

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

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In response to:

Terms of Reference for GeSCI Request for Proposal

Meta-review of ICT in Education Research

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Narrative Analysis of Key Findings

Equity of Access to ICT Resources

What are the major research trends?

Equity related to gender, race, ethnicity and nationality.

The question of equity may be viewed from a variety of perspectives. We examine this question from the perspectives of personal identity (e.g., gender, ethnicity, national origin, disability/special need and socioeconomic status (SES). Although we make no particular effort to identify equity issues pertaining specifically to developing countries, research dealing with this challenge will be evident from the following discussion.

Teo (2008) points out that gender disparity related to ICT is trending downward from the differences observed in the late 1990s and early 2000s. Tondeur, Valcke, and van Braak (2008) report mild gender differences between male and female teachers in Belgium, with males more prone to using ICT as an information tool in primary schools. Similarly, Kuhlemeier and Hemker (2007) uncovered minor gender differences at various levels of Dutch education. Singh, Allen, Scheckler, and Darlington (2007) report to the American Educational Research Association (AERA) that relative US female participation in computer-related higher education programs has been declining over the past decade. From a British context, Kennewell and Morgan (2006) report little difference between genders in curricular ICT use but stress the importance of play to promote effective learning for boys and girls across a wide variety of age levels.

A recent empirical study from Greece (Barkatsas, Kasimatis, & Gialamas, 2009) raises troubling gender questions at the high school level. In this quantitative study, boys were found to possess significantly higher levels of confidence and affinity with computer-based technology than girls. Particularly troubling is the background relationship between positive attitudes and scholarly achievement. This research points out a pervasive performance gap between boys and girls in secondary mathematics, urging new research-backed policy and practice to improve the ICT attitudes and engagement of girls.

Vekiri and Chronaki (2008) surveyed more than 300 elementary school boys and girls, revealing that technological conditions in their homes influence their attitudes about ICT in school. They found that Greek boys use computers more frequently and with greater parental support than do girls, and that such support is related differentially to their respective perceptions of self-efficacy. In a different Greek study, on the other hand, high school girls and boys were found to benefit equally

and to be similarly motivated by curricular gaming methods aimed at teaching concepts of computer memory, suggesting that strategies are available to help break down gender disparities (Papastergiou, 2009).

In a comprehensive quantitative/qualitative study comparing test results in level-10 science learning in Australia, differences were found among sub-groups undergoing traditional classroom teaching versus a blended classroom/e-learning setting (Chandra & Lloyd, 2008). Subject cohorts were divided between boys and girls and then further broken down into performance quartiles. Boys in the lowest quartile appeared to benefit the most from the blended setting; performance of the girls in the top quartile actually fell. The attitudes toward e-learning revealed in the qualitative facet of this study were positive across the full range of subjects. In survey research on secondary Australian schoolgirls pursuing subject matter via ICT, researchers found low rates of participation and dubious attitudes toward computers (Anderson, Lankshear, Timms, & Courtney, 2008). According to a study of cyber-bullying in Canadian and Chinese junior high schools, Li (2007) reports that boys are more likely than girls to engage as bullies, but the girls are more likely to be victimized. This appears to be consistent with experience in other countries.

Teo (2008) uncovered no gender distinction in teacher perceptions of school ICT integration in Singapore but found significant distinctions based on length-of-teaching service and the quality teacher training experience. He points out the importance of teachers as change agents in schools because they are powerful role models for the kinds of attitudes and behaviors that students will exhibit during and after their formal studies. On the question of leadership, Gokce (2009) urges improved administrative preparation and a more equitable distribution of school leadership jobs for female educators in Turkey.

In a report on Tanzanian conditions, Stambach and Malekela (2006) opine that ICT development for schooling relies excessively on traditional practice and fails to capitalize on the systemic transformation needed to produce satisfactory results. They question, for example, the local deployment of equipment and material without sufficient investment in human resource development and infrastructure. These researchers ask whether the apparent isolation of lesser developed countries (LDCs) in adjusting to the knowledge-based society is not more attributable to the on-going prejudices of the developed world as it is to LDC shortcomings. ICT development may indeed be held hostage to the past; the question is, whose past is doing the holding?

Equity related to special learner need and SES.

Digital divide concerns have been repeatedly described for schools within the United States. In an analysis of statewide data in Florida, researchers describe an improving situation in the equitable distribution of technological resources for schools, but they claim that continuing inequities persist between high and low SES

districts in access to software, technological support, and teacher use – the infrastructural foundation for systemic ICT integration (Hohlfeld, Ritzhaupt, Barron, & Kemker, 2008). In Chile, a summative account of the nationwide ICT infrastructure initiative, labeled "Enlaces," offered mixed results. Despite acknowledged gains in information access and the equitable distribution of resources nation-wide, there is no hard evidence of improved student learning (Sánchez & Salinas, 2008).

From a large survey study (1024 subjects), Iske, Klein, Kutscher, and Otto (2008) report significant inequalities in digital access and use-strategies among German youth aged 14 to 23. These researchers urge educational policymakers to implement strategies explicitly dedicated to reducing these inequities. According to Stevenson (2008), however, relative affluence in the UK does not necessarily translate into superior learning. Based on a qualitative case study of eight relatively affluent families, she found barriers to effective educational use of ICT. Schools, she suggests, will need to adopt improved policies and practices to address the needs of children in this seldom discussed facet of the digital divide.

A study from the Netherlands (Peltenburg, van den Heuvel-Panchuizen, & Doig, 2009) discusses the efficacy of ICT-based assessment devices for improving mathematics learning outcomes of 8-12-year-old children from two special-needs schools. Pupils were placed in experimental and control assessment groups. Members of the experimental group were given ICT-based assessment tools along with on-screen manipulatives to assist with problem-solving. Control group children were assessed traditionally. ICT-based assessment was found to be particularly useful to teachers for diagnosing individual problems and planning appropriate instructional remedies. Tan and Cheung (2008) conducted an in-depth study of a 7-year-old attention deficit hyperactive disorder (ADHD) school boy in a mainstream classroom setting and found that computer-enabled collaborative work resulted in increased peer acceptance. The setting for this study was unique, but it may provide a useful model for student collaboration and coaching elsewhere.

While much of the literature on technology and special needs promotes ICT integration with mildly or severely disabled children, Woodfine, Nunes, and Wright (2008) raise a serious question about the efficacy of text-based synchronous ICT tools. Their paper suggests that cognitively-impaired schoolchildren, particularly those with dyslexia, tend to be further marginalized, de-motivated, and disappointed by the integration of these tools into their classrooms. Rather than bridging distances, as claimed by advocates, e-learning appears to erect obstacles that impede learning progress. Technology product developers and educational policymakers need to take these dangers into account when building curriculum for this population of students. Young (2008) suggests that ICT designers, nationally and internationally, have a long way to go in order to achieve effectiveness in producing appropriate material for diverse cultures.

Wittwer and Senkbeil (2008) studied nearly 1500 mid-teen German school children in more than 200 schools, associating their math performance with their home computer use. Nearly all of the students enjoy access to computers at home and use a computer almost every day. The researchers found that levels of home computer use had no substantial influence on academic achievement. Of particular interest is the finding that leisure activities such as watching televised action, horror, or pornographic material was negatively associated with mathematics performance.

Dwyer (2007) describes a different kind of inequity in Australia. She reports that in New South Wales, the early primary school grades are shortchanged in ICT resources distributed across the grade levels. Among other things, she attributes this to uninformed, entrenched attitudes about curricular needs in the early grades, and she makes a variety of policy recommendations to remedy this inequity. In their book, *ICT in the Early Years*, Hayes and Whitebread (2007) make a persuasive case for efficacious ICT integration in the curricula of early years schooling.

What works; what does not?

A study on Australian secondary school girls suggests that negative attitudes toward technology stem partly from the cultural perception that ICT activity is inherently "male-gendered" and that it reflects aspects of masculine culture sometimes deemed negative by girls (Anderson et al., 2008). This would seem to call for deliberate attempts to stress female career visibility in ICT policy, commerce, and public service.

Aderinoye (2008) addresses the issue of equity in developing countries by advocating the use of more traditional technological tools such as radio and television to support literacy education. Similarly, from outside the educational technology research base, Atchoarena, Da Grace, and Marquez (2008) opine that ICT investment and distance learning are essential to the developmental sustainability of lesser-developed and middle-income countries, in this case, Cape Verde.

As reported in the Hohfeld et al. (2008) study from Florida, SES-based equity issues stem not so much from a disparity in the resources owned by poor versus affluent schools as much as from the infrastructural policy support behind hard, material investments. Over the years this has been a recurring theme in ICT literature. The theme speaks to the need for enforceable centralized standards and support at national or regional jurisdictions to reinforce the practical initiative that depends so much on local creativity. This observation comports with Dwyer's (2007) observation that the effective integration of ICT, especially in Australian primary schools, depends upon the environmental conditions that effective leadership alone can provide (e.g., excellent teacher support, superior software resources, thoughtfully-designed technology facilities, and participatory decision-making).

Barbour and Reeves (2009) present an international (predominantly Canadian and American) literature review on the efficacy of accredited virtual schooling. They posit that virtual schooling is typically provided primarily in an asynchronous mode via computer networks. Their analysis reflects the concern that virtual school programs have been designed according to assumptions about adult rather than younger learners. They suggest that such schooling is typically targeted at literate students performing at relatively high levels with strong intrinsic motivation and the ability to work independently. Students with steeper academic needs are less appropriately served.

McKenney and Voogt (2009) examine literacy learning in early-grade Dutch schools through an analysis of a computer-based tool called *PictoPal*. Software of this nature appears associated with improved learning outcomes pupils with special-needs but only when integrated with effective non-computer strategies. They also report that children are able to work independently and effectively with *PictoPal*.

How should these resources be organized and deployed?

Mukama and Andersson (2008) suggest that properly-coordinated nationwide ICT deployment can be a force for generating gender inequity in developing countries, in this case Rwanda. Forlin and Lock (2006) propose investment in ICT as an effective means to serve the inclusion requirements of special needs students in remote areas of rural Western Australia.

Calulator (2009) argues for the systemic integration of augmentative and alternative communication (AAC) strategies and devices to support effective literacy education and successful inclusion of severely-disabled students throughout the school curriculum. AACs, of course, may or may not be technologically intensive, but an increasing array of technologically-driven devices is being tested and marketed. Further supporting inclusion, Causton-Theoharis, Theoharis, and Trezek (2008) stressed the importance of effective teacher preparation to meet the diverse needs of all students.

Writing from the field of curriculum studies, DeGennaro (2008) describes the beneficial effect of high school peer coaching, where suburban high school boys teach their less affluent African-American middle-school counterparts in after-school programs to promote Web page development. Using ICT, such a model might be scaled up to support such technology-intensive coaching from students in developed countries to their developing-world peers.

What further research is needed to advance “best practice?”

Although their research reveals gender distinctions in the benefit that technology brings to learning, Chandra and Lloyd (2008) suggest that several imponderable variables remain that could influence future trends. As the authors declare, “There is

not, and possibly will not ever be, a single unified metanarrative on the benefits of ICT in education” (p. 1098). Barbour and Reeves (2009) urge new research on the learning needs of all elementary and secondary students related to virtual schooling, not just the academically-talented. More comprehensive design research for all populations is also needed as distance education programs are developed. Edmunds (2008) believes that research on teacher practice with low performing students needs to begin from a perspective of teacher attributes and practice rather than from the viewpoint of technology.

Gaming techniques (Papastergiou, 2009; Tüzün, Yılmaz-Soylu, Karakuş, İnal, & Kızılkaya, 2009) show efficacy in Greek high schools and Turkish primary schools under certain environmental conditions. Practical studies of this nature need to be replicated under different conditions and in diverse cultures. As we consider questions of gender ICT equity in schools, Waite, Wheeler, and Bromfield, (2007) urge educators not to forget factors focused on individual learning attributes among children. This sentiment would comport with educational research outside the ICT field, notably Howard Gardner's writing about multiple intelligences.

Studies on the various aspects of ICT and gender equity tend to focus on particular geographies and cultures. A more robust meta-analysis is needed to compare and contrast phenomena cross-culturally. For example, gender equity may be deemed irrelevant or undesirable in some cultures whereas others would prize it as a normal and noble educational aim. Regarding the relationship between home computer use and scholarly achievement, Wittwer and Senkbeil (2008) suggest a refocus of research on the quality of home computer use rather than the degree.

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