media to write texts *within classrooms*; in particular, there is a need to investigate the potential of affordable mobile computing.

2. A gap exists between the rate and reach (potentially global) of text and content creation outside of educational institutions as compared with inside. Outside of educational institutions, the traditional printed page is giving way to the screen. Multi-modality, (including audio, video, images, hyperlinks, and gameplay) is adding new dimensions, layers, and media to writing. Outside of educational institutions, text is often dynamic and spread over multiple platforms: a story, for example, can start on one page, and then be linked to a video on another site. That video could then have a comment that takes the reader to a set of images, or another story with a differing point of view. An animated online story, such as Inanimate Alice http://www.inanimatealice.com/, shows the educative possibilities of combined interactive text, audio, images, and games. Unfortunately, too few schools take advantage of these possibilities, as most institutions teach exclusively with traditional forms of text.

We recommend a broader implementation and greater focus on how new digital infrastructure can create convergence of ideas and content and open new doors for education, both at the University and K-12 level. For students there is the opportunity for a real audience and the potential for global collaboration. This increased public voice in turn increases engagement, critical thinking, and creativity. Individual teachers, too, can support student communication through multiple channels and multiple forms and genres of writing. Key is encouraging students to create (write) using the full possibilities of the digital modes of communication.

We also recommend that educational institutions continue to update their policies and programs regarding knowledge access. For example, traditional structures of academic journal publishing often lead to information being hidden behind firewalls and pay-only password protected areas. These kinds of journal structures are closed, and reserved for those in the 'academic inner circle.' Projects such as the Google book scanning, or open source journals open accessibility to knowledge. A person does not have to be a university scholar to access the latest research or vital archives. As the internet opens up new possibilities and sources of knowledge, the traditional journal structure and process needs to be examined with a global perspective in mind. The tools and environments Universities and K-12 use to teach, publish, and encourage writing need to align with the needs of 21st century economy, society and students.

3. A knowledge gap exists with respect to research on and the application of the writing process. The writing process is changing to reflect a deeper emphasis on sharing and interacting with the audience, text, and other texts, instead of static publication. The pace of publication and turnover of production is faster with more immediate response. Writers are producers and consumers, building a community of exchange and openness. However, these changes are seldom reflected in research design or pedagogy. Issues of plagiarism, publication, editor's feedback, audience (to name only a few) still show that educational institutions do not know how to respond to the changing nature of writing. In almost all cases, students still write for their teacher, receive delayed feedback from only their teacher, and rarely share their work outside the confines of the classroom.

We recommend further research which explores how teachers and students are using the connected nature of the web in collaborative and collective knowledge creation beyond the walls (i.e. closed networks) of the institution's traditional borders. A significant body of research over the last twenty-five years has demonstrated that children and youth are capable of acquiring skills usually associated with high-level research teams at a much earlier age than previously thought possible. Most of this research has focused on closed online environments designed specifically to support knowledge building: less work has been done on the conditions under which the more open, less focused Web 2.0 technologies can be coherently brought to bear on writing instruction in general and knowledge creation in particular. By way of example, we recommend research which explores how writing classrooms can utilize digital tools to give more meaningful, immediate feedback, both for improving one's writing, and for connecting the writer to a wider and more authentic audience. Such studies would set out to better understand the changing purposes and audiences for writers.

4. Through both quantitative and qualitative meta-analyses it was found that there are too few studies which look at how writing is learned in the K-12 context. In fact, the quantitative meta-analysis study search and exclusion process resulted in five studies that fit the criteria. Of those five, only two studied K-12 students. Even though the effect size was found to be high (.31), the small number of studies could not support the claim that Web 2.0 tools contribute to higher writing quality, as the test of Effect Size measure testing whether it varies significantly from zero

was calculated at $Z = 1.9$, $p = 0.11$ (see Figure 1). Furthermore, the qualitative search revealed that most studies which investigate digital tools show what those who already know writing fundamentals can do.

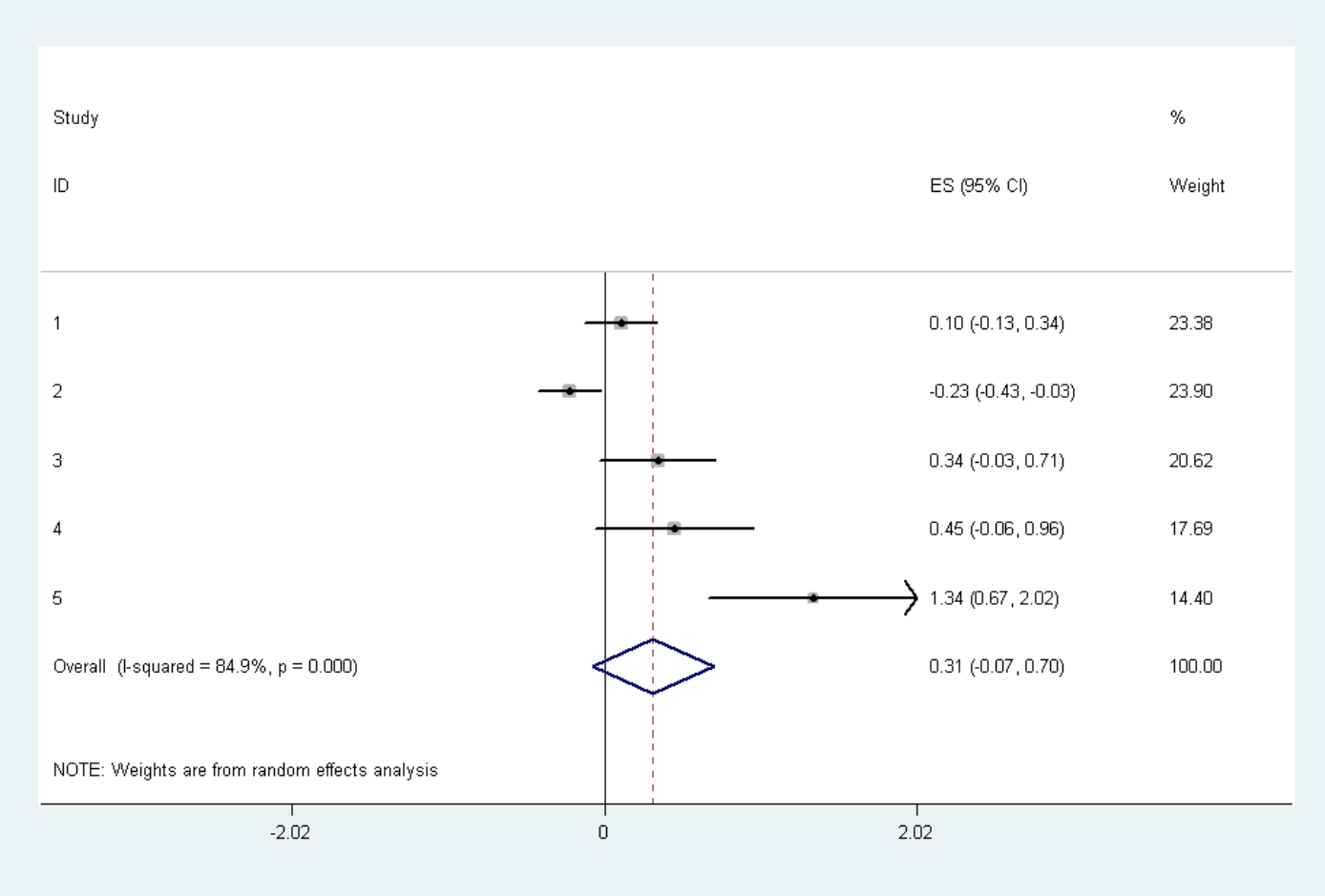

Figure 1: Web 2.0 and Effects on the Quality of Writing

We recommend there be further research which focuses on Web 2.0 and its effects on learning,

particularly for those who are learning to write: such as struggling learners, new language learners, and younger learners. What we know from studies *with participants from university and professional learning contexts* is that Web 2.0 tools lead to higher levels of knowledge (Figure 2) and skills (Figure 3). But more research is needed with different types of learners using digital tools in an online environment (such as those mentioned above). For example, how should a writing teacher understand feedback with these learners? When in the writing process is it best to receive feedback (such as online responses in threaded discussions), and should that feedback be instructor only, with peers, or not at all? Could social networking sites help build

confidence for

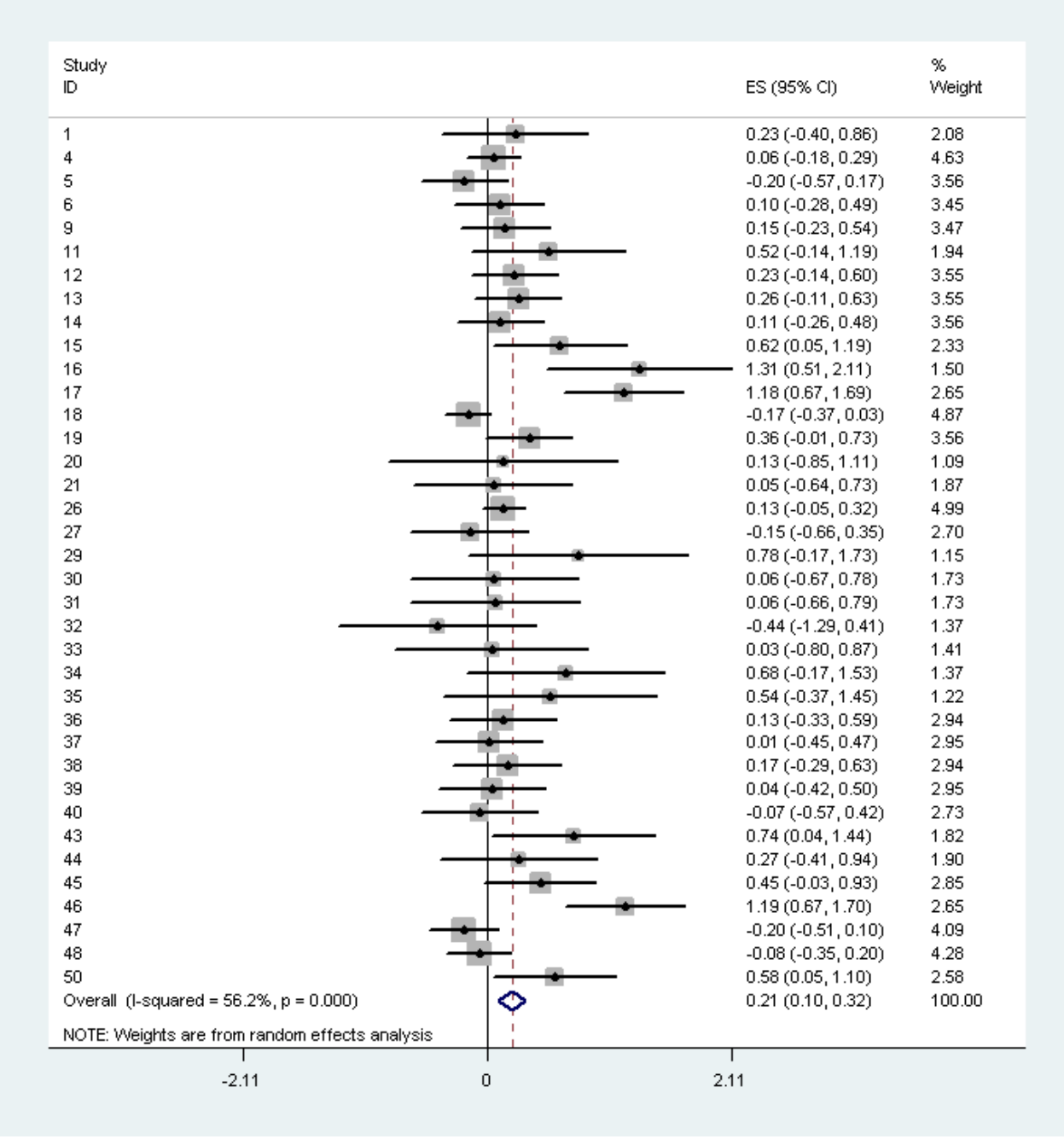

Figure 2: Effect sizes with Knowledge as dependent variable (pooled effect size = .21)

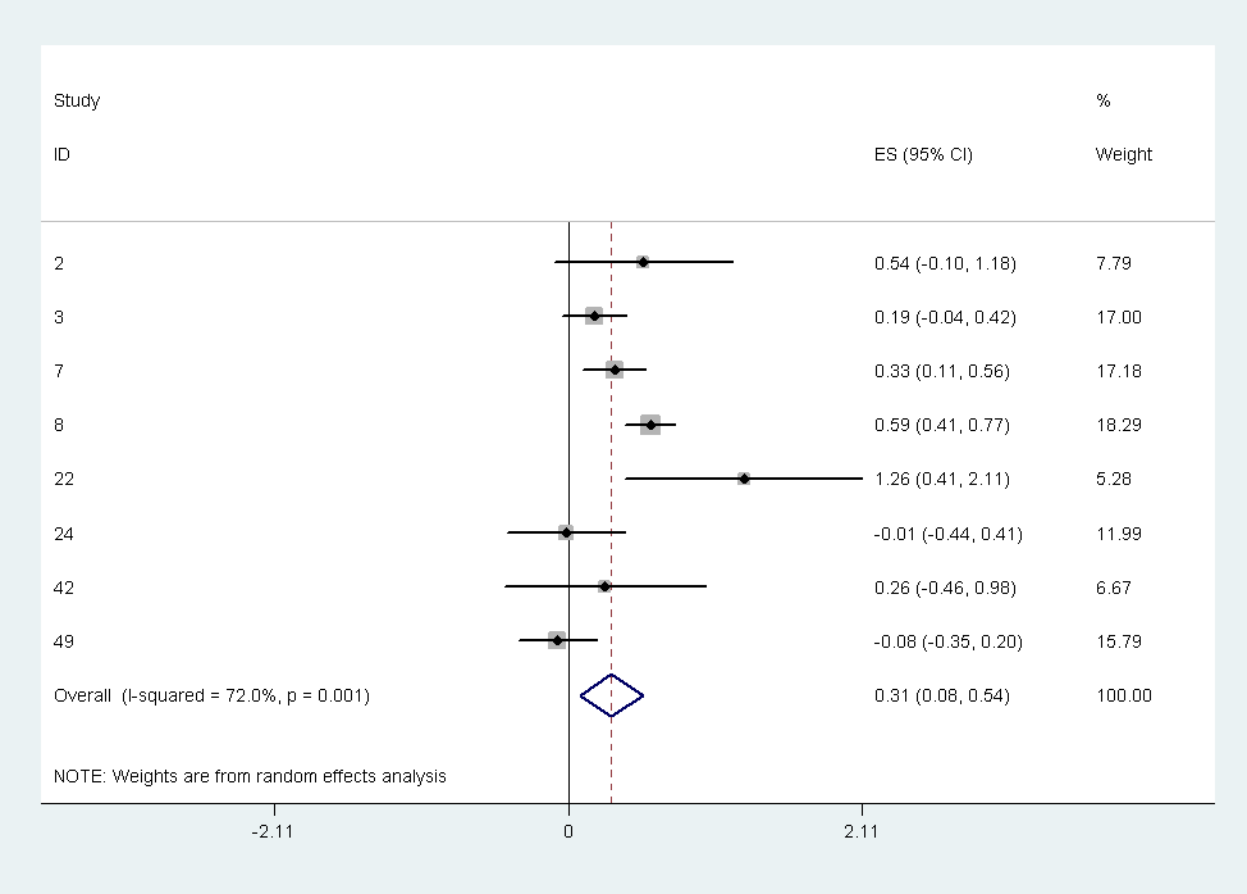

Figure 3: Effect sizes with Skills as dependent variable (pooled effect size = .35)

a beginner to share thoughts and ideas and then refine them after receiving feedback from others (even from those not enrolled in the class)? Social networking sites might also be used build an audience. Working together on a blog, a group of writers in a class (or the whole class) might build up an audience of dedicated readers. Regarding class work in general, adult learners appear to learn at about the same level when no one else sees their work as when their peers and their instructors are the audience (see the higher effect sizes compared to when just the instructor views the online work, Table 2). What is not currently known is how feedback at different stages of the writing process influences writing quality.

Table 2: *Effect Sizes of Coded Variables for Adult Learners*

Coded Variable		Effect Size
Type of Learning		
	knowledge	.21
	skills	.35
	attitudes	.12*
Audience		
	self	.31
	self and instructor	.20
	self and peer	-.21
	self, instructor and peer	.28
Level of collaboration		
	Collaborative	.24
	Non-collaborative	.24
Instructor Support		
	monitoring only	.26
	sporadic feedback	.16
	constant feedback	.12*
Mode		
	online	.24
	blended	.22

* effect size is not significant

We further recommend there be research which focuses more exactly on the nature of collaboration in Web 2.0 learning and writing. Collaboration is often suggested as a vital twenty-first century skill (see http://goo.gl/ZWIuE). We don't disagree entirely. But the nature of collaboration is complex and overly simplified by enthusiasts such as Rheingold (2010). In our meta-analysis, two coded variables showed no difference in learning preference: there was no difference whether the tool/medium provided for collaboration, and there was no difference whether it was used in a purely online or a blended learning situation. Interestingly, participants in the studies we examined appear to prefer to go it alone--with the teacher acting only as a monitor. We recommend further studies which look at how collaboration is linked to specific tools and processes. Collaboration may work better in some contexts and not others.

Important Trends for Education

One of the more compelling applications of digital technologies is digital storytelling. Human beings have told stories to share news and capture their histories over millennia, and these stories have become part of the auditory-oral culture transmitted from one generation to the next. Storytelling as a means of communication is steeped in tradition and culture, and is

available to all, even to those citizens unable to decode and make sense of story as printed word. Digital storytelling utilizes the power of multimedia and engages multiple senses to spark the creativity of writers and readers. The Digital Storytelling Association suggests that "Digital stories derive their power by weaving narrative, images, music and voice together, thereby giving deep dimension and vivid colour to characters, situations, experiences and insights." Digital storytelling facilitates the development of important stories, and the dissemination of these stories globally via the internet. One example of digital storytelling can be found in the National Archives of the United Kingdom, where staff members use twitter to bring a more complete picture to learners about a moment in history. Archive staff play the role of members of the UK War Cabinet, and send out tweets as if World War II were underway in the present (see https://twitter.com/ukwarcabinet). This stream of written communication--the story presented digitally--demonstrates the decision-making process and provides a realistic context for teaching, learning, and exploring history. We recommend a program of expansion for digital storytelling, and that the most effective means of engaging a broad range of writers in creating digital texts be determined and disseminated.

Another application of digital technologies that we find compelling is *social media in all its forms and subforms.* The social nature of the internet is at the heart of a digital economy based on the attention of the consumer. For example, the social networking and digital gaming industries are bringing in billions of dollars; it is also clear that these are not separate domains in the digital economy. The point is convergence, and it is a point that educationalists usually miss. Structured around individual units such as biology or physics, or separated into individual skill sets, those who are involved in teaching and learning rarely prepare students to think dynamically. For an example of what is possible, consider how the new Call of Duty: Black Ops Online gaming community had over one million members signed up and playing within twelve hours of the release of the game. The online community is a free connection point to play in a Massive Multiplayer Online Game (MMO). Game playing and online interaction is a social experience. The boundaries of what is familiar are being pushed. If the subject is writing, then educational institutions ought to be thinking about how digital technology is changing they way we interact with text and the way we interact as producers and consumers of content.

A third application of digital technologies that we find compelling is *the way writing is moving cross-platform and using web 2.0 media to give multiple view points and perspectives.*

The site Project 1968 http://www.project1968.com/ is on a blog, but it is a work of historical fiction recreating the events of the 1968 American Democratic Convention in Chicago. It includes posts from two perspectives, one of a political campaigner, and one of a protester and peace activist. The story is told through their eyes and posts written from their perspectives. The digital nature of the site allows for links to historical archives, a myspace page about the author and the project, and a BBC radio recreation of 1968 in sound, linking writing and audio based text from two different sites, media, and continents. In Japan a trend of mobile phone novels has become so popular it has reached the best seller list. Magic iLand (http://ip.tosp.co.jp/index.asp - the site is in Japanese, but with a tool such as Google Translate you can view an English version) is an example of a sharing site for these books. Readers (who are also acting as writers) can view, download, or comment on the site. These novels are now emerging with mobile phone features such as vibrating, sound, and images built in. Books can be purchased in print, or consumers can get an e-book to read on an iPad or Kindle, or they can get a copy with sound and interactive features, for a gaming console, such as a Nintendo DS. These electronic versions of text have built in social networking features such as the abilities to "like" it on Facebook, or tweet one's progress in the novel. Digital technologies are allowing writing to come to new media and cross boundaries into other platforms.

A Summary of Our Recommendations

- Encourage educational institutions to adopt an approach to literacy that actively engages students' use of social media and other web 2.0 tools.
- Encourage the seamless adoption of technology as a tool, not the focus of instruction;
- Support research which outlines the effective ways of supporting learners' use of social media to write texts *within classrooms*;
- Support research to investigate the potential of affordable mobile computing;
- Encourage universities and K-12 institutions to focus on how new digital infrastructure can create convergence of ideas and content;
- Encourage educational institutions to continue to update their policies and programs regarding knowledge access;

- Support research which explores how teachers and students are using the connected nature of the web to collaboratively create knowledge;
- Support research to determine how digital tools will allow for more meaningful, immediate feedback to writers;
- Encourage the expansion of programs for digital storytelling;
- Support research to investigate the most effective means of engaging a broad range of writers to create digital texts.

Where Do We Go from Here?

Education systems affected by the development of global knowledge economies and the concepts of 21st century learning have been slow to adapt. Public education, the cornerstone for leadership development, critical thinking, and life-long learning needs to adapt. As part of our research process, our team organized a knowledge exchange forum for 30 researchers, policy makers and K-12 educators. One predominant message from the forum was that the gaps identified in the literature were real. Teachers experienced these gaps as barriers to implementation of innovative teaching. We have learned that teachers recognize the need for different practices in the classroom, but that their schools are moving too slowly in creating changes within the curriculum and providing the support to take on the challenges a new curriculum would create.

“We’re not really talking about technology as much as the processes of connections and participation and collaboration” (participant at knowledge exchange forum).

“We were taught in traditional ways but we are not thinking that way now”. (participant at knowledge exchange forum).

When addressing the gaps noted in this study concerning teaching and learning in the digital age, translating knowledge into the practice of education needs to be intentional, structured and supported by evidence-informed research that fosters consensus among administrative decision-makers, policymakers, and local stakeholders. As a gap can be defined as

a lack of continuity between research, evidence and practice, and policy making, all strategic initiatives to bridge the knowledge to practice gap should involve rigorous methods to incorporate the views and opinions of relevant stakeholders. Gaps exist for a number of reasons stemming from systematic issues related to political ideologies, personal attitudes, organizational power and workplace hierarchies (*Straus, Tetroe, & Graham. 2009,(Eds)*.

"To empower these kids you are looking at more than instruction, you are looking at resources, pedagogies, the processes…there is a desire to be there, but there are so many constraints upon us, so we have to be pragmatic…institutions are not keeping up with teachers' desires to change pedagogy… it's hard to change the world when your hands are tied behind your back" (participant at knowledge exchange forum).

The implementation of research into education has greater acceptance among educators if there is institutional and policy reinforcement and support, if there is opportunity for professional development and dialogue with colleagues, and if knowledge sharing is combined with ongoing feedback (Grol & Grimshaw, 2009). The best way of ensuring that research gets translated and utilized into practices is to have a variety of implementation strategies to support individual, institutional, and jurisdictional perspectives and partnerships (Lomas, 2000).

We believe Canadians are at the beginning of a new era for re-imagining a web which moves beyond traditional uses of documents and websites. Writing and its related digital literacies are central to the entrepreneurial promise of the convergence between a social and economic web. In addition to identifying major gaps in the available research, our knowledge synthesis notes the potentially powerful contribution of Web 2.0 technologies to the instruction of writing and other learning, and provides directions for further thought, experimentation, and innovation.

References

Alexander, B., & Levine, A. (2008). Web 2.0 storytelling: The emergence of a new genre. *EDUCAUSE Review*, 43(6), 40-56.

Alexander, J. (2009). Gaming, student literacies, and the composition classroom: Some possibilities for transformation. *College Composition and Communication*, 61(1), 35-63.

Al-Jarf, R. (2004). The effects of web-based learning on struggling EFL college writers. *Foreign Language Annals,* 37(1), 49-57.

Anzai, Y. (2008). Introducing a Wiki in EFL writing class. In G. Richards (Ed.), *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* 2008 (pp. 547-552). Chesapeake, VA: AACE.

Banister, S., Ross, C. & Vannatta, R. (2008). The impact of Web 2.0 tools in the reading classroom:. In K. McFerrin et al. (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference* 2008 (pp. 3617-3621). Chesapeake, VA: AACE.

Benjamin, S. E., Tate, D. F., Bangdiwala, S. I., Neelon, B. H., Ammerman, A. S. & Dodds, J. M. & Ward, D.S. (2008). Preparing child care health consultants to address childhood overweight: A randomized controlled trial comparing web to in-person training. *Maternal and Child Health Journal, 12*, 662-669.

Benkler, Y. (2008). The university in the networked economy and society: Challenges and opportunities. *EDUCAUSE Review*, 43(6-), 59-72.

Bertot, et al. (2008). *Public libraries and the internet: Study findings and results*. Tallahassee, FL: Information Institute.

Blin, F., & Munro, M. (2008). Why hasn't technology disrupted academics' teaching practices? Understanding resistance to change through the lens of activity theory. *Computers and Education 50* (2), 475-490.

Block, A., Udermann, B., Felix, M., Reineke, D., & Murray, S.R. (2008). Achievement and satisfaction in an online versus a traditional health and wellness course. *MERLOT Journal of Online Learning and Teaching, 4*(1), 57-66.

Burke, J. N. & Cizek, G. J. (2006). Effects of composition mode and self-perceived computer skills on essay scores of sixth graders. *Assessing Writing, 11*(3), 148-166.

Canadian Institutes of Health Research (2009). Knowledge translation in health care: Moving from evidence to practice. S. Straus, J.Tetroe & I. Graham *(*Eds.). Singapore: Blackwell Publishing Ltd.

Carr, N. (2010). *The shallows.* London: Atlantic Books.

Cavanaugh, C., Gillan, K. J., Kromrey, J., Hess, M., & Blomeyer, R. (2004). *The effects of distance education on K–12 student outcomes: A meta-analysis.* Learning Point Associates.

Cavus, N. (2007). Assessing the success rate of students using a learning management system together with a collaborative tool in web-based teaching of programming languages. *Journal of Educational Computing Research, 36* (3), 301-321.

Chang, C.W., Lee, J.H., Chao, P.Y., Wang, C.Y., & Chen, G.D. (2010). Exploring the possibility of using humanoid robots as instructional tools for teaching a second language in primary school. *Educational Technology & Society*, *13*(2), 13–24.

Clark, J. E. (2010). The digital imperative: Making the case for a 21st-century pedagogy. *Computers and Composition*, *27*(1), 27-35.

Colby, R., & Colby, R. (2008). A pedagogy of play: Integrating computer games into the writing classroom. *Computers and Composition*, *25*(3), 300-312.

Crook, C., & Bennett, L. (2007). Does using a computer disturb the organization of children's writing? *British Journal of Developmental Psychology*, *25*(2), 313-321.

DeBord, K. A., Aruguete, M. S., & Muhlig, J. (2004). Are computer-assisted teaching methods effective? *Teaching of Psychology, 31*(1), 65-68.

Dubisar, A.M. & Palmeri, J. (2010). Palin/Pathos/Peter Griffin: Political video remix and composition pedagogy. *Computers and Composition*, *27*, 77–93.

El-Deghaidy, H., & Nouby, A. (2008). Effectiveness of a blended e-learning cooperative approach in an Egyptian teacher education programme. *Computers & Education, 51*(3), 988-1006.

Fajardo-Lira, C., & Heiss, C. (2006). Comparing the effectiveness of a supplemental computer-based food safety tutorial to traditional education in an introductory food science course. *Journal of Food Science Education,5*(2), 31-33.

Farmer, B., Yue, A., & Brooks, C. (2008). Using blogging for higher order learning in large cohort university teaching: A case study. *Australasian Journal of Educational Technology*, *24*(2), 123-136.

Fishman, J., Lunsford, A., McGregor, B., & Otuteye, M. (2005). Performing writing, performing literacy. *College Composition and Communication*, *57*(2), 224-252.

Frederickson, N., Reed, P., & Clifford, V. (2005). Evaluating web-supported learning versus lecture-based teaching: Quantitative and qualitative perspectives. *Higher Education 50*(4), 645-664.

Geisler, C., Bazerman, C., Doheny-Farina, S., Gurak, L., Haas, C., Johnson-Eilola, J., Kaufer, D. S., Lunsford, A., Miller, C. R., Windsor, D, & Yates, J. (2001). IText: Future directions for research on the relationship between information technology and writing. *Journal of Business and Technical Communication*, *15*(3), 269-308.

Godwin-Jones, R. (2008). Web-writing 2.0: Enabling, documenting, and assessing writing online. *Language Learning & Technology*, *12*(2), 7-12.

Goldberg A., Russell M., & Cook A. (2003). The effect of computers on student writing: A meta-analysis of studies from 1992-2002. *The Journal of Technology, Learning and Assessment, 2*(1).

Grol R., & Grimshaw J. (2003). From best evidence to best practice. *Lancet, 361*, 1225-1230.

Gustafson, K. (2004). The impact of technologies on Learning. *Planning for Higher Education*, *32*(2), 37-43.

Hart-Davidson, B., Cushman, E., Grabill, J.T., DeVoss, D.N., & Porter, J. (2005). Why teach digital writing? *Kairos*, *10*(1).

Harris Jr, J. M., Elliott, T. E., Davis, B. E., Chabal, C., Fulginiti, J. V., & Fine, P. G. (2008). Educating generalist physicians about chronic pain: Live experts and online education can provide durable benefits. *Pain Medicine, 9*(5), 555-563.

Hegarty, M. (2004). Dynamic visualizations and learning: Getting to difficult questions. *Learning and Instruction*, *14*, 343–351.

Jang, K. S., Hwang, S. Y., Park, S. J., Kim, Y. M., & Kim, M. J. (2005). Effects of a web-based teaching method on undergraduate nursing students' learning of electrocardiography. *Journal of Nursing Education, 44*(1), 35-38.

Jewitt, C., Bezemer, J., Jones, K., & Kress, G. (2009). Changing English? The impact of technology and policy on a school subject in the 21st century. *English Teaching: Practice and Critique*, *8*(3), 8-20.

Kardong-Edgren, S., Oermann, M. H., Odom-Maryon, T., & Ha, Y. (2010). Comparison of two instructional modalities for nursing student CPR skill acquisition. *Resuscitation, 81*(8), 1019-1024.

Kear, D. (2005). Impacting teacher writing through blogging. In G. Richards (Ed.), *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* 2005 (pp. 806-809). Chesapeake, VA: AACE.

Kinzer, C.. (2010). Considering literacy and policy in the context of digital environments. *Language Arts*, *88*(1), 51-61.

Klages, M., & Clark, J. (2009). New worlds of errors and expectations: Basic writers and digital assumptions. *Journal of Basic Writing (CUNY)*, *28*(1), 32-49.

Komoski, K. (2007). 21st century teachers as prosumers in a bi-literate knowledge-driven global economy. In R. Carlsen et al. (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference* (pp. 1303-1311). Chesapeake, VA: AACE.

Kumar, S. (2010). The net generation's informal and educational use of new technologies. *In Education: Technology & Social Media* (Special Issue, Part 2). *16*(1).

Lewis, C., & Fabos, B. (2005). Instant messaging, literacies, and social identities. *Reading Research Quarterly*, *40*, 470–501.

Legutko, R. S. (2007). Face-to-face or cyberspace: Analysis of course delivery in a graduate educational research course. *MERLOT Journal of Online Learning and Teaching, 3*(3), 288-294.

Liang, M.Y. (2007). Rethinking blog-integrated EFL curricula: A reflection on participation and learning. In T. Bastiaens & S. Carliner (Eds.), *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 1686-1691). Chesapeake, VA: AACE.

Liu, M., Kalk, D., Kinney, L., Orr, G. & Reid, M. (2009). Web 2.0 and its use in higher education: A review of literature. In T. Bastiaens et al. (Eds.), *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 2871-2880). Chesapeake, VA: AACE.

Lofstrom, E., & Nevgi, A. (2007). From strategic planning to meaningful learning: diverse perspectives on the development of web-based teaching and learning in higher education. *British Journal of Educational Technology*, *38*(2), 312–324.

Lomas J.(1997). Improving research dissemination and uptake in the health sector: beyond the sound of one hand clapping. Retrieved from www.chsrf.ca/knowledge_transfer/pdf/handclapping_e.pdf

Long, M. & Jennings, H. (2005). *Does it work-Impact of technology and professional development on student achievement.* Paper presented at MICCA Conference, USA.

Luce-Kapler, R., & Dobson, T. (2005). In search of a story: Reading and writing in e-literature. *Reading Online*, *8*(6), 1-16.

Maratano, G., & Barton, M. (2010). Paradox and promise: MySpace, Facebook, and the sociopolitics of social networking in the writing classroom. *Computers and Composition*, *27*(1), 36-47.

Means, B., Toyama, Y., Murphy, R., Bakia, M. & Jones, K., (2009). Department of Education (ED), Office of Planning, Evaluation and, Policy Development. *Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies.* US Department of Education.

Meyer, E., Abrami, P. C., Wade, C. A., Aslan, O., & Deault, L. (2010). Improving literacy and metacognition with electronic portfolios: Teaching and learning with ePEARL. *Computers & Education, 55*(1), 84-91.

Hugenholtz, N. I. R., Croon, E. M., Smits, P. B., van Dijk, F. J., & Nieuwenhuijsen, K. (2008). Effectiveness of e-learning in continuing medical education for occupational physicians. *Occupational Medicine, 58*(5), 370-370.

Nguyen, H. Q., Donesky-Cuenco, D., Wolpin, S., Reinke, L. F., Benditt, J. O., Paul, S. M., & Carrieri-Kohlman, V. (2008). Randomized controlled trial of an internet-based versus face-to-face dyspnea self-management program for patients with chronic obstructive pulmonary disease: Pilot study. *Journal of Medical Internet Research, 10*(2) 1-14.

O'Dwyer, L. M., Carey, R., & Kleiman, G. (2007). A study of the effectiveness of the Louisiana Algebra I online course. *Journal of Research on Technology in Education, 39*(3), 289-306.

Padalino, Y., & Peres, H. H. (2007). E-learning: A comparative study for knowledge apprehension among nurses. *Revista Latino-Americana De Enfermagem, 15*(3), 397-403.

Passig, D. & Schwartz, G. (2007). Collaborative writing: Online versus frontal. *International Journal on e-Learning, 6*(3), 395-412.

Petersen, S. A., Canova, C. I., Divitini, M., Haugaløkken, O .K., & Rossitto, C. (2010). *Connectedness in practice-based education: The why, who, what*. Conference Proceedings of mLearn 2010, p. 92-99.

Peterson, C. L., & Bond, N. (2004). Online compared to face-to-face teacher preparation for learning standards-based planning skills. *Journal of Research on Technology in Education, 36(*4), 345-360.

Pearce, N., Weller, M., Scanlon, E., & Kinsely, S. (2010). Digital scholarship considered: How new technologies could transform academic work. *In Education: Technology & Social Media* (Special Issue, Part 2). *16*(1).

Priemer, B., & Ploog, M. (2007). The influence of text production on learning with the Internet. *British Journal of Educational Technology*, *38*(4), 613-622.

Powell, D. C. (2007). Student satisfaction with a distance learning MPA program: A preliminary comparison of on-campus and distance learning students' satisfaction with MPA courses. *MERLOT Journal of Online Learning and Teaching, 3*(1), 1-18.

Purdy, J. P. (2010). The changing space of research: Web 2.0 and the integration of research and writing environments. *Computers and Composition*, *27*(1), 48-58.

Radia, P., & Stapleton, P. (2008). Unconventional internet genres and their impact on second language undergraduate students' writing process. *Internet and Higher Education*, *11*(1), 9-17.

Rockman, et. al. (2007). *ED PACE final report. West Virginia Department of Education.*

Scottish Education. (2009) *Curriculum for excellence*. Retrieved from http://www.ltscotland.org.uk/Images/all_experiences_outcomes_tcm4-539562.pdf

Selwyn, N. (2007). "*Screw Blackboard...do it on Facebook!': An investigation of students' educational use of Facebook. Poke 1.0* – Facebook Social research symposium.

Senior, R. (2010). Connectivity: A framework for understanding effective language teaching in face-to-face and online learning communities. *RELC Journal*, *41*(2) 137–147.

Shachar, M., & Neumann, Y. (2010). Twenty years of research on the academic performance differences between traditional and distance learning: Summative meta-analysis and trend examination. *Journal of Online Learning and Teaching*, 6(2).

Shareski, D. (2010) *Sharing: The Moral Imperative*. [online video]

Sheetz, D. & Curcher, M. (2008). Using blogs to enhance content learning for students who are learning in a second language. In G. Richards (Ed.), *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* 2008 (pp. 1254-1259). Chesapeake, VA: AACE.

Siemens, G., & Matheos, K. (2010). Systemic changes in higher education. *In Education*: *Technology & SocialMedia* (Special Issue, Part 2). *16*(1).

Smith, C. (2008). Technologies for transcending a focus on error: Blogs and democratic aspirations in first-year composition. *Journal of Basic Writing (CUNY)*, *27*(1), 35-60.

Smith, S. D., & Caruso, J. B., (2010). *The ECAR study of undergraduate students and information technology, 2010*. EDUCAUSE Center for Applied Research.

Sorapure, M. (2010). Information visualization, Web 2.0, and the teaching of writing. *Computers and Composition*, *27*(1), 59-70.

Sun, K., Lin, Y., & Yu, C. (2008). A study on learning effect among different learning styles in a web-based lab of science for elementary school students. *Computers & Education, 50*(4), 1411-1422.

Tapscott, D., & Williams, A. D. (2010). Innovating the 21st-century university: It's time! *EDUCAUSE Review*, *45*(1), 16-29.

Thurston, A., Duran, D., Cunningham, E., Blanch, S., & Topping, K. (2009). International on-line reciprocal peer tutoring to promote modern language development in primary schools. *Journal of Computers & Education*, *50*(3), 462–472.

Turner, M. K., Simon, S. R., Facemyer, K. C., Newhall, L. M., & Veach, T. L. (2006). Web-based learning versus standardized patients for teaching clinical diagnosis: A randomized, controlled, crossover trial. *Teaching and Learning in Medicine, 18*(3), 208-214.

Valdes-Corbeil, M. & Corbeil, J. (2008). Enhancing social presence by replacing the discussion forum with a blog. In G. Richards (Ed.), *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 1318-1323). Chesapeake, VA: AACE.

Vasudevan, L. (2010). Literacies in a participatory, multimodal world: The arts and aesthetics of Web 2.0. *Language Arts*, *88*(1), 43-50.

Vie, S. (2008). Digital divide 2.0: 'Generation M' and online social networking sites in composition. *Computers and Composition*, *25*, 9–23.

Wake, J. D., Dysthe, O., & Mjelstad, S. (2007). New and changing teacher roles in higher education in a digital age. *Educational Technology & Society*, *10*(1), 40-51.

Wang, L. (2008). Developing and evaluating an interactive multimedia instructional tool: Learning outcomes and user experiences of optometry students. *Journal of Educational Multimedia and Hypermedia, 17*(1), 43-57.

Zhang, D. (2005). Interactive multimedia-based E-learning: A study of effectiveness. *American Journal of Distance Education, 19*(3), 149-162.

Zhang, D., Zhou, L., Briggs, R. O., & Nunamaker, J. F. (2006). Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness. *Information & Management, 43*(1), 15-27.

Appendix 1: Table 1

Table 1: *Studies Included in the Quantitative Meta-analysis*

Author (year)	Tool	Type of Learning	N	Cohen's d	SE	Audience	Level of Collaboration	Instructor Support
Nguyen, HQ. et al (2008)	website using PDA	Knowledge	39	0.23	0.32	self, instructor and peer	collaborative	sporadic feedback
Nguyen, HQ. et al (2008)	website using PDA	Skills	39	0.54	0.33	self, instructor and peer	non-collab.	sporadic feedback
Meyer, E. et al. (2010)	ePEARL	Skills	296	0.19	0.12	self, instructor and peer	non-collab.	sporadic feedback
Meyer, E. et al. (2010)	ePEARL	Knowledge	296	0.06	0.12	self, instructor and peer	non-collab.	sporadic feedback
Wang, L. (2008)	Virtual Optics Labs	Knowledge	112	-0.20	0.19	self	non-collab.	monitoring only
Wang, L. (2008)	Virtual Optics Labs	Knowledge	112	0.10	0.20	self	non-collab.	monitoring only
Kardong-Edgren, S. E. et al. (2010)	(HeartCodeTM BLS)	Skills	372	0.33	0.11	self and instructor	non-collab.	monitoring only
Kardong-Edgren, S. E. et al. (2010)	Computer-based course	Skills	229	0.59	0.09	self and instructor	non-collab.	monitoring only
Jang, K.S. et al. (2005)	Web-based ECG	Knowledge	105	0.15	0.20	self and instructor	non-collab.	monitoring only
Jang, K.S. et al. (2005)	Web-based ECG	Attitude	105	0.12	0.20	self and instructor	non-collab.	monitoring only
Cavus, N (2007)	Moodle	Knowledge	36	0.52	0.34	self, instructor and peer	collaborative	constant feedback
DeBord, Aruguete and Muhlig (2004)	Blackboard	Knowledge	112	0.23	0.19	self and instructor	non-collab.	monitoring only
DeBord, Aruguete and Muhlig (2004)	Blackboard	Knowledge	112	0.26	0.19	self and instructor	non-collab.	monitoring only
DeBord, Aruguete and Muhlig (2004)	Blackboard	Knowledge	112	0.11	0.19	self and instructor	non-collab.	monitoring only
Padalino and Peres (2007)	e-learning using power point	Knowledge	49	0.62	0.29	self and instructor	non-collab.	monitoring only
Fajardo-Lira and Heiss, C. (2006)	Web-based computer tutorial	Knowledge	31	1.31	0.41	self	non-collab.	monitoring only
Zhang et al. (2006)	E-learning with interactive video	Knowledge	69	1.18	0.26	self	non-collab.	monitoring only

Table 1: *Studies Included in the* Quantitative Meta-analysis (continued)

Author (year)	Tool	Type of Learning	N	Cohen's d	SE	Audience	Level of Collaboration	Instructor Support
Rockman et al. (2007)	Virtual School Spanish program	Knowledge	403	-0.17	0.10	self and instructor	non-collab.	monitoring only
Sun, Lin and Yu (2008)	Web-based lab system	Knowledge	113	0.36	0.19	self and instructor	non-collab.	monitoring only
Frederickson, Reed and Clifford (2005)	Interactive web site	Knowledge	16	0.13	0.50	self, instructor and peer	collaborative	monitoring only