A Survey to Assess the Potential of Mobile Phones as a Learning Platform for Panama

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Abstract
Education is a major concern in developing countries. We believe that new and emerging technologies offer hope in improving their educational systems. While the use of personal computers in developing countries is still very low, they have seen a widespread adoption of mobile phones in recent years. Since mobile phones have become small computing platforms, this inspired us to investigate their potential as educational tools. In this paper we report on a large survey (300 school children, 85 teachers) that was carried out in Panama to assess the status quo of technology use, as well as the initial ideas of the potential of using mobile phones in the context of school education. Results show that there is a high proliferation of mobile phones among school children, and that teachers and pupils were all able to envision using mobile phones for learning purposes. The results indicate that mobile devices have the potential to integrate into existing learning contexts, as well as enable new learning contexts.

Keywords
Mobile learning, developing countries, education

ACM Classification Keywords
H.5.2 [Information Interfaces and Presentation (e.g., HCI)]: User Interfaces – User-centered Design; H.5.m [Information Interfaces and Presentation (e.g., HCI)]: Miscellaneous

General Terms
Human factors

Introduction
Improving education is a major concern in many countries around the world. From a governmental perspective, improving education is an investment in the country's future that can result in economic growth and increased global competitiveness. For individuals and families in these developing regions, the motivation to participate in education is typically very high, since education is seen as a way to improve personal living conditions and gain eventual prosperity. Overall, providing a better education can help lead to sustainable improvement in a developing country's living standards as well as economy. Nevertheless, resources for education are limited both on a national level (e.g. budgets available for schools) and on a personal level (e.g. time that is available for learning). The use of new technologies to improve education is tempting but very difficult at the same time. New technologies often seem to offer easier and wider access to educational materials and means for improving learning efficiency. However at the same time, new technologies often impose new ways of teaching and learning. If these new ways do not meet the users' needs acceptance is typically low.

There is a very strong cultural influence on how schools are organized and how teaching is conducted. The agreement within a society on what knowledge and skills are important is deeply rooted and not easy to change. Thus, the approach taken in teaching and the relationship between the teacher and pupil is very much dependent on the culture. Introducing technologies that impose certain teaching/learning paradigms, even if considered superior to the traditional way of teaching, are therefore likely to fail.

To assess the potential of mobile phones as learning tools, we conducted a survey to better understand:

- **how mobile phones are currently** used and how widespread access to these devices is for children,
- where in the current educational systems pupils and teachers see a **need for support**, and
- how mobile technologies could **fit into the learning context** in urban as well as rural Panama.

Related Work
In related literature, we found several approaches oriented towards improving the limited access and use of technology in schools of developing countries. One of the most outstanding projects is the OLPC [9], which aims to provide each child with a low-cost laptop (XO-laptop) equipped with multimedia, collaborative UI (Sugar) and educational software. Based on the constructionism learning model [10], the OLPC' authors claim that children learn mainly by creating and sharing with their peers using only the XO-laptops. However, it has been criticized by governments of developing countries [1,4]. They are concerned that this learning model would not fit their educational curriculum, requirements and policies.

Mischief [8] is a project that investigates the use of multiple mice connected to a large display. This

approach allows children to work simultaneously on the screen and supports cooperative work and learning. This approach is very economic but is difficult to use in multigrade schools environments, where children from different grades and learning background share same classroom. Multigrade schools are very typical in many developing countries.

There are several projects, e.g. [3,5,7], that have explored the use of mobile phone for learning with encouraging results. Kam et al. [3], implemented games on mobile phones for learning English in India based on current games practices in rural areas there. M4Girls [5] and Mobi [7] looked at supporting Mathematics learning for students in South Africa. In all these examples, the cultural-social context of the country and the available technologies were considered.

Education in Panama

Panama has a very young population and a large portion of the population is at school age: 39% of Panamanians are between 0-19 years. Maintaining schools, providing sufficient educational material and having enough qualified teachers is a great challenge. Schooling is typically organized in two shifts: some children have school in the morning and the rest attend in the afternoon. A large portion of multigrade schools (74%) can also be found in rural areas. This highlights the efforts to maximize the utilization of resources. All children are required to attend school from ages 5 to 17 (13 years of school). Panamanian laws also guarantee them free access to public education. The major subjects taught in schools are Spanish (the native language for most pupils), Mathematics, Science, Social Sciences (Geography and History) and English (as a foreign language). The vast majority of children attend public schools.

Government Perspective on Technological Challenges in Education

Before planning the survey, we met with the Secretary of State for Education, the Head of National Education, and Head of Primary Education of Panama. During these meetings, they explained to us the situation and their opinions on implementing new technologies in the schools, i.e. computers in Panamanian schools. With the high number of students and a lack of human resources and infrastructure, their limited budget is often used to fulfill other priorities. In rural areas that are difficult to access, the existence of computer labs is almost zero. Overpopulation of children in classrooms and the multigrade system both limit the children's access to computers. *"In the luckiest schools, two children share a PC during 40 minutes once a week. [For] many, the visits to computer lab [are] once a month or even more seldom".* Another concern is the security of the equipment. In some areas, computers have been "lost". A further worry is allowing children access to the Internet. They do not want children to visit unsuitable sites. (Some schools have solved this by restricting Internet access for students). Another problem is computer maintenance. As one teacher that we interviewed pointed out, *"in our school there are 1000 students, 20 machines of which only 5 work"*.

Design the Survey

The survey is conducted to analyze the educational situation in Panama with regard to the use and the access to technology by children and teachers. In Panama, as in Latin America in general and in other developing regions, there exists an internal digital

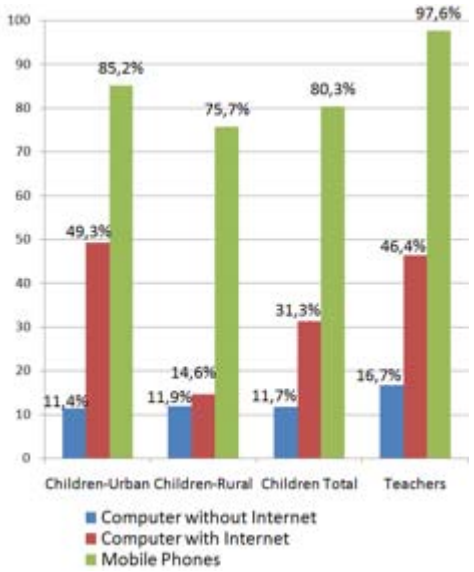

Figure 1. Access to Computers, Internet and mobile phones for children and teachers in Panama

division between schools situated in urban areas and school situated in rural areas. We wanted to capture this division as well in the survey.

Description of the Participants and Schools
The survey was conducted in three public schools in Panama, where two were urban schools located in Panama City and a rural school located in Panama East. The interviews were conducted during a 12-day period: May 19 - 30, 2009.

Design of the Questionnaires
The survey for the schoolchildren contained 26 questions. The suitability of the questionnaires was tested on two occasions with a total of 13 children to make sure they were easy to understand. The survey for the teachers had 24 questions, which were also tested for comprehensibility with 12 teachers. For both surveys this initial testing phase was very useful and helped us to clarify confusing questions.

Survey Results

In total, 300 children were interviewed – 148 from urban schools and 152 from rural schools. The children were between 9 and 17 years of age. The average age was 12.4 years. 52.2% of the students were male and 47.8% female. Additionally, 85 educators were interviewed, of whom 65% were female.

Access to Technology
Although we expected a higher penetration of mobile phones than access to computers, the actual numbers were still surprising: 97.6% of teachers and 80.3% of schoolchildren own a mobile phone (see Figure 1). This is accordance with the worldwide trend [2] of mobile phone penetration in developed as well as developing countries. Overall, the children have limited access to computers and Internet at home: only 31.3% of the children have access to Internet at home. Most, however, do not even have a computer at home. Figure 1 makes it clear that children from rural areas have significantly lower access to computers and Internet than their urban peers. Also, the majority of teachers do not have computers with Internet access at home. Although not all children have their own mobile phone, most of them had access to one at home. 98.2% indicated that they had at least one mobile phone at home. Furthermore, in 72.4% of the households, there are three or more mobile phones.

Use of Mobile phones
Making calls, sending SMS and playing games are the top functions that children and teachers use on the mobile phones. Amongst the children, the main difference was that music consumption is much more popular in urban areas than in rural areas (see Figure 2). A considerable number of teachers and pupils have modern mobile phones. About 60% of the educators and 77% of children have access to mobile phones with Internet access and/or an integrated camera.

Potential Use of Mobile Phones for Learning
In order to see where mobile phones could be best used as learning platforms, the children were asked about subjects where they have the most difficulties learning. Additionally, they were asked about how they get to and from school. This information gives us a better picture of possible user scenarios where the children might be able to learn with the mobile phones.

Subjects	Urban Schools	Rural Schools	Total
Mathematics	59.5%	28.9%	44.2%
English	8.1%	23.0%	15.6%
Spanish	6.1%	5.9%	6.0%
Nature Sciences	6.1%	24.3%	15.2%
Social Science	6.7%	13.8%	13.3%

Table 1. Academic subjects where children have more difficulties and would welcome additional support

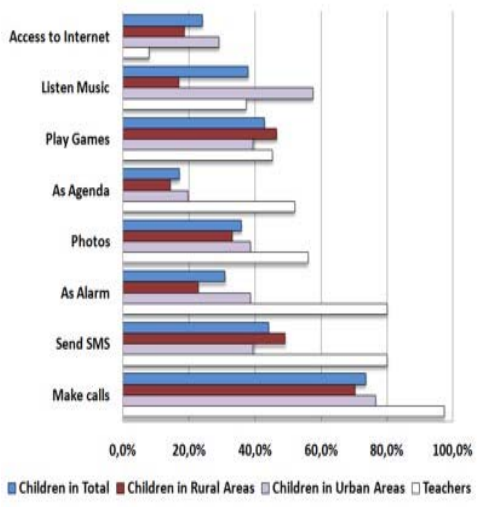

Figure 2. Use of mobile phones by teachers and children

Difficult Subjects for the Children

We asked the children which subjects they found difficult and might want to have help with (e.g. through learning games). The answers indicate that many children (44.2%) would like help with Mathematics. They seemed to be open to having more practice with multiplication. Some children felt that they *"cannot learn the multiplication table"* or do *"not [have] much time to practice".*

A more detailed analysis is shown in Table 1. Although Mathematics is the subject where most children had problems and wanted more support with, the overall responses differed greatly between rural and urban areas. Students in rural areas wanted support in a more diverse set of subjects, whereas students in urban areas were largely concerned with Mathematics. These results are consistent with a report [6] from the Ministry of Education of Panama, which showed that Math, Science and Spanish were the subjects with the highest fail rates.

We also asked teachers which subjects they thought children struggled with and could benefit from the use of technology (computer and/or mobile phones). The majority of teachers considered Mathematics (94.8%), English (35.1%), and Spanish (25.6%) as the most difficult subjects. Teachers stated that children in primary schools *"do not know the multiplication table"*, and those in middle schools exhibit a *"lack of [basic mathematical principles]" and "do not know the four basic arithmetic operations".*

The teachers were asked about their opinions of educational applications on mobile phones. In particular, we asked about the suitability of applications for mathematical exercise (e.g basic Arithmetic) and the idea of using mobile application to reinforce mathematics learning and 54.1% support the idea for English language learning.

The teachers were asked to evaluate the use of mobile phones versus laptops for supporting learning in Mathematics and English. They were asked to rate the devices from not useful to very useful (on a 5-Point Likert scale). Figure 3 shows the results. The phone and laptop are rated similarly with a marginal preference for the laptop. To our surprise, a large majority of teachers rated the mobile phone as a good learning platform for practicing Mathematics and English at home, as we expected that the primary usage context would be in mobile situations (e.g. on the bus).

Time Traveling by Children to/from School

For the majority of rural children the travel time to school is fairly short (82% of the children need less than 30 minutes). In urban areas about half the pupils (49%) have a travel time to school of more than 30 minutes. Most children in primary school (78.5%) use the bus to go to school. Overall age groups about 42% of the children and 80,5% in rural areas go by foot to school. Besides talking to friends revising for exams was the main activity on the way from home to school (stated by 47.5% of the children). On the way back from school pupils and students stated they wanted to relax.

Discussion and Conclusion

In Panama, there is a large number of mobile phones that are able to run software applications. Both children living in urban areas and rural areas had low access to

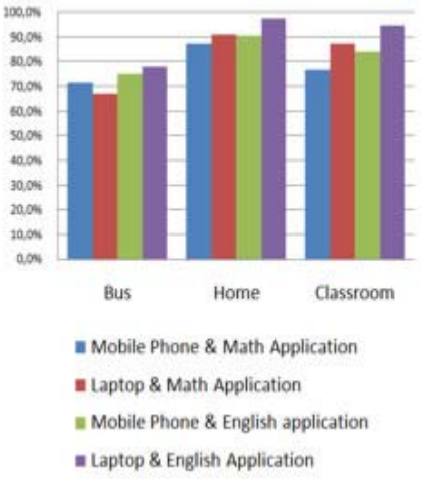

Figure 3. Acceptance of the use of mobile phones and laptops for solve mathematics and English exercises

computers but high access to mobile phones. In addition, a considerable percentage of teachers and pupils reportedly have access to modern mobile phones that include multimedia and networking features, i.e. integrated audio player, integrated camera and Internet access. This would allow them to run rich, interactive learning applications on these phones.

Additionally, students and educators would seemingly welcome edutainment applications on their handsets, especially for basic Mathematics and Languages. Their responses suggest that there would be a high acceptance of educational games designed for the mobile phone that would reinforce concepts learned in class.

Although mobile phones can be used virtually anywhere, most educators felt that the home is the most feasible place where children would benefit from learning with their mobile phones. Teachers seem to choose the home, because nearly all children have access to mobile phones at home. They also think that children would be more distracted if they used their mobile phones for learning in the classroom. For children in urban, areas, traveling to schools could also be a good setting for learning on their mobile phones, since half of them take 30 minutes or more to travel to school. For children in rural areas, audio-based learning applications would be more suitable, since most travel by foot to school.

Finally we believe that providing a sustainable learning solution where teachers can design the content or tasks of the educational games on the mobile phones of their pupils is core. Such tool could help to overcome some of the learning deficiencies in the children since they know where their pupils have problems and need more practice. This customized mobile learning approach would also be useful in multigrade schools.

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