FIRE: Forum for International Research in Education

Volume 2
Issue 1 *Information and Communication Technology (ICT) for Development - Special Issue*

Article 3

2015

Plans for Embedding ICTs into Teaching and Learning through a Large-Scale Secondary Education Reform in the Country of Georgia

Jayson W. Richardson
University of Kentucky, jayson.richardson@uky.edu

Gregory Sales
Seward Incorporated, gsales@sewardinc.com

Sonja Sentočnik
sonja.sentocnik@gmail.com

Plans for Embedding ICTs into Teaching and Learning through a Large-Scale Secondary Education Reform in the Country of Georgia

Abstract
Integrating ICTs into international development projects is common. However, focusing on how ICTs support leading, teaching, and learning is often overlooked. This article describes a team's approach to technology integration into the design of a large-scale, five year, teacher and leader professional development project in the country of Georgia. The main goal of this project was to improve student outcomes via changing core pedagogical practices such as formative assessment, higher order thinking, and student-centered learning. In this article, we describe the background of the project, detail the country and sector context, the project team composition, the technological approach used in the development plan, and offer an analysis of how the proposed technology interventions push teachers and leaders to use technology to improve tasks and improve the teaching and learning experience.

Keywords
ICT, pedagogy, Georgia, assessment, project, STEM

FIRE - Forum for International Research in Education
Vol. 2, Iss. 1, 2015, pp. 19-32

PLANS FOR EMBEDDING ICTS INTO TEACHING AND LEARNING THROUGH A LARGE-SCALE SECONDARY EDUCATION REFORM IN THE COUNTRY OF GEORGIA

Jayson W. Richardson[1]
University of Kentucky, USA

Gregory C. Sales
Seward Incorporated, USA

Sonja Sentočnik
Hiša znanja dr. Sentočnik, Slovenia

Digital technologies are reshaping norms in nearly every industry from telecommunications, to health and wellness, to transportation. Across industries, digital technologies are being used to redesign existing tasks and create entirely new ones. These technologies might allow for a modification of a task or augmentation of a task by serving as a direct replacement tool that is functionally better, or they can be used as a direct substitute with no functional improvement for completing the task (Puentedura, N.D.). This notion can be applied to any educational technology initiative.

Puentedura (N. D.) developed the SAMR (Substitution, Augmentation, Modification, Replacement) model to describe levels of technology integration. However, all too often the designers of educational technology interventions focus more on the technology than the teaching and learning that occurs through the introduction of the technology. This is partially understandable given that technology innovations require detailed planning for and around hardware, software, and infrastructure. Nevertheless, valuable opportunities are lost by focusing on the technology itself rather than how technology can transform an organization to support teaching and learning.

West (2012) noted that "digital technology enables fundamental shifts in instructional methods, content, and assessment. However, technology by itself will not remake education. Meaningful change will require alterations in technology, organizational structure, instructional approach, and educational assessment" (p. 2). West went on to say, "if we combine innovations in technology, organizations, operations, and culture, we can overcome current barriers, produce better results, and reimagine the way schools function" (p. 2). Thus, technology has the potential to be used as a powerful lever of change. This

[1] *Correspondence*: University of Kentucky Department of Educational Leadership Studies, 111 Dickey Hall, Lexington, KY 40506, USA; Email: Jayson.richardson@gmail.com

opportunity, however, can only be leveraged if educational planners focus on technology as a foundation to support a paradigmatic shift.

In this article we describe recommendations for technology integration into the design of a large-scale paradigm shift in teacher and leader professional development for a five year project in the country of Georgia. The main goal of this project is to improve student outcomes by changing core pedagogical practices such as formative assessment, higher order thinking, and student-centered learning (Millennium Challenge Account - Georgia, 2014). Additionally, in this article we describe the background of the project, provide details of the country and sector context, introduce the project team composition, discuss the technological approach used in the development plan, and offer an analysis of how the proposed technology interventions encourage teachers and leaders to use technology to facilitate the efficient completion of tasks and improve the teaching and learning experience.

Technology in Less Developed Nations

Donner and Kentaro (2009) discussed how most information and communication technology (ICT) in education projects tend to focus on closing the digital divide where this divide is computed as a percentage of users with technology compared to a percentage of users without technology. One issue with this measure, however, is that it "tends to privilege technologies' use, rather than their usefulness" (p. 4). Thus these authors noted how a focus should be shifted to the user rather than the tool. Donnor and Kentaro also noted how projects often tend to focus on inputs (e.g., interventions and hardware) and outputs (e.g., use) rather than processes (e.g., training) or outcomes (e.g., change).

Some authors have called for a human development approach to ICT for development (ICT4D) (see Hamel, 2010). This approach acknowledges that human development is both participatory as well as empowering. This approach also enforces that technologies can empower societies by providing opportunities to collaborate, network and learn beyond national borders. Hamel (2010) noted how "ICTs are most effective when they are seen as a means of engagement and enhancers of participation" (p. 16). Heeks (2009) discussed two models of innovation. The first is a passive diffusion perspective that often leads to "messy regurgitation" (p. 28). The second is an opposing model, active innovation. This model describes how the market in less developed nations will not experience the intended educational outcomes simply by introducing technology and training. Active and ongoing attention needs to occur when introducing technology initiatives in less developed countries to achieve the outcomes.

Debate on the effectiveness of ICT4D in education continues. While some authors argue that ICTs have limited pedagogical promise (see Cuban, 2001; Postman, 1993), other authors argue that ICT are central to improving educational systems in less developed countries (Negroponte, 1995; Papert, 1996). Raiti (2006) described how ICT is only part of the solution to international development. ICT4D is seen as "a piece of a larger puzzle regarding development" (p. 2). Raiti explained that "although ICT4D may not be a cure-all for the needs of developing countries, the literature has well documented its many successes from aiding rural farmers to increasing literacy and facilitating communal communication" (p. 3).

Justifications for introducing ICT in education in less developed nations vary. Jhurree (2005) noted that benefits might include enhancing the learning environment, supplementing teacher instruction, increased administrative efficiency, improved assessment, better communication, and increased employment competitiveness. Kozma (2005) warned however that these justifications fall short when faced with non-conducive or contradictory national policies. In effect, ICT4D efforts must take on a holistic, systems approach. Such an approach to ICT4D was discussed by Turpin and Alexander (2014) who noted that "system thinking's emphasis on a whole-view, and on the interrelationships

between entities of the system can assist us in having a more inclusive view of the factors affecting and affected by an ICT4D initiative" (p. 4).

The Georgia project described in this article was developed around lessons of other nations. The project is long term (5 years) and introduces elements of passive and active innovation adoption. It was designed so that the project team will actively work with policy makers to ensure that polices support teaching, learning, and leading practices and that technology is a tool rather than a lever. The project was created around the notion that change occurs when human capacity is developed. This developmental approach takes a systems perspective where support is extended at various levels and through a variety of means.

Background

The Government of Georgia, through the Millennium Challenge Account – Georgia, initiated a 5-year project titled Georgia II: Improving General Education Quality starting in 2015. The technical support and activities provided through the project were intended to supplement and enhance the efforts of the Ministry of Education and Science and associated agencies and build capacity through project implementation. The Millennium Challenge Account - Georgia (2014) noted that the two main areas of focus for this project are: 1) continuous professional development of grades 7-12 teachers of biology, chemistry, physics, geography, mathematics, English, ICT, and school leaders as well as other relevant education personnel; and 2) classroom-based student assessment. A 5-year educator professional development plan, which included a strong focus on ICT, was produced in 2014. The plan was co-constructed in collaboration with various members of the Ministry of Education and Science, associated education agencies, and other stakeholders by Gesellschaft für Organisation, Planung und Ausbildung mbH (GOPA), a Germany-based consulting group. GOPA was tasked with designing activities for the professional development of educators, including principals, teachers, school-based professional development facilitators (SPDFs), staff, and trainers from various agencies within the Ministry of Education.

Country and Sector Context. Georgia is a post-Soviet country situated at the juncture of Western Asia and Eastern Europe located between the Black Sea and the Caspian Sea. Georgia shares borders with Russia, Azerbaijan, Armenia, Turkey, and the Black Sea. Its size in area is approximate 26,911 square miles making it slightly smaller than the country of Ireland. National census data are inconsistent, but the estimated population of Georgia is between 4.5 and 5 million persons (Index Mundi, 2014: Infoplease, 2014).

In recent years Georgia has made substantial progress in reforming its education sector at both the general education and tertiary levels. Examples of reforms in general education include: (a) restructuring the governance and financing of schools; (b) developing and introducing a new national curriculum; (c) introducing a standardized, reliable, and publicly credible national university entrance examinations; (d) introducing a qualifications-based salary for teachers; (e) setting new teacher professional standards; (f) initiating a teacher certification and recertification program; and (g) adopting continuous professional development programs to better prepare teachers for modern challenges in the classroom.

Enrollment rates at the primary levels are high, but are lower at the secondary level (UNICEF, 2013). In general education, international assessments of student learning indicate low education quality outcomes (Trends in International Mathematics and Science Study, 2011). Such a reality seriously impacts Georgia's potential for economic growth. In particular, the Government of Georgia identified the lack of science, technology, English, mathematics, and geography professionals as a critical bottleneck to economic growth in Georgia. This is reflected in Georgia's rank of 69 out of 142 countries on the availability of scientists and engineers in the 2014/2015 Global Competitiveness Report by the World

Economic Forum (2014).

The Millennium Challenge Corporation in Georgia

Through its current compact, the Government of Georgia worked with Millennium Challenge Corporation to develop a plan that addresses the quality of human capital in Georgia. Three activities were selected to improve general education quality. Table 1 below summarizes the three activities of the Improving General Education Quality project.

Table 1

Activities of the Millennium Challenge Corporation-Georgia Project

Activity	Supporting Efforts
Improved Learning Environment Infrastructure	• Facilities rehabilitation* • Provision of laboratory furniture/equipment* • Professional development in the use of equipment
Training Educators for Excellence	• Teacher professional development in pedagogy, curriculum delivery, use of equipment, and classroom-based assessment • School management and leadership strengthening • Targeted support for socially disadvantaged students
Education Assessment Support	• Support participation in international assessments • Strengthen the quality and implementation of current national assessments • Development of a coherent national system of classroom assessment

* Not covered in the project detailed in this article

The first activity includes investing to improve the learning environment through renovating and equipping approximately 130 schools. The design of these schools is not part of the scope of the current project described herein. However, providing professional development on the use of the science laboratory equipment that will be included in these schools is included in the scope of the proposed project.

The second activity will provide professional development for educators. The professional development will include improving grade 7-12 school teachers' and other education professionals' performance in the classroom in science, geography, ICT, English, and math. The Government of Georgia refers to these subjects as STEM subjects. It should be noted however that other countries refer to STEM as being limited to science, technology, engineering, and mathematics. Another focus of professional development will be on principals and improving their school management and leadership skills. The last training focus will be on improving teacher pedagogy and providing support for socially and linguistically disadvantaged students.

The third activity of the project will support the implementation of high quality education assessments at the classroom, national, and international levels. These assessments will contribute to the continued improvement of the general education system by tracking student progress as well as holding teachers, administrators, and national authorities accountable to Georgian stakeholders for achieving high-level outcomes.

Determining the role of ICT in these assessments is part of the project plan.

Design Team and Deliverables

An eight-person team consisting of three international consultants and five Georgian consultants was assembled in Tbilisi, Georgia from February 2014 to December 2014 to develop design recommendations. The international consultants included the Team Leader who also served as the Classroom Assessment Specialist, a Professional Development Specialist, and an ICT / General Education Specialist. Local Georgian consultants included a Georgia Education Specialist, a Private Sector Engagement Specialist, a Costing Specialist, a Local Program Manager, and an Office Manager/Translator.

This team worked on four key deliverables. These deliverables included: 1) an Inception Report, 2) a Sector Policy and Practice Report, 3) a Project Design Recommendations document, and 4) the Terms of Reference for work that would need to be conducted to support the five year project implementation. The international consultants and domestic consultants worked collaboratively on all of these deliverables.

ICT Strategy

In Georgia, ICT in grades 7-12 is taught as an elective course in the curriculum. Thus, students seldom have the opportunity to study with or about ICTs. More rare is the opportunity to connect ICTs with course content. Currently, there is no system to integrate ICTs into the teaching and learning process. All schools in Georgia have a computer lab where computers are Internet accessible. These labs however, are often underutilized. In most schools, content teachers do not use ICTs in the classroom for teaching and learning. The reasons for non-use vary and include:

- A lack of knowledge of how to integrate technology into subject areas
- Computer labs are reserved for teaching electives.
- Computer labs are controlled by the school administration and are often not freely available.
- Some high tech computer labs (called Future Labs) may be underutilized due to poor infrastructure and limited teacher training.
- Some Future Labs are not being used because of a lack of training to support their operation and maintenance.

In the project described below, the ICT in education recommendations are based on the following statements. For ICT in education to be implemented effectively, essential conditions (as adapted from the International Society for Technology in Education, 2014) must be in place. These conditions include:

- A shared vision for ICT in education must exist among all stakeholders including Ministry officials, school leaders, teachers, parents, and students.
- School leaders must be empowered to change the status quo on how ICTs are used for leading, teaching, and learning.
- School technology plans must be aligned with national plans, local policies, as well as the school vision for how ICT can be used for teaching and learning. Technology plans must also be aligned with the realities of ICT access in a particular school.
- Funding must be provided to initiate and support ICT in education innovations.
- Access to ICTs should be equitable (i.e., available to all stakeholders regardless of gender, location, language, social level, or ability).
- School leaders, teachers, and support staff are skilled in using ICT in education.
- ICT professional development for school leaders, teachers, and support staff is ongoing and responsive to the needs of the Georgian context.
- Technologies selected need to take into account the local, Georgian context and the

needs of the educators being served.

Project Design

The project designers employed Law and Plomp's (2003) model for how ICTs can be applied to curriculum and instruction. Law and Plomp differentiate three distinct roles that ICTs have in teaching and learning. First, ICT can be taught as a subject to focus on information literacy, computer science, and computer literacy. Second, ICTs can be used to enhance the teaching and learning process. Third, ICTs can be integrated as an essential tool such that the curriculum cannot exist without it.

The team of consultants, in coordination with Millennium Challenge Corporation - Georgia, were charged with creating recommendations for each of the 14 tasks listed in Table 2. Table 2 also lists the ICT initiatives that were included in the design of each task. These components are not the only components for the corresponding tasks; they are simply the ICT components for that particular task. These ICT components are detailed in the following sections.

Table 2

Tasks and ICT Design Components

Task	Task Title	ICT Design Components
1	Design of Teacher Professional Development Center Policy and Practice Improvement	Not applicable
2	Design Professional Development Activities for Teachers	• ICT Course Development • Online Courses on Teaching Pedagogy • Tablet Pilot • NCD Portal • Teacher Portal • e-Gradebook • STEM Test Bank • e-Portfolio • Integrated Human Resource Software
3	Design Professional Development Activities for Principals	• Tablet Pilot • NCD Portal • Teacher Portal • e-Gradebook • e-Portfolio • Integrated Human Resource Training Management Software
4	Design Professional Development Activities for School-based Professional Development Facilitators	• Online Courses • Tablet Pilot • NCD Portal • Teacher Portal • e-Gradebook

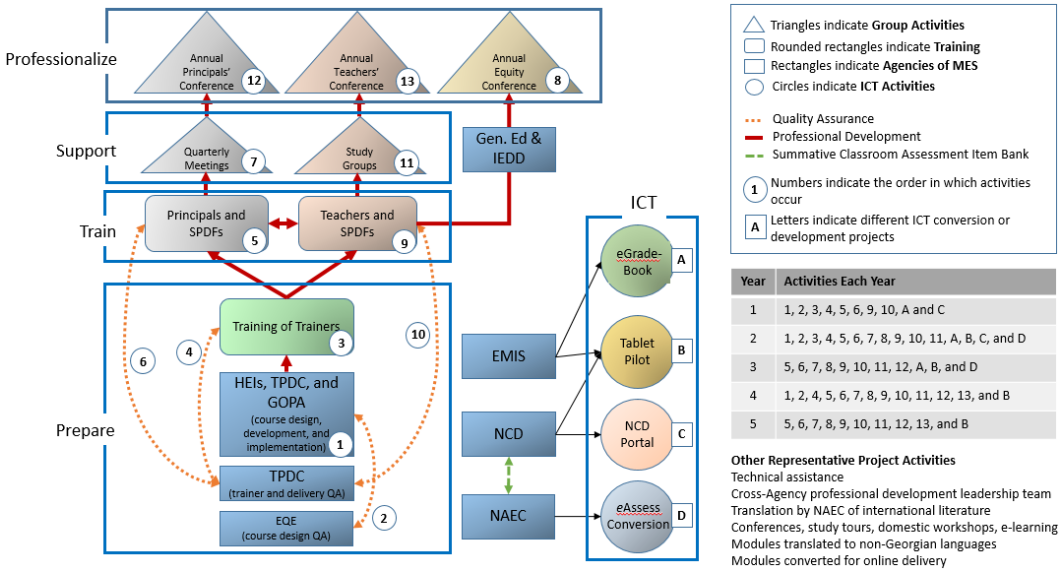
Task	Task Title	ICT Design Components
		• STEM Test Bank • e-Portfolio • Integrated Human Resource Training Management Software
5	Design of Professional Development/Capacity-Building Plan for Teacher Professional Development Center Staff	• Consultant on ICT Professional Development • Consultant on Software Design and Development • Evaluation of Courses / Trainers (online, telephone, mail) • Technology Support Call Center
6	Social and Gender Integration	• Online Courses • Tablet Pilot
7	Design an Approach to Classroom Assessment	• Online Courses • Technology Support Call Center Tablet Pilot
8	Design Framework for Training Current Educators in Classroom Assessments	• Online Courses • Tablet Pilot
9	Integrate Classroom Assessment into the Teacher Professional Development Scheme	• Online Courses • Tablet Pilot • NCD Portal • Teacher Portal • e-Portfolio • Integrated Human Resource Training Management Software
10	Design an Outline for a Teacher Pre-Service Course in Classroom Assessment	• Online Courses • NCD Portal • Teacher Portal • e-Portfolio
11	Design Technical Assistance for National Assessment and Examination Center, Teacher Professional Development Center, National Curriculum Department, and Other Relevant Staff in Developing and Managing Classroom Assessment	• Consultant on ICT Professional Development • Consultant on Software Design and Development • Evaluation of Courses / Trainers (online, telephone, mail) • Technology Support Call Center

Task	Task Title	ICT Design Components
12	Develop Private Sector Engagement and Partnership Plan	Not applicable
13	Develop a Monitoring and Evaluation Framework	Not applicable
14	Develop a Work Plan for Implementing the Activities	Not applicable

Project Design Overview

Law and Plomp (2003) noted that "staff development is a key element in the implementation for any educational change"; however, "if ICT is introduced only as a school subject, the challenge is relatively small" (p. 23). However, "if ICT is implemented as a tool for learning and teaching across the curriculum, then every teacher is affected" (p. 23). Law and Plomp further discussed how teachers constitute the largest group requiring professional development around ICT in education. The authors were careful to note, however, that leaders also require professional development around this topic. In looking at case studies from around the world, Law and Plomp concluded that few ICT in education innovations succeed without focusing on two things. First, there must be a heavy dependence on providing professional development to teachers and leaders. Second, learning communities must be created for teachers and leaders to "generate, refine, consolidate, and disseminate emerging pedagogies and emerging professional competencies" (p. 28). The current project takes into account these valuable lessons. Figure 1 below details the overall design of the project. The following sections present how the ICT strategy was crosscutting in these various activities.

Figure 1
Project Design



Learning about Technology. Law and Plomp (2003) noted that "while all countries consider ICT skills to be fundamental skills that all students should acquire, they differ in how they operationalize" this goal (p. 20). Unfortunately, in the country of Georgia, there is a dearth of qualified teachers to instruct students on and about ICTs. Thus the project

includes a dedicated initiative to directly address this need.

An output of the project is to create a suite of subject-specific professional development courses for grade 7-12 STEM teachers (see Step 9 in Figure 1). Thus every secondary STEM teacher in the country, in these grades, will be given professional development on pedagogy in their particular content area. One of those courses is a discrete ICT course. As of 2014, there were 179 grade 7-12 public school computer teachers in the country. The project is designed to upgrade the ICT and pedagogy knowledge of these teachers. To accomplish this task, an international Secondary ICT Professional Development Expert will be hired in year 1. This person will work with local agencies to develop the curriculum for a 16-hour professional development course. Once the curriculum is developed, it will be localized into the Georgian language by a local firm that will translate and prepare the developed materials. After the course is developed, trainers will be trained on how to deliver the course in locations across the country (see Step 3 in Figure 1). The training will include the content but also elements of student centered pedagogy, assessment, and equity.

This course will be piloted to 25 teachers in year 2. During the pilot, digital videos will be produced for use in future trainings and for use in teacher training colleges. After the pilot, the training will be revised based on feedback and evaluations. In year 3, 75 ICT teachers will be trained. An additional 75 ICT teachers will be trained in year 4. The remaining teachers, along with new teachers who have not received the training, will be trained in year 5 of the project.

School leaders (i.e., principals, assistant principals, and school-based professional development facilitators) need to understand how to support, monitor, and evaluate instructional technology use. The current project is designed to give school leaders four weeks of training that is focused on, among other things, management, distributed leadership, mentoring, learning communities, and the creation of 21st century classroom environment. The technology used will be embedded in the training modules, thus helping the leaders gain a better understanding of how to use technology, how to support teachers to use technology, and how to monitor student learning of technology. Steps 5, 7, and 12 in Figure 1 above each support leaders and their understanding of technology for teaching, leading, and learning.

The ICT trainings for teachers will be sustained with local teacher study groups (see Step 11 in Figure 1 above). Teacher study groups are often formed around subject areas to support collaborative work in a variety of areas, from studying content, to examining and exchanging teaching practices, to formulating ideas for classroom curriculum (Stanley, 2011). Teacher study groups must be well organized and effectively managed. Subject teachers (from 10 to 20 teachers per group) should be assigned to a study group based on the region and subject area. Teachers may obtain new ideas and skills from professional development but are then unable to implement them in their particular context because of the specific characteristics or idiosyncrasies of their workplace. The teacher study groups will address this need.

In addition to schools providing site-specific support on both the small and the large scale (e.g., some changes in teaching practice may require school-level adjustments to scheduling, staffing, or curricula while other changes may only require encouragement, reminders, or feedback from colleagues), study groups should provide reinforcement for practical implementation of teaching strategies in particular classrooms. The key to sustaining teacher study groups is to base the meetings on teachers' shared interest around issues or problems in their own classroom practices. The study group leader has to establish a supportive environment for the study group members to communicate and collaborate, and to help each teacher benefit from participation in the group. Ongoing support for study groups and training for study group leaders is provided in this project.

Learning with Technology. Within this project, various technology initiatives will

be supported including a national portal, a teacher portal, and an integrated human resources management system. The National Curriculum Department is currently developing and refining an interactive Internet-based National Curriculum Department Portal (see Step C in Figure 1 above). As the National Curriculum Department refines and continues to develop this portal, it will host media, lesson plans, and resources based on the National Curriculum. This will be a useful resource that might help increase teacher competencies across the country. Portals are common around the world and are viewed as a valued resource as long as teachers are taught how to use them (Tatnall, 2005). This project will support the National Curriculum Department by providing resources for this portal and by introducing the portal in the teacher training seminars. Additionally, video vignettes will be created using footage taken in the teacher professional development courses as well as ones that are staged to model effective classroom teaching and learning situations. These resources can be made available on the National Curriculum Department Portal.

Various stakeholders in Georgia are interested in creating an online Teacher Portal where teachers, principals, and school-based professional development facilitators could contribute their own materials. Allowing educators to contribute subject matter content and communicate about professional topics in an open and collaborative way, would help to create a robust learning community. These materials could be user rated and user modified. The Teacher Portal could be linked to the National Curriculum Department Portal. In doing so, user-generated resources could hyperlink back to National Curriculum Department generated resources and vice versa. The teacher study groups will also be integrated into this initiative. The project can increase sustainability and scalability by encouraging teacher study groups to contribute to and use the Teacher Portal. The Department of Education Management Information Systems should set up an account for every teacher but the content should not be guided, monitored, or controlled by any outside entity.

Georgia is currently investigating an integrated human resources management information system that will monitor individual professional development, classroom performance, and future training needs. The Government is also working on an e-portfolio system as part of a teacher assessment mechanism. In the proposed project, we link both of these efforts to create a robust system to help monitor professional development needs across the country. This system will be a vital asset to the professional development project proposed in this document. The school-based professional development facilitators should serve as the point person who logs and monitors teachers' needs as well as needs of the entire school faculty. The Department of Education Management Information Systems could then provide data to the Teacher Professional Development Center (or provide access so they can retrieve it directly) on the needs associated with different areas of the country. The Teacher Professional Development Center could create trainings based on those identified needs. This data would thus help provide the right trainings to the right places at the right time. This project will also support locating and integrating such a system into practice. A Software Design and Development Consultant is provided for over 100 days on this project to help with this initiative, among others.

Linking the Teacher Portal and e-portfolio with the integrated human resources management information system will create a useful system for multiple stakeholders. For teachers, resources could be uploaded onto the Teacher Portal for public use. A teacher could select key resources (along with corresponding peer ratings) housed on the Teacher Portal (public) that they created to be included into their personal / semi-private e-portfolio. Internal evaluators (school level) and external evaluators (Ministry level) could use these e-portfolios in a system of evaluation. The semi-private e-portfolio system could also be linked with the human resource management system to help teachers and evaluators track, record, and suggest professional development.

Another technology initiative supported in this project includes an e-gradebook (see

Step A in Figure 1 above) as well as a STEM test question bank (see Step D in Figure 1 above). An open source electronic gradebook will be selected and modified to the Georgian language and the 10 point grading system that is currently used. Modifying this system should be managed by The Department of Education Management Information Systems in consultation with the Software Design and Development consultant. The product should be made available to all teachers. This electronic gradebook could be created as a residential software program, a web-based program, and/or an app-based program.

An electronic STEM question bank will be created in year 1 and year 2 of the project (see Step D in Figure 1). This will be done in consultation with the Higher Order Thinking Assessment Consultant. The Software Design and Development Consultant will help scale up the existing G-PriEd testbank software, known as *eAssess* that is currently used in grades 1-6. In support of summative assessment development, National Assessment and Examination Center should manage the expansion of the test generation software developed under the G-PriED project. The modification should enable teachers to:

- Select a subject area
- Select a course within the subject area
- Select the unit of study in the course
- Select the outcomes being assessed from that unit
- Select assessment items that correspond to the outcomes
- Create online or print-based tests (with answer keys) using the selected items

This software and the associated assessment items also could be used for formative assessment activities.

Ongoing technology support will also be provided in this project. A technical support help desk and call center will be created to assist with ICT training, online learning, the electronic gradebook, the STEM test bank, the National Curriculum Department Portal, the Teacher Portal, and other technology initiatives. A system for professional development course evaluations will also be created. Teachers need to be able to rate their experiences in the professional development courses they take. This system should be robust allowing participants to evaluate online, by mail, or by telephone.

Learning through Technology. As noted by Law and Plomp (2003), technologies can be used in less developed countries to change traditional pedagogy. With ICTs, pedagogy can be more learner-centered and more focused on individualized learning. In this particular project, the overall focus was on improving pedagogy, classroom assessment, and shifting instruction toward student-centered practices. Thus ICTs can play a pivotal role in a paradigm shift. To that end, the project supports a 5 year pilot of a tablet program in grades 7-12 STEM subjects.

Piloting 25 classroom sets of 25 tablets in various schools around the country will provide valuable data on infrastructural issues, professional development needs, teacher capacities, and student capacities (see Step B in Figure 1). The tablets will be made available on carts to integrate into classroom teaching and learning as needed. Teachers will be trained on the use of tablets with ongoing training and support from the Teacher Professional Development Center, the National Curriculum Department, and the ICT Professional Development Training Expert. The ICT Professional Development Expert will work with teachers, leaders, and technology experts across the 5 years of the program to ensure consistency and provide just-in-time training to teachers, leaders, and support agencies. Research shows that technology innovations succeed if there is ongoing support, if the technology is integrated with the demands of the teacher, if the leader supports the innovation, and if teachers can see results of using the technology (Richardson, 2011a; Richardson, 2011b; Vikashkmar, 2005; Wagner, Day, James, Kozma, Miller, & Unwin, 2005). All of these issues will be addressed by forming a strong relationship with the consultant and the applicable agencies.

The 25-school tablet pilot supports this project in various ways. First, teachers can use these devices for formative assessment. By trying and monitoring various applications across the pilot, we can determine what works best in which Georgian schools and under what circumstances. Second, tablets can be used to support the STEM content areas. The tablets can thus directly support aspects of the training teachers receive. That focus on tablet use should be on teaching and learning with and through the technology. Piloting the tablets will allow for the collection of data on how teachers use these devices for their own professional learning either on their own or in the study groups. Third, by testing various hardware and software configurations, the project can inform the various agencies about what works with regards to any future large-scale 1-1 device deployment. Finally, support from the Software Design and Development Consultant will be provided to work with local businesses to create applications and modify software to fit the Georgian context.

Another way that the project focuses on learning through technology is by introducing online learning for teacher professional development. There are five, 16-hour core teacher pedagogy professional development training courses that will be delivered face-to-face in this project. These pedagogy courses focus on student-centered environments, classroom assessment, and equity and inclusion. All 24,000 public school STEM teachers in grades 7-12 will be trained face-to-face; however, to sustain and scale up the project, all five pedagogy courses will be converted to an online delivery format. These courses can be used to "top up" skills, reiterate lessons learned in training and teacher preparation programs, and provide ongoing training to new teachers.

Discussion

Digital technologies can be infused into leading, teaching, and learning in various ways. ICTs may modify an existing task, augment a task, or be a direct substitute with no functional improvement for completing the task. ICTs in the current project are infused at all three of these levels. The project design described in this article is paradigmatically framed around Law and Plomp's (2003) conceptualized ICT integration into the teaching, leading, and learning process. By focusing on how to teach ICTs, how to enhance the education via technology, and by integrating technology into the process of learning, we created a holistic approach to the ICT in education design.

This Georgian project provides an example of how ICTs can be used to support leading, teaching, and learning throughout the system. By focusing on the tasks and the desired outcomes of those tasks, the recommendations weave ICTs into the process only when they truly facilitate a means to the end. The fields of ICT4D and comparative education may gain significant insights by watching and monitoring the process of project development (described herein), project inception, project implementation, and project delivery.

The opportunities for success in this project are many. However, the obstacles are just as plentiful. Without looking at the reform initiative at the macro level and thinking about how ICTs support that reform, we risk making the same mistakes as past initiatives. Chapman, Garrett, and Mählck (2004) noted that ICTs in education should result in better teaching and learning or else the investment is moot. They state that "only with sensible planning that takes into consideration the concerns and interests of those directly affected can instructional technologies be implemented in ways that promote, rather than undermine access and quality of education" (p. 36). This project attempts to heed this warning and thus offers promise for sustained and scalable educational change in Georgia.

References

Chapman, D. W., Garrett, A., & Mählck, L. O. (2004). The role of technology in school improvement. In D. W. Chapman, & L. O. Mählck, (Eds.). *Adapting technology for school improvement* (pp. 19-38). Paris, France: UNESCO.

Cuban, L. (2001). *Oversold and undersold: Computers in the classroom.* Cambridge, MA: Harvard University Press.

Doner, J., & Kentaro, T. (2009). *Persistent themes in ICT4D research: Priorities for inter-methodological exchange.* Paper presented at the 57th session of the International Statistics Institute, Duban, South Africa. Retrieved from http://www.academia.edu/2716922/Persistent_themes_in_ICT4D_Research_priorities_for_inter-methodological_exchange

Hamel, J. (2010). *ICT4D and the human development and capabilities approach: The potentials of information and communication technology.* United Nations Development Programme. Retrieved from http://hdr.undp.org/en/content/ict4d-and-human-development-and-capability-approach

Heeks, R. (2009, June). ICT4D 2.0: The next phase of applying ICT for international development. *Computer*, *41*(6), 26-33.

Index Mundi, (2014, November 25). Georgia, Population. Retrieved from: http://www.indexmundi.com/georgia/population.html

Infoplease, (2014, November 25). Georgia, Population. Retrieved from: http://www.infoplease.com/country/georgia.html

International Society for Technology in Education (2014). ISTE standards administrators. Retrieved from http://www.iste.org/docs/pdfs/20-14_ISTE_Standards-A_PDF.pdf

Jhurree, V. (2005). Technology integration in education in developing countries: Guidelines to policy makers. *International Education Journal*, *6*(4), 467-483.

Kozma, R. B. (2005). National policies that connect ICT-based education reform to economic and social development. *Human Technology*, *1*(2), 117-156.

Law, N., & Plomp, T. (2003). Curriculum and staff development for ICT in education. In T. Plomp, R. E. Anderson, N. Law, & A. Quale (Eds.), *Cross-national information and communication technology policy and practices in education* (pp. 15-30). Greenwich, CT: Information Age Publishing.

Millennium Challenge Account – Georgia, (2014). Terms of reference: Improving general education quality. Tbilisi, Georgia: Author.

Negroponte, N. (1995). *Being digital.* New York, NY: Vintage Books.

Norris, P. (2001). *Civic engagement, information poverty, and the Internet worldwide.* Cambridge, UK: Cambridge University Press.

Papert, S. (1996). *The connected family: Bridging the digital generation gap.* Atlanta, GA: Longstreet Press.

Postman, N (1993). *Technopoly: The surrender of culture to technology.* New York, NY: Knopf.

Puentedura, R. R. (N. D.). SAMR and TPACK: Intro into advanced practice. Retrieved from http://hippasus.com/resources/sweden2010/SAMR_TPCK_IntroToAdvancedPractice.pdf

Raiti, G. (2006). The lost sheep of ICT4D research. *Information Technology and International Development*, *3*(4), 1-7.

Richardson, J. W. (2011a). Challenges of adopting technology for education in less developed countries: The case of Cambodia. *Comparative Education Review*, *55*(1), 8-29.

Richardson, J. W. (2011b). Technology adoption in Cambodia: Measuring factors impacting adoption rates. *Journal of International Development*, *23*(5), 697-710. doi: 10.1002/jid.166.

Stanley, A. M. (2011). Professional development within collaborative teacher study groups: Pitfalls and promises. *Arts Education Policy Review*, 112, 71-78.
Tatnall, A. (2005). *Web portals: The new information gateways to Internet information.* Hershey, PA: IDEA Group.
Trends in International Mathematics and Science Study (2011).*TIMSS 2011 international database.* Chestnut Hill, MA: Author. Retrieved from http://timssandpirls.bc.edu/timss2011/international-database.html
Turpin, M., & Alexander, P. M. (2014). Desperately seeking systems thinking in ICT4D, *Electronic Journal of Information Systems in Developing Countries*, *61*(1), 1-15.
UNICEF (2013). Statistics: Georgia. Retrieved from http://www.unicef.org/infobycountry/georgia_statistics.html
Vikashkmar, J. (2005). Technology integration in education in developing countries: Guidelines to policy makers. *International Education Journal*, *6*(4), 467, 483.
Wagner, D. A., Day, B., James, T., Kozma, R. B., Miller, J., & Unwin, T. (2005). *Monitoring and evaluation of ICT in education projects: A handbook for developing countries.* Washington, DC: The World Bank.
West, D. M. (2012). *Digital schools: How technology can transform education.* Washington, DC: The Brookings Institute.
World Economic Forum (2014). *Global competitiveness report 2014/2015.* New York, NY: Author. Retrieved from http://reports.weforum.org/global-competitiveness-report-2014-2015/rankings/

About the Authors

Jayson W. Richardson is an Associate Professor in the Department of Educational Leadership Studies and a Director of the Center for the Advanced Study of Technology Leadership in Education (CASTLE). He currently teaches educational leadership, emerging technologies, technology leadership, action research, and qualitative methods at the graduate level. His research and teaching focus on how digital technologies can be used across the globe to create opportunities for individuals and to increase intercultural understanding between individuals.

Gregory Sales is a former classroom teacher and university professor. In addition, for nearly thirty years he has worked as an international education and training professional. He has extensive experience working in the fields of curriculum development, instructional design, teacher education, higher education, evaluation, research, and information and communications technologies. Greg has worked for a wide variety of clients around the world on donor-funded projects addressing the needs of primary and secondary education, higher education, and Education Ministries. Greg's work has included designing and managing educator professional development programs, developing assessment instruments and survey tools, and conducting monitoring and evaluation activities.

Sonja Sentoĉnik is CEO of a private institute Hiša znanja dr. Sentočnik in Slovenia. She holds Ed.D. in Educational Leadership from Lehigh University (Pennsylvania, USA). She has trained teachers and principals in Slovenia and Italy and worked as a consultant on educational reform in Bosnia and Herzegovina and in Georgia. Her research and publications focus on the study of teacher and principal professional development, distributed leadership development, alternative assessment of student performance, and post-socialist education transformation processes.