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A comparative analysis of a game-based mobile learning model in low-socioeconomic communities of India

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ABSTRACT

This study explores the effectiveness of a game-based mobile learning model for children living in underdeveloped regions with significant contextual variations. Data for this study came from a total of 210 children between the ages of 6–14 years old from six marginalized communities in India. The findings reveal that children with little or no previous exposure to technology were able to not only figure out the given mobile learning technology, but also solve a series of incrementally challenging problems by playing math games without specific intervention or instruction by adults. The study also found that various factors, including gender and group size, do affect children's ability to adopt and learn while presenting a unique set of learning interaction patterns. This paper concludes with specific recommendations for future ICT4D (Information and Communication Technology for Development) projects for educational development particularly targeting developing regions.

1. Introduction

There are over 5 billion mobile subscribers worldwide today – an astounding number considering the world's current population which is roughly 6.8 billion (ITU, 2010). This means that even in very rural areas of the developing world, today's children are more often than not already exposed to some type of mobile technology, and their exposure is only expected to increase in the coming decades. The rapid proliferation of mobile technologies throughout the world has brought substantial attention to the potential to leverage the power of these new technologies to address decades old problems, including educational inequalities (see Keen and Mackintosh, 2001; Ling, 2004).

Today's mobile devices, with their increasing affordability and storage, can be equipped with a vast amount of educational content, including mobile videos, learning simulations, and education games targeted to appropriate ages. Moreover, unlike desktop computers or even notebook computers, handheld mobile devices require substantially less infrastructure and electricity, which gives them many advantages over traditional computers. Most importantly, mobile devices are capable of reaching even the most marginalized communities (Attewell, 2005; Kim, 2009), and research has shown mobile learning devices have the potential to widen access and supplement education in remote and underserved areas of the world (Zurita and Nussbaum, 2004).

A number of studies have examined how mobile technologies can be used for both formal and informal literacy development and language learning (Brown, 2001; Cabrera, 2002; Chinnery, 2006; Joseph et al., 2005; Kadyte, 2004; Kiernan and Aizawa, 2004; Levy and Kennedy, 2005; Norbrook and Scott, 2003; Ogata and Yano, 2004; Paredes et al., 2005; Thornton and Houser, 2005). Many others have attempted to leverage mobile technologies for numeracy and math skill development (e.g., Baya'a and Daher, 2009; Franklin and Peng, 2008; Matthee and Liebenberg, 2007). In addition, several studies have shown that mobile learning devices can be effective educational resources for schools that lack educational resources and places where traditional learning cannot take place (see Attewell, 2005; Sharples et al., 2005; Stead et al., 2006), as well as for underperforming students (Shin et al., 2006).

This interest in mobile technologies is just part of the rapid growth in the number of ICT (Information and Communication Technology) projects for developing regions, often referred to as ICT for Development (ICT4D) (Avgerou, 2008; Prakash and De, 2007; Walsham, 2010). Within education, ICT4D projects aim to help young learners not only reach their full potential through ICT-integration into education system, but also contribute to the larger

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social, economic, and political development of their communities and nations (Thompson, 2008). However, the real impact of ICT4D reform projects is often hard to measure, and such projects tend to garner mixed reviews.

Among the many issues identified with ICT4D projects, teacher training is an oft-mentioned challenge (Rusten, 2003). In ICT4D and educational development more generally, the idea is to train teachers first so teachers can incorporate technology in their classroom pedagogies, while also helping children learn to leverage technology in their own learning. Although this idea seems ideal, it is not practical in many cases. Teachers in rural villages of underdeveloped regions usually have very little experience with technology (even email or word-processor), and very few own any type computing devices or have any reason to visit an Internet cafe hours away. The closest thing to a computer many have ever owned or seen is most likely their mobile phone or neighbor's smartphones.

Moreover, we know that children's aptitude with technology is often much greater than their teachers, and the speed at which children adopt technology can be quite astonishing to many adults. Vail (2003) asserts that, "it is no secret that adults take longer to learn new technology than children do, and that has certainly been the case with teachers." The rapid growth of a whole new array of mobile game technologies such as Nintendo, which children often play without any training by adults or help from instructional manuals, also suggests that children themselves are perfectly capable of adopting and learning from technology without adult interventions (Kamenetz, 2010).

Considering this conflux of factors, namely, the issues with large-scale ICT4D projects with top-down approaches, challenges with teacher technology training, the recent mobile revolution and its potential impact on education, we wonder why could we not involve young children as partners in the training and implementation stages of ICT4D. It seems that children (especially living in developing regions) could be our best partners in helping us (adults) learn about their use of technology in education. They could even serve as teachers for our teachers and our helpers in figuring out and enhancing new technology tools. It is easy to conceive of how, by simply playing with mobile devices, children can fulfill various roles in the technology design process such as: *user*, *tester*, *informant* and *design partner* (Druin, 2002). Considering the questionable successes of previous ICT4D attempts that employed top-down or teacher-first approach, a new approach that embraces the concept of children as active agents seems worth investigating. This paper researches how children in underdeveloped regions, with low levels of exposure to technology, come to use and learn from mobile technology, while also investigating which factors promote self-directed learning from mobile devices. The study is situated in India, a country with diverse population and low levels of development in both rural villages and urban slum areas; we draw on qualitative observations and quantitative measures of students' success at solving game-based math problems to argue that children can learn to manipulate and learn from mobile devices without adult interventions.

2. Research questions and rationale

Despite the great promise of mobile technology to help combat educational inequalities worldwide, researchers are still struggling to make mobile learning solutions relevant to the local needs of communities, replicable in a wide range of conditions, and sustainable even in under-resourced regions. For example, in an exploratory study of mobile device usage by children in India, Kumar et al. (2010) have shown that lack of regular electricity and concerns over theft inhibit mobile device adoption. In addition, they find that children's life paths vary substantially across gender, caste and regional lines. They argue that as a result, future mobile-based educational interventions may need to be targeted to certain children's distinct life circumstances. Building off of their research, this study examines how children in different conditions of the developing world adopt mobile devices and learn to play for fun while acquiring basic numeracy skills, with the ultimate aim of better designing and implementing ICT4D educational initiatives. Specifically, this research project asked three major questions:

1. Can children, in developing regions, who may have little or no technology exposure, adopt and teach themselves mobile learning technology without specific interventions by adults?
2. What processes do children go through in figuring out and solving problems presented by mobile devices?
3. What factors contribute to and accelerate children's ability to learn technology?

These inquiries are important steps in our larger research on how to increase access to self-directed learning opportunities for marginalized students; we think that large-scale mobile device interventions might be the only viable solution to many long-standing educational inequalities, and therefore, want to learn what factors make mobile device interventions scalable. However, this process entails two sub-goals as well – first, how to make user-friendly devices, and second, understanding which factors affect technology adoption.

In our current information age, characterized by the rapid development of ICT, the marginalized with the least amount of schooling will find it increasingly more difficult to participate in knowledge-based societies, deepening the social divide (Reimers, 2000). Without innovative interventions, the gap will only increase, further excluding the poor and uneducated from the connected world, and leaving them without the necessary skills to secure a livelihood and maintain their well being. Therefore, investigation of a highly portable and lower cost mobile learning technology, as a potential means to ignite self-directed and exploratory learning, will be beneficial for future ICT4D planning.

3. Theoretical framework

In order to test the effectiveness of various models of child-centered technology adoption, prior studies have suggested three sources of variations:

(1) *Group size*

Prior pilot conducted by the research team in other countries suggest that children will naturally form groups of various sizes when asked to figure out how to use new devices. For example, Kumar et al. (2010) find through ethnographic observations that young people often collaborate to figure out and use mobile devices in their daily lives. Moreover, in a prior pilot studies of mobile device adoption in Mexico and Rwanda, we found that small group formations occurred naturally around 20–30 mobile learning devices distributed to a large group of 40–50 children. We observed that when a few children gathered around a device, they quickly began to share their knowledge and took turns examining the device. However, in most cases, each child wanted to play individually with a device. The tension between the collaborative sharing information in groups and the desire to control the device individually suggested an important line of inquiry. Specifically, we wondered what might be the optimal group size in terms of actual speed and performance at problem solving, as this was not clear from earlier pilot tests in other countries.

(2) *Technology exposure*