

Research Report for GeSCI Meta-Review of ICT in Education Phase Two -Partial document-

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Terms of Reference for GeSCI Request for Proposal

Meta-review of ICT in Education Research

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Narrative Analysis of Key Findings

Transformational Migration to a New Century

What are the major research trends?

David Buckingham's book, *Beyond Technology: Children's Learning in the Age of Digital Culture* (Hedberg, 2008) presents a critique of technological implementation in schools and calls for transformational innovation to shake education beyond conventional practice for an outmoded world. He suggests that children cannot become digitally literate if they use technology to learn conventionally. He suggests that much contemporary application, driven by commercial objectives, is "uninspiring and mundane." He views the technology as potentially transformational and draws upon contemporary research and innovation to illustrate his points. Richards (2006) re-focuses the discussion back to effective pedagogy; without it, the transformative application of ICT is unlikely to occur. Teo (2008) and Teo, Chai, Hung, and Lee (2008) correlate the beliefs that teachers bring to the classroom with the quality of their technology use. Teachers with a constructivist predisposition to teaching in general are more likely to integrate ICT creatively.

As noted earlier, Martínez Arbeláiz and Correa Gorospe (2009) raise the intriguing term "the grammar of schooling," suggesting that its rules constrain transformational curricular innovation especially ICT integration. Schools seem to be quite unique among types of organization in constraining the transformational effects of technology. Marsh (2007) suggests that out-of-school literacy habits of children are leading school practice by a significant and widening margin, with negative consequences for the curricular relevance of literacy education. Martínez Arbeláiz and Correa Gorospe (2009) suggest that if technology deployment fails to disrupt the comfortable assumptions of traditional practice, then the resources spent on it will fail to produce meaningful improvement. Through a case study of two out-of-school projects, this research depicts models that might breach the grammatical orthodoxy of change-resistant school practice. This perspective is supported by research in Turkish schools (Demiraslan & Usluel, 2008) reporting that the typical organizational culture of schools is characterized by rigid hierarchies and inflexible curricular timetables that inhibit the transformational effect of ICT.

How does a new "grammar of schooling" reflect itself in transformational practice? Drawing upon young students' inherent fascination with ICT tools, Ching and Kafai (2008) urge integration driven by thematic and interdisciplinary curricular designs. Some theories presented as "new" actually seem to harken back to earlier educational movements such as progressivism. Yelland, Cope, and Kalantzis (2008)

present an approach that they call "knowing-in-action," which depends upon ICT for teacher-driven communication, problem-solving, and documentation for better teaching. Hennessey et al. (2007) and Lim (2007) declare success in using ICT tools to promote higher-order science learning in British and Singaporean secondary schools.

Based on research conducted in the two American states of California and Maine, Warschauer (2007) reports mixed efficacy results on the one-on-one school infusion of laptop computers. It appears that other factors of school quality determine the effects of computer distribution. McGrail (2006) reports ambivalence among American high school English teachers regarding a one-on-one laptop initiatives. In her opinion, successful undertakings of this nature require sufficient autonomy, resources, and professional development. Thus, massive laptop distribution to pupils throughout schools is not a solution to the problem of educational transformation; it is a tactic to be deployed as part of a systemic commitment to institutional change. (One-on-one laptop projects are discussed more fully in the P1 report.)

Outlining the substantial cultural and political differences between India and Western countries, Mohanty and Vohra (ICT strategies for schools, 2008) explain why national implementation models that work for one culture might fail in other cultures. They point out, for example, the absurdity for a country that typically spends less than \$100 annually on the public schooling for each child, of investing \$200 per head to finance individual laptop computers for all. Many developing countries are substantially poorer than India. In this regard, the viewpoints of Mohanty and Vohra are reinforced by Aczel (2008). Jules (2008) suggests that successful ICT integration in the post-colonial, English-speaking Caribbean area is impossible in the absence of systemic educational restructuring. Without such transformation, small developing nations will continue to be marginalized.

Writing from an Asian perspective, Bigum and Rowan (2008) describe what they call the "landscape" of teacher education, suggesting that the massive shifts of society and commerce occasioned by the rapid contemporary pace of technological development fail to reflect in teacher education organization and practice. These researchers suggest that teacher education has stressed developmental window-dressing at the expense of substantive transformation. As long as teacher education resists transformation from the strictures of bygone practice, meaningful change in teaching practice and school structure cannot be expected. Leach (2008) presents a similar case in the face of resistance to ICT for educational transformation in sub-Saharan Africa.

In addition to the issues discussed in other sections of this report, challenges in ICT research and development for educational transformation include ethical use (Beycioglu, 2009), information literacy (Probert, 2009), and school interaction with non-school entities (Sloan, 2008).

What works; what does not?

From the relatively advanced settings of Hong Kong and Singapore, ICT-intensive teaching transformation is typically anchored in teachers' mindful migration away from a teacher-centered strategy of instruction toward student-centeredness (Wong & Li, 2008; Wong, Li, Choi, & Lee, 2008). These studies propose that effective leadership and collaborative school climate are essential to the kinds of transformation that optimize investments in ICT. In the upper grades of an American elementary school, Ching and Kafai (2008) report that learning outcomes in a technology-rich marine biology curriculum are advanced through explicit strategies anchored in student collaboration and peer scaffolding.

Reflecting the landscape of educational technology in American schools described by Cuban (2001), in a large-scale study of Cypriot elementary schools by Eteokleous (2008), ICT integration was found to be perfunctory and non-transformative. Gülbahar (2007) reports similar findings for Turkey. In the studied schools, technology was used sporadically, and when it was implemented, tended to reinforce traditional classroom practice. In significant measure, Eteokleous (2008) attributes these circumstances to poor training and support. Cypriot teachers, in his opinion, simply do not know how to use technology in transformative ways. Clearly, this puts pressure on leadership across borders and at all levels of the educational enterprise.

Watson and Hempenstall (2008) bridge the gap between educational tradition and the needs of the 21st century. Describing the implementation of a technology-rich program to support literacy acquisition in the early Australian school grades, positive effects were revealed for phonemic awareness, letter-sound fluency, non-word decoding skills, and oral reading fluency when compared to a non-treatment control group. This research concludes that at-risk students may particularly benefit from the strategies described. Young (2008) addresses the question of ICT program development and culture, suggesting that designers have not yet effectively accounted for the cultural needs of diverse learning populations in the development of products and curriculum.

Increasingly, multi-user virtual reality (MUVE), virtual learning environments (VLE), and Web 3-D technologies are being proposed and described as 21st-Century ICT innovations (Chittaro & Ranon, 2007; Colomar & Guzmán, 2009). Although learning results are mixed, tools such as *Second Life* seem to have facilitated students in Singapore to work constructively in groups and to monitor their social behaviors in a purposeful context (Rappa, Yip, & Baey, 2009).

Bottino, Ferlino, Ott, and Tavella (2007) report success in the elementary school grades with computer-based gaming strategies. From a Turkish primary school setting, Tüzün, Yılmaz-Soylu, Karakuş, İnal, and Kızılkaya (2009) report positive results of gaming tactics for learning outcomes and intrinsic motivation. Lin and Zini (2008) opine that the low-cost and local adaptability of open-source software solutions will ultimately trump costly commercial products for educational adaptation, especially in lesser developed regions of the world. Kuiper, Volman, and Terwel (2009) describe a Dutch project where fifth-graders develop Web literacy skills through the use of cooperative learning techniques that employed, among other things, networking tools available on the Web.

Networked technology shows potential for authentic collaboration across cultures and national boundaries. In this respect, Simovska and Jensen (2008) describe an initiative concerning health awareness among students in the Czech Republic, Denmark, Macedonia, and Sweden in connection with the WHO-supported Schools for Health in Europe initiative. The technology used was supported by explicit strategies to promote student collaboration. Evaluation results demonstrated strong motivation among the learners, in addition to an enhanced sensitivity to the perspectives of other cultures. Vavoula, Sharples, Rudman, Meek, and Lonsdale (2009) describe concrete strategies through which students may use a dedicated tool designed for mobile devices to record and transmit museum field trip experiences back to their classrooms and homes. This tool is called "myartspace."

What does not work? Clearly, classroom practices that simply embellish traditional modes of direct instruction with ICT tools have been repeatedly labeled as ineffective. Lin (2008) argues against separating instruction for technology literacy from the overall curricular mainstream of schooling. She describes the integration of ICT across the curriculum as critical to learning how technology is productively applied in real-life situations. Hassett (2006) suggests that traditional theoretical constructs for early-literacy education fail to reflect the new communicative realities emerging from the affordances of networked technology.

As Huang, Kuo, Lin, and Cheng (2008) point out, resource deployment needs to reflect student migration toward mobile technologies and Web 2.0 applications. From a Norwegian case study, Elstad (2006) affirms that the dynamics of the technology-infused classroom reduces teacher control thereby creating a threat that students will carry out non-educational activity with the available technology devices. Teacher control, however, seems hardly to be the point of ICT transformation in the curriculum. Teacher roles must change, not toward tighter control but toward the more effective orchestration of independent learning.

How should resources be organized and deployed?

Writing from outside the ICT field in the *American Educational Research Journal*, Cilesiz (2009) suggests that educators examine leisure-related computer habits of young people and design relevant curriculum with these habits in mind. Clearly, this recommendation has implications for the infusion of mobile devices. By formal research and by informed anecdote, it is well-known that young people use mobile devices voraciously for networked communication.

Dangwal and Kapur (2008) describe a fascinating experiment with the distribution of networked computers in open, public locations across Indian urban slums. Equipped with easy to use GUI interfaces, these “hole in the wall” installations promoted a rich variety of informal learning activity, representing not only an innovation for the deployment of educational resources but also a means to reduce equity disparities across demographically unequal groups.

As for teacher education, Clarke's (2009) call for the development of networked communities of practice (COP) has already been mentioned, as have the community-building recommendations of Hadjithoma and Karagiorgi (2009). Gulsecen and Kubat (2006) report positive results from Turkish teacher education initiatives that incorporate technology-supported project-based learning (PBL) activities into curricular programs. Although such a strategy does not appear to influence incipient teacher attitudes, students undergoing such a curriculum emerged more competent than their control-group peers who experienced a teacher-centered approach. Morgan and Kennewell (2006) stress the importance of play in effective initial teacher education (ITE). Unfortunately, according to these researchers, ITE students' own traditional schooling seems to erect psychological barriers to the effective pursuit of play-centered study and action. Leadership is required to create safe environments for exploring such methodologies.

Can ICT resources be deployed constructively at the earlier grade levels? According to O'Hara (2008), indeed they may. Although pedagogical innovation at these levels does not always keep pace with the provision of resources, based on observations and interviews of young children and their teachers, technology has been shown to promote academic learning and social skill development. Barton and Hayden (2006) found that massive ICT investments in specialized training and time for beginning teacher educators do not translate into improved attitudes or efficacy, suggesting that the better strategy is to infuse technology seamlessly throughout the teacher education program.

Ashton and Newman (2006) perceive networked technology as an ideal vehicle for heutagogy (defined as the principle of teaching and learning created on a foundation of authentic self-determination), independent of credentialing institutions. They suggest that education is moving in this direction in any case, that such transformation is enabled by ICT, and that formal education at all levels needs to recognize and adjust to this socially-embedded, technology-driven change. According to this vision, there will be no future "heutagogues" in the sense that

"pedagogues" currently exist in the educational workplace. Learners will determine their own educational path, availing themselves of a growing quiver of electronic learning tools.

What further research is needed to advance effective deployment and "best practice"?

As we discuss teacher education in the context of 21st-century transformation, we find extensive literature touching upon techniques that might or might not benefit subsequent teacher practice. For example, Bai and Ertmer (2008) proclaim the efficacy of an introductory teacher preparation course to improve teachers' technology attitudes. We have already discussed Edmunds' (2008) call for technology applications research to focus on teaching rather than technology, especially related to low-performing students. Hermans, Tondeur, van Braak, and Valcke (2008) make a similar case for all learner populations. Lim, Lee, and Hung (2008) take their research methodology one step further, focusing qualitatively in great depth to study an individual teacher's evolution toward technology competence. Chen (2008) finds that technology specific prior training and continuous professional development are essential to successful ICT integration in second language school instruction. These truths have previously been established.

Research by Owston, Sinclair, and Wideman (2008) on Canadian professional development for middle school math teachers highlights the complexity of variables involved in assessing the impact of technological application. Even when certain treatments are correlated with the putative results, specific variables are often difficult to isolate. Therefore, claims that particular variables are solely responsible for the co-related results are typically suspect. For this reason, a blend of naturalistic inquiry with quantitative methodologies tends better to describe real phenomena as they occur in the field.

Drent and Meelissen (2008) conducted a case study of teacher educators in the Netherlands. Although they expected school-level factors to influence ICT innovation, they found that personal attributes (such as a spirit of entrepreneurship) were more influential. Of course, such entrepreneurship can be stimulated and promoted by effective leadership and organization, but this research suggests that the impact of top-down change strategies will be blunted without the benefit of bottom-up risk-taking. This speaks to the importance of effective teacher recruitment and preparation supported by incentives to attract top talent to the teaching profession. It also addresses the need for leadership that treats failed experimentation as opportunity for learning, growth, and professional improvement.

Angeli and Valanides (2009) affirm that the transformational impact of ICT requires a clear, commonly understood epistemological framework. Without such clarity, it is

very difficult for teachers to understand ICT's transformational potential or for educational decision-makers to assess whether or not high standards are being met. In the context of the extensive discussion about ICT as a potentially "disruptive" force in schooling, Conole, de Laat, Dillon, and Darby (2008) lament that much contemporary research has focused on quantitatively measured learning outcomes instead of strategies that disrupt curriculum in transformative ways. About best practice, they write, "Technology is not simply seen as an 'add on' for these students, it is central to how they organize and orientate their learning" (p. 522).

In Australia, Donnison and Haynes (2007) describe a conflicted generation of pre-service school teachers simultaneously carrying conservative and progressive mindsets about the prospect of ICT integration. Yuen and Ma (2008) report from Hong Kong that perceived ease-of-use is a superior predictor of subsequent teacher ICT curricular integration than perceived usefulness. These questions demand further research. Finnish researchers Ryymin, Palonen & Hakkarainen (2008) compared leadership characteristics among teachers operating simultaneously in computer networked and informal non-technological environments. They found that effective leadership in one setting did not necessarily translate into other environments, suggesting that a methodological blend best suits a broad base of professional development needs.

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