Open access • Journal Article • DOI:10.1080/15391523.2017.1388200

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Published on: 02 Jan 2018 - Journal of research on technology in education (Routledge)

Topics: Laptop and Multimethodology

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JRTE | Vol. 0, No. 0, pp. 1–16 | © 2017 ISTE | iste.org/jrte
DOI: 10.1080/15391523.2017.1388200

Everyday Laptop Use by Children in a Southern Country: A Mixed-Method Approach

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Abstract

Information and communication technology (ICT) use among children in low-income countries remains understudied. The purpose of this study is to describe laptop usage among children in the context of the One Laptop per Child (OLPC) project 4 years after the laptops were first introduced in a community in Madagascar. The study was conducted using a mixed-method approach combining analysis of ICT use history, empirical observations, and interviews with children and parents. In class, activities involving laptops—including educational games, information research, and the creation of texts and storyboards—were found to be aligned with existing classroom activities. Outside school, computers were found to be used in individual, group, or family settings to listen to music and watch videos, play games, share content, and do homework. The study also found that computers play a major role in everyday routines, opening up new possibilities in photography and video-making. The findings also indicate that computer usage encourages children to learn new literacies in which image plays a central role and new forms of self-expression if they are accompanied and supported by their family. (Keywords: ICT, children, everyday use, developing countries, formal and informal learning, One Laptop Per Child)

The diffusion of digital technologies in southern countries to promote development and education has become a major objective for international organizations such as UNESCO and UNICEF (United Nations Children's Fund, 2013). The One Laptop Per Child (OLPC) project was a pioneering program in this field. The aim of the project is to enable every child, regardless of country of origin or social background, to learn and to develop autonomy and creativity by giving children the opportunity to use a laptop adapted to their living conditions. Developed from 2005 at the instigation of Nicholas Negroponte at MIT, the implementation of the project involved the design of laptops suitable for 6- to 12-year-olds (XO laptops), an operating system (Sugar), free software, and a roll-out to a number of countries throughout the world. Since then, UNESCO has developed information and communication technology (ICT) in education policy, the aim of which is to contribute to the reduction of educational inequalities, to the improvement of educational standards, and to the development of skills valued in our knowledge society (autonomy, initiative, collaboration, creativity, etc.).

Assessments of large-scale programs have shown that technology use in school contributes to promoting increased student engagement in learning activities and the development of numeracy, but that it does not necessarily affect the development of cognitive skills or the transformation of learning methods (Harper & Milman, 2016; Zheng, Warschauer, Lin, & Chang, 2016). In other

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words, making computers widely available is not enough by itself. The impact and effectiveness of computer use also depend to a great extent on the uses to which computers are put, the strategies used by teachers, and the match between available educational content (software, digital resources) and educational curricula (Cristia, Ibarraran, Cueto, Santiago, & Severin, 2012; Díaz, Nussbaum, Ñopo, Maldonado-Carreño, & Corredor, 2015; Zucker & Light, 2009).

It is important, therefore, to go beyond impact studies and to describe technology use among children by considering the economic and political context and the way in which technical solutions are implemented. Currently, most of the studies are carried out in North America, Western Europe, and Asia (Pérez-Sanagustin et al., 2017). How do children in low-income countries use laptops, particularly in regions where computer ownership is unusual and access to the Internet is limited? What do they experience when they use technology both in and outside of school? These are the questions examined in this study conducted in Madagascar—where less than 20% of youths use the Internet (International Telecommunication Union 2017)—in an island village involved in the OLPC project for more than 4 years.

Laptop Use in Class

According to a recent meta-analysis (Zheng et al., 2016), writing, editing documents, and research are the most common uses of laptops in schools. Productions of original texts in a range of genres and formats are the most common outcome when every child is given a laptop. In class, the use of laptops tends to favor individualized learning and learner-centered pedagogy. Many studies have found evidence of increased task engagement and perseverance when computers are used. The links between school and family have also been studied, with laptops having been found, for example, to improve monitoring of both schoolwork and homework by parents (particularly at secondary level) (Zheng et al., 2016).

Studies focusing specifically on computer use in primary school have highlighted a range of different activities and practices. Aside from information search activities, computers are used in some classes as textbooks for doing exercises, particularly in mathematics (Warschauer & Ames, 2010; Larkin, 2011), thus extending existing pedagogical practices. Other class practices involve carrying out projects resulting, for example, in the production of textual, audio, video, and multimedia documents in different disciplines (literature, art, science) (Larkin, 2011; Petersen & Bunting, 2012); students are thus able to make their work visible and to derive pride from their work.

ICT Use Among Children Aged 6 to 12 Years Outside School

The uses of different technologies (computers, tablets, Internet) by children, the associated social practices, and their experience in using them have been a focus of research in several disciplinary fields (psychology, sociology, education). These studies show the diversity of uses and practices.

Computers play a major role in a wide range of everyday activities. According to studies conducted in the United States (Salaway, Caruso, & Nelson, 2008) and Europe (Livingstone, Haddon, Görzig, & Ólafsson., 2011; Holloway, Green, & Livingstone, 2013), computers are used to stream videos and music and for social networking and game-playing from the youngest age (Fleer, 2011; Livingstone et al., 2011). Digital technologies also provide informal learning opportunities: They provide easy access to information and educational games; they support self-teaching, content sharing, playing, and creative digital production. However, creative uses such as multimedia document creation and blogging are less common (23% of participants, according to Livingstone et al. [2011]). In short, children use technologies to play, learn, interact, and maintain relationships with relatives and other children.

Ito et al. (2009) drew a distinction between relationship-oriented and interest-oriented activities. An increasing proportion of instrumented activities are directed toward the maintenance of social relationships in line with everyday friendships (Bond, 2014). These environments also provide new opportunities for experimenting with different self-images. Within households, information technology (IT) tools contribute to radically altering the boundaries between the public and private spheres,

with children and teenagers connecting increasingly in their bedrooms—out of sight of their parents—to an increasingly public space in which they are brought to expose themselves (Bond, 2014). Internet and social network usage carries risks, all major causes of concern for parents (see Livingstone et al., 2011; for an overview see also Holloway et al., 2013).

More generally, the use of digital technologies in families is often viewed positively because of the informal learning opportunities the technologies provide (Stevenson, 2011). However, digital technology use can also create problems and conflicts with other family practices, leading to the implementation of rules serving to establish why and how ICTs are to be used at home (Stevenson, 2011). Families also act as mediators enabling children to appropriate these technologies (Holloway et al., 2013; Plowman, 2015). This mediating role is often taken on by older siblings, who often show their younger siblings how to use technology and guide and encourage them to explore new applications and websites. Uses are thus subject to and shaped by different regulations and mediations among family members. In this context, ICT use needs to be seen, in short, as a negotiated practice shaped by individual aspirations, parent availability, the relationship to ICTs of the generations involved, and the desire to maintain rules consistent with family values (Stevenson, 2011).

The instrumented activities described in this section vary according to age, gender (Drabowicz, 2014), interests, the needs of children and teenagers (Bennett & Maton, 2010), the level and type of Q3 skill, and the social and cultural environment (Warchauer & Matuchniak 2011; Brown & Czerniewicz, 2010). According to a study conducted in England, social class and educational level are predictors of Internet use (Livingstone & Helsper, 2007). This study highlights the digital divide, an economic and social inequality with regard to access to, opportunities for use of, or impact of ICT. Since the 2000s, while digital technologies have become far more widely accessible, cultural and communication practices and uses vary in different social environments, and education level of parents and higher family income were directly related to use of computers in the home (Warschauer & Matuchniak, 2010; Dolan, 2016 for revues). Children or teenagers living in an underprivileged socioeconomic environment appear to favor activities focused on communication, music, clips, and videos, while children and teenagers from more privileged backgrounds tend to prefer creative activities and strategy games, what Schradie (2011) described as a digital production gap. Other studies have found that the support (confidence, encouragement) provided by the social environment in general and by parents in particular is a predictor of home computer use (Vekiri & Chronaki, 2008). Such support is needed to enable a diversification of uses.

Most of the research studies about the digital divide were conducted in the United States, but there is an emerging body of research in this field throughout the world (Van Deursen & Van Dijk, 2014; Li & Ranieri, 2013; Liao, Chang, Wang & Sun, 2016). However, only a small number of studies are conducted on the African continent. In these countries, inequalities of access to digital technologies have yet to decrease. In South Africa, Brown and Czerniewicz (2010) highlighted what they described as digital apartheid; their findings indicate that only a small group of students belonging to the socioeconomic elite presented the characteristics of digital natives. Digital inequalities among students replicate the pattern of social inequalities in the country (Oyedemi, 2012).

Laptop Use in Southern Countries

Endowment programs such as those offered by the OLPC project aim to reduce inequalities of access in southern countries. The starting point of the one-to-one OLPC programs is summarized by Urrea and Bender (2012):

> For children at this age, the computer can be both a toy to play with and a tool to learn with, blurring the lines in the child's mind between play and learning and reinforcing the rewards of "hard fun." As children grow, they should transition from the tools of expression to the tools of production. But first, the children need to learn about how to take intellectual risks, to be expressive with technology, to build confidence in their abilities as problem solvers. (Urrea and Bender, 2012, p. 228)

According to studies conducted on the roll-out of large-scale OLPC programs in Uruguay (economic rank: 43/178), Peru (economic rank: 47/178), or in India (economic rank: 130/178), classroom uses depend to a great extent on the adaptation to the local context (Warschauer & Ames, 2010; Ale, Loh & Chib, 2017). Local language use, available content, and teacher training are crucial factors for the efficient execution of the project. For instance, in Peru, where teacher training was limited, soon after they were introduced laptops came to replace notebooks in certain classroom activities, such as when copying out lessons written on the board (Santiago et al., 2010). In Uruguay, where all primary school students have received an XO laptop, the main classroom activities were initially limited to writing and online information search before a wider and more diverse range of applications came to be used (Area Assessment Ceibal, 2011); promoted in part by the training and content proposed by the Ceibal Plan, these changes have nevertheless been slow and gradual (Area Assessment Ceibal, 2011). These changes in use are also dependent on the level of education of students. In Sri Lanka (Hewagamage, Meewellewa, Munasinghe, & Wickramarach, 2011), the usage pattern of XO laptops shows that laptop use reaches a peak at the end of the fourth year before declining abruptly, probably because of the exams at the end of the fifth year, which take priority.

Very few studies have been conducted on informal learning or computer usage at home by children in developing countries. In spite of the potential of mobile technology to support children informal learning, publications in this field are limited (Chee, Yahaya, Ibrahim & Noor Hassan, 2017). Few initiatives currently target children in developing countries—for instance, the mobile learning lab in Sierra Leone, which promotes after-school use of mobile technologies, providing mobile phones. Another project, the MobiLiteracy Uganda (MLit-U) program, aims to improve early literacy development by providing parents and caregivers with daily reading activities to use at home with their children (UNESCO, 2014). However publications about these programs are limited. OLPC programs remain the main source of information on this topic. In OLPC programs when children have the option of using their computer outside of class time, they tend to use it very frequently (several times per week). In Uruguay, where many network access points are available, children's preferred activities are games (particularly online games), online videos, and social networking (Area Assessment Ceibal, 2011). However, uses vary widely, with the study highlighting a group of intensive users predominantly composed of urban-dwelling boys (54%). According to this report, variations in use depend on language skills, subject knowledge, and ICT-related practices among the child's social network (family, friends, teachers, etc.). In Peru, "standard" applications (word processing, browser, calculator) are the most commonly used (45% of the most widely used applications according to the log analysis), followed by game applications (18%), applications for producing, listening to, or recording music (14%), video recording (8%), and programming applications (5%) (Cristia et al., 2012). Computers are used to play games (79% of participating children), do homework (75%), listen to music (67%), watch videos (38%), and access the Internet at home (38%) (Beuermann, Cristia, Cruz-Arago, Cueto, & Malamud, 2013). The time spent using computers has an effect on the activities in which children engage at home (Meza-Cordero, 2016) and, in particular, on the time spent on homework.

There have been fewer studies in this area in Africa, where opportunities for access to technology and the Internet tend to be more limited. In a study of the OLPC in Ethiopia (Hansen et al., 2012), the authors found that the children surveyed (ages 10–15 years) were more likely to use computers outside of school than in class. Their favorite applications included word processing (34%), followed by digital books and Wikipedia entries (19%), the drawing application (10%), games (12%), and recording activities (11%). In short, the study found that children are mainly engaged in writing, reading, and gaming activities. These preferences appear to differ quite significantly from those identified in Latin America and in northern countries. Various hypotheses may need to be considered to account for these differences; for example, lack of access to pedagogical resources and to the Internet may impact uses. It is important to note, however, that this study is solely questionnaire based. Further studies are needed to better understand the uses of technologies among children in low-income countries.

This Study

This study forms part of a research program on the use and appropriation of laptops by children (PICRI UOPO project). This program managed by the Paragraph Lab (Paris 8 University, Cergy-Pontoise University) in partnership with the OLPC-France association. As noted by Hansen et al. (2012), it is hard to imagine the significance that owning a laptop can have for children in southern countries. How are laptops used by children in low-income countries where computer are not usually accessible? What are their experiences when they use this technology?

This study aims to describe laptop use among Madagascan children aged 6 to 12 years both in school and in their everyday environment. The study was conducted in an insular village of the northeast of the country, where XO laptops were first made available 4 years ago as part of the OLPC project.

Methods

A mixed-method approach combining log analysis and qualitative analysis of activity was used. The following analyses were conducted:

- a quantitative analysis of logs recording the applications used throughout the year;
- a qualitative analysis of productions (recorded files);
- tests on reading levels;
- observations, interviews, and focus groups conducted among children and parents living in the village.

First, quantitative and qualitative analyses have been carried out separately. Qualitative methods were used to supply additional information to quantitative analysis; they were used to describe the activities in which children engage when using their XO laptop and to understand their experiences. Providing contextual elements, qualitative analyses have supported the interpretation of quantitative results.

Research Context

Madagascar is a developing country with 75% of the population living below the poverty line (ranked 154 out of 188 globally according to the human development index). The country has a young population, and education remains a major challenge. Madagascar is also poorly equipped; class size is more than 40 pupils in primary grades, 33% of schools don't have toilets, and 93% have no electricity, one of the highest proportion in Africa (UNESCO Institute for Statistics [UIS], 2016). The country is ranked 164 out of 167 on the ICT development index; the use of technology in education remains limited. A range of initiatives aimed at equipping and connecting schools is being promoted by associations and business foundations to facilitate access to ICT for all.

The study was conducted in a village selected because it was equipped with XO laptops for several years. This coastal village is located in northeastern Madagascar. The village has a population of 500 (100 households). An Italian nongovernmental organization (NGO) called "We work, it works" has been working there for a number of years to develop access to health care and education. The village currently has a school composed of 5 classes comprising more than 160 students, a private middle school, and a boarding school (Martins, Haun, & Wilfing, 2015).

XO laptops were supplied by two French associations (OLPC-France and Gducœur) handling all technical, logistical, administrative, financial, and pedagogical matters as part of a pilot experiment. On the ground, the deployment of the laptops was carried out in line with the principles of the OLPC project, as follows: (a) "Focus on early education, children aged six to twelve": The XO laptops are targeted at children aged 6 to 12 years. (b) "Kids get to take the laptops home": Every child owns his or her computer and so can take the device home to use it as the child sees fit outside of school. (c) "Every child receives a laptop": The project aims to equip all primary school children and all teachers with computers in order to involve the community as a whole and to ensure that

every member of the community feels a sense of responsibility for the equipment. (d) "Connectivity": Every XO laptop is equipped with Wi-Fi antennas designed to promote the collaborative development of documents. (e) "Free and open source software": The operating system and software used are free of charge and access is unrestricted.

In line with the principles of the OLPC project, the XO laptops were entrusted to the children at the beginning of the year and collected again a year later for repairs, cleaning, and updates. French students visit to maintain the computers, to introduce teachers to new applications, and to run training sessions with the children. After the volunteers leave, children may use their XO laptops during their spare time and attend weekly sessions run by teachers.

Material

During the first 4 years of the project, 166 XO laptops were supplied; 140 were provided every year to primary school children and their teachers. While the original plan was to equip every child with a laptop and to allow the children to take their laptops home, differences in classroom size meant that only 80% to 90% of the children could be provided with a computer. In addition, 15 XO laptops were provided to the middle school.

The computers provided as part of the project (XO laptops) were designed by MIT for children and are resilient to shock and easy to use. The Linux operating system is accessible via a graphical user interface (Sugar) designed for children. On another partition, Gnome, a graphic interactive desktop environment for GNU/Linux platforms, is deployed.

A range of educational applications were available on every laptop and were provided by the association according to local needs. These included educational games such as Gcompris, photo and video capture software, programming software for children (Turtle art, Etoys, scratch), word-processing software, storyboard software, and resources such as a selection of Wikipedia pages on Madagascar and digital books writing in French and Malagasy languages made available by a local publisher (Predif).

Participants

One hundred forty children enrolled in one of the five classes of the village primary school (aged 5 to 14 years) were given XO laptops. Data from 110 computers were recorded and analyzed. Twenty-one children enrolled at the primary school agreed to be interviewed in focus groups (see Table 1).

Protocol

Data collection took place during two visits: The first visit took place 4 years after the introduction of the XO laptops, in 2014 (phase 1) and the second occurred a year later, in 2015 (phase 2). In phase 1, initial observations were made in classes and were supplemented by informal conversations with teachers. Browsing and traces of computer use during the previous year were also recorded. Lastly, informal interviews were conducted with parents and some children.

In phase 2, a more systematic analysis of uses by children was carried out. Observations were made in classes but also outside school. Focus groups with children of each class were organized on the school campus (21 participants; see Table 1). In addition, 10 individual interviews were conducted with parents of children enrolled at the village school volunteering to participate (two fathers, six mothers, and two couples, aged 24 to 50 years, representing 10% of the total number of

Table 1. Students Participating in the Focus Groups

Class	First grade (CP1)	Second grade (CP2)	Third grade (CE)	Fourth grade (CM1)	Fifth grade (CM2)
Mean age	6 years	9.1 years	10.6 years	12.2 years	12.8 years
Class size: girls	3	0	2	2	2
Class size: boys	0	4	2	3	3

households in the village). In the selection process, a stratification of people from different professions, ages, and living places was considered. To handle the language barrier, an interpreter attended all interviews.

Furthermore, in order to better understand skill levels and the characteristics of the students' family environment, a standardized reading test based on fluency (number of words read in 1 minute) and comprehension among a sample of 29 students in levels three, four, and five and a small survey was carried out on their environment (number of books owned by each household, access to electricity, etcetera).

Qualitative Data Collection and Analysis

In each phase of the study, approximately 40 hours of observations were made in classroom during ordinary lessons and XO sessions; several sessions were recorded. In each session, we noticed the conditions under which it was conducted, the learning tasks, classroom organization, and teaching strategies. During each XO session we took notes about applications used and pupils' activities. In addition, teachers provided a journal describing XO sessions made during the year. With these data, activity analysis was conducted according the principles of activity theory (Kaptelinin & Nardi, 2006) and child-oriented ergonomics (Decortis, 2015).

Observations were also made outside the classroom; in the village we observed in which context children used the XO, which application they used, and what they did with the laptop. These observations were completed by a focus group with children. The questions related first to the use of the XO laptops in the week preceding the focus group (context and frequency of use, applications used, computer activities), before turning more generally to computer use at home and to their individual preferences. A thematic analysis was undertaken.

Furthermore, semistructured interviews were conducted with parents. After questions about their personal background and their career path, the purpose of the interview was to understand perceptions of the OLPC project and views of the use of computers by children. A thematic analysis was undertaken.

Quantitative Data Collection and Analysis

Backup analysis provides a means of analysing content and use to better understand usage profiles and learning (in short, learning analytics). The files of 66% of the computers were recorded (see Table 2), with the informed consent of teachers and families. Student characteristics (gender and level) were reported in approximately 75% of cases.

The number of observations (110) is sufficient to enable the use of factor analysis methods. However, the data have limitations. First, the files associated with certain applications were not recorded.

Table 2. Volume of Information Collected by Year

Statistics		At 4 years after implementation
Number of XO laptops supplied		166
Number of backed up XO laptops		110
Number of implemented activities		67
Number of backed up activities		14
Folder size in GB		11
Number of files/activities		45606
Number of students by gender	Girls	43
	Boys	42
	Unknown	25
Number of students by level	Third grade	32
	Fourth and fifth grades	25
	First grade	3
	Second grade	25
	Middle school	9
	Unknown	16

Q4

Table 3. Rate of Use of Activities by Educational Level ($N = 110$)

Level	jpeg	epub	pdf	ogg	memorize	Gcom	Speak	Turtle	calculate	chat	physics	Fototoon
First grade	100%	33%	0%	100%	33%	0%	100%	100%	100%	0%	100%	100%
Second grade	88%	44%	28%	92%	56%	44%	96%	76%	88%	48%	92%	88%
Third grade	97%	47%	34%	84%	53%	13%	91%	53%	69%	47%	75%	78%
Fourth grade	100%	86%	43%	100%	29%	14%	100%	71%	86%	71%	100%	100%
Fifth grade	94%	61%	39%	89%	50%	39%	94%	39%	72%	44%	89%	89%
Mean	95%	52%	32%	88%	55%	33%	95%	59%	77%	46%	82%	87%

Furthermore, the data show that applications were opened but do not provide any indication of how they were used; for example, some children may have opened applications but not used them.

Nevertheless, analysis of the correlations between activities shows that the use of activities is indicative of latent behavior and not the result of chance. Cronbach's alpha, measuring the internal consistency of data (the way in which activities are used in combination), was 0.74, above the 0.7 threshold generally used in psychology, and aside from word processing (rtf) there were no negative item–test correlations.

Results

Context of Laptop Use

A detailed description of the uses of computers by children in their everyday environments was proposed on the basis of the observation and interviews conducted with children enrolled at the local primary school and with parents. Let us begin by considering the living environment. The village is composed of around 100 houses grouped by family. A typical day is structured as follows: The family rises at 6 a.m. and every member of the family contributes to the daily chores. The children then go to school (from 8 a.m. to 1 p.m., or 4 p.m. in fourth and fifth grades) and then spend the afternoon playing in the village. Before nightfall (6 p.m.), everyone goes home. Although all households are equipped with electricity (as a result of facilities put in place by the development project), it is not unusual for households to own just a radio and a mobile phone by way of electrical equipment. Only a small number of households own a television. Based on our findings, 50% of families own no more than one book. It was not uncommon for the laptop to be the children's only personal possession. Children will often take ownership of their laptop by personalizing it; for example, they may write their name on it, draw on it, or decorate it with stickers or photos.

Content Analysis

The dates of creation of the files show that XO laptops were more commonly used in the morning at weekends, outside of class time. Throughout the year, the use of the XO laptops was found to increase during periods when volunteers were present.

The activities promoted by volunteers and teachers during the year that preceded the analyses were **Write, Fototon, Record**, Tuxmath, Implode, **Gcompris**, Falabracman, Memorize, TamTam-Mini, Ruler, Reflection, **Madagascar**, Etoys, Clock, and **Calculate** (recorded activities are indicated in boldface). The activities used by more than 75% of students during the fourth year of the

Table 4. Rate of Use of Activities by Type

Type	jpeg	epub	pdf	ogg	memorize	Gcompris	Speak	Turtle	calculate	chat	physics	Fototoon
Girls ($n = 43$)	98%	53%	30%	93%	56%	30%	98%	65%	86%	53%	86%	93%
Boys ($n = 42$)	91%	51%	37%	86%	47%	23%	91%	56%	70%	40%	86%	79%
Mean	94%	52%	34%	90%	51%	27%	94%	60%	78%	47%	86%	86%

Note. Overall, girls were found to explore activities more than boys and to make greater use of certain applications, including Calculate and Fototoon (mean test ($N = 86$, $p < .10$) (cf. Table 4).

Q5

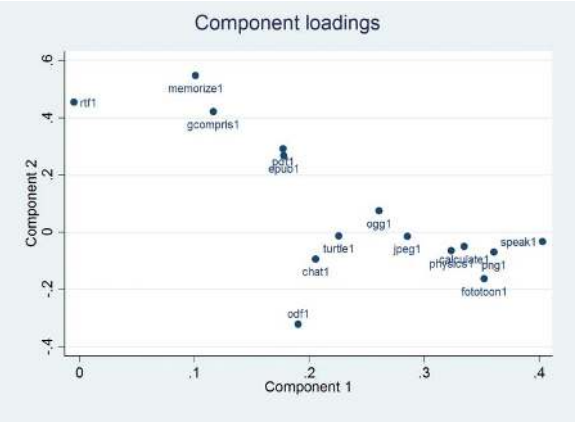


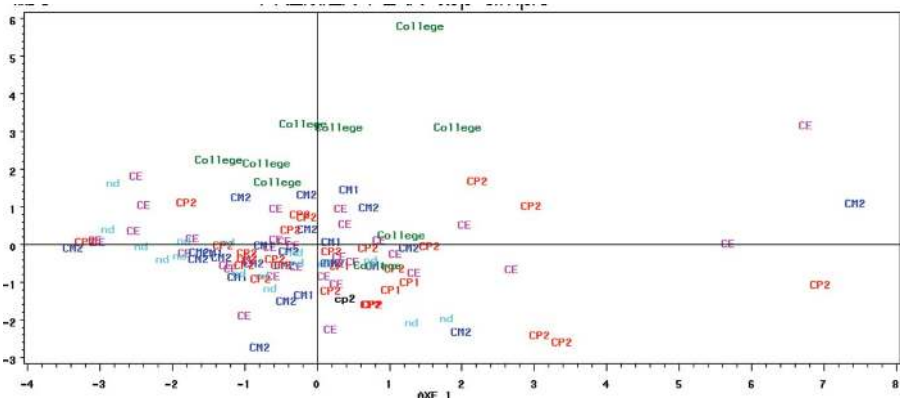
Figure 1. Principal component analysis—representation of variables.

project were Writing, Recording (photos [jpeg], videos [ogg]), Speak, Fototon, Calculate, and Etoys.

First- and second-grade (CP1–CP2) students engaged in very few activities involving reading and writing skills, such as digital books (epub or pdf) and Chat. Fourth- and fifth-grade (CM1, CM2) students made greater use of digital books but less use of Turtle. The tendency of teachers at different levels to promote different activities must be taken into account when analyzing these data, which may be said, therefore, to reflect both students' skill levels and teachers' choices. In addition, fourth-grade students appeared to be more active, while in fifth grade students were focused to a greater extent on preparing for the competitive exam at the primary/secondary juncture.

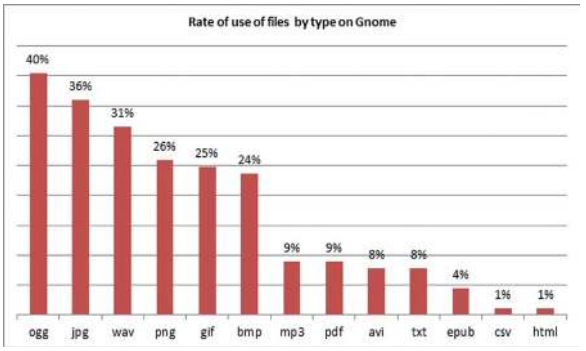
Principal component analysis was used to group activities into several dimensions/axes and to represent the variables and individuals in the same factor design (Figure 1). Two axes were found to account for 40% of inertia. The first (vertical axis) is composed of activities promoted in class (memorize, Gcompris) or requiring basic reading and writing skills (rtf, pdf, epub). The negative values are tight to the use of communication tools, such as chat or text writing (odf). The second axis (horizontal) is composed of less education-centered activities with a greater recreational and multimedia focus (Speak, png, Fototon, ogg).

The representation of individuals in the two dimensions just presented provides a visual indication of significant variations according to educational level. Students at the middle school in green were found to make greater use of educational activities, while first-, second-, and third-grade (CP1, CP2, CE) students who make greater use of recreational activities can be seen on the right of the



Q6

Figure 2. Principal component analysis—representation of individuals by level.



Q7 *Figure 3.* Rate of use of file by extension on Gnome.

horizontal axis. Behavior was also found to be differentiated according to gender, with more varied behaviors observed among boys. Eighty-one percent of students were found to use Gnome.

The main files on Gnome were video and audio files and images. The average number of photos per student was 91. The average number of videos viewed was 22, while the average number of HTML files was 13. The average number of sounds listened to was three per student. Unlike Sugar, Gnome was found to be mostly used on Mondays (38% of files) and Fridays (44%). Gnome was mostly used early in the morning (between 5 a.m. and 8 a.m.) and around 4 p.m. (i.e., outside of class time).

To supplement the statistical analysis of the logs, an analysis of the productions available on the XO laptops was also carried out. Here the analysis focused on the applications identified by Urrea and Bender (2012) as supporting and fostering creativity. Students' creations consisted mostly of photographs (between 0 and 320 recorded photographs across the sample of computers) representing the everyday environment (friends, family, village), but also videos, written productions, storyboards, drawings, and programs created using Turtle art. Written productions consisted of texts copied out in class. Storyboards, found on 87% of the computers, focused for the most part on everyday hygiene practices and village activities (i.e., both those run by volunteers and those led by teachers). Twenty-four percent of the children also used this application to produce their own storyboard.

The Turtle art programming software was used on 59% of the computers. However, from the history of its use, the principles of the software appear not to have been understood, with most productions being limited to a disorganized set of juxtaposed bricks. Only 5% of the programs were executable and produced original geometric figures.

Thus, while students' productions varied widely, for the most part they were the result of in-class activities or activities involving the help and guidance of volunteers. By contrast, the photos and some of the pictures were original productions created by the children themselves.

XO Sessions at School

One afternoon per week at primary school, every teacher led an "XO session" in class; these sessions were devoted to learning how to use the computer and to developing basic skills (mainly writing and counting) and subject-specific knowledge (history, geography, etc.). A distinction can be drawn between different types of use of laptops in class (see Table 5).

Teachers' use preferences generally depend on their age, level of IT competence, and the school curriculum. In first and second grades, computers were generally used to learn about word processing, to play educational games, or as an exercise book for copying out lessons. From second grade onward, computers were also used as a virtual learning environment offering a range of resources. For example, students used the Wikipedia Madagascar application, which includes maps of the country, photos and articles on local history, and information about geography, flora, and fauna

Table 5. Uses of XO Laptops With the Teacher in Class During Extracurricular Time

	Activities	Applications (XO activities)
First grade	Sound dictation	Speak
	Dictation of letters and numbers	Write
	Copying out a lesson, learning how to use a word processor	Write
	Discovering the sound of different musical instruments	Tam-tam mini
		Memorize
Second grade	Finding out about the XO laptop	
	Copying out words	Speak, write
	Copying out a lesson, knowing how to use accents and punctuation	Write
	Reading, word recognition	Madagascar
	Vocabulary lesson	Write
	Mental arithmetic	Tuxmaths
	Symmetry	Reflection
	Geography	Maps of Madagascar, Geo Quizz
Third grade	Writing numbers and letters	Speak, write
	Copying out texts about the island's economic activities	Write
	Memorizing French and Malagasy vocabulary	
	Creation of comic strips to learn French greeting practices	Memorize
	Arithmetic	Fototoon
	Measuring (size, distance)	calculator
	Drawing, drawing animation	Ruler, calculator
	Revision of a geography lesson	Etoys
		Memory
Fourth and fifth grades	Revision: text copying	Write
	Dictation	Write
	Arithmetic: division	Calculator
	History and geography	Madagascar, write
	Science: insects	Madagascar
	Telling the time	Clock

(among other things). From the third grade onward, computers were also used as a support for creative activities (drawing, storyboards). In fourth and fifth grades, computers were mainly used as textbooks and as a documentary resource for lesson work and exam preparation. During these sessions, students were found to collaborate, with the more experienced students guiding others in the use of applications.

Home Uses

At home, laptops were commonly used in the morning before school, after school, and in the evening after dinner. Use was, however, determined by the condition of the battery, with the limited capacity of aging batteries tending to limit use. The main activity cited by parents was gaming, while children referred first and foremost to photography and music listening. Children generally used their laptop to record music broadcast on radio and television and to record themselves singing before playing it back. XO laptops were also found to be used at home to learn. Students in first and second grades reported using their XO laptop to write, while students in fourth and fifth grades reported using it to read, to learn about the history of their country, to revise lessons, and to learn to calculate using games. The XOs were also found to be used for various everyday tasks, such as cameras being used as mirrors for hairstyling in the morning and backlit displays being used to light up the house or as a flashlight at night.

While the XO laptop is designed for personal use, the study found that siblings and indeed the entire family often join in the activities, with parents often reporting that "I play with them," "we listen to music," and "we're doing arithmetic," while children often showed their parents the photos they had taken. Video streaming was often a whole-family event.

Parents' Perceptions of Computers

Among parents, a laptop tends to be seen as a "high status object" with both a significant monetary value as a luxury commodity (none of the parents in the village can afford to buy one) and a high

symbolic value. A computer is also perceived to be a vehicle for knowledge; its mastery is thought to promote the development of intelligence in their children and is seen as an opportunity to develop professional skills and to learn about the world—"knowing how to handle a computer is to open up a whole new world," as one father reported.

Their material value also implies a risk factor (theft, damage), with participants reporting that they felt exposed to an increased risk of theft, which some were not prepared to accept. Some families who live outside the village thus opted to leave their computer with their teacher. Evidence of this attitude has been found previously in Peru (Cristia et al., 2012).

As an everyday activity, parents describe computer use as a healthy pastime for their children after school—a pastime more suitable for children than TV or radio programs. Parents also reported that they pay close attention to how their children use their computer at home. Some mothers emphasized the importance of ensuring a balance between games and homework. In short, computer use tends to be governed by the rules operating within the household. Lastly, computers were sometimes used by parents for bookkeeping, viewing files, taking photos, or making family photo albums.

Other Uses Within the Peer Group

It is important to note that children use computers in other settings besides school and home. In the afternoon after school, children often meet up in groups to play outside and computers are part of these recreational activities. Children will typically congregate around a fully charged computer to watch someone playing a game, to play together, or to comment on photos stored on the computer. During these moments shared among peers, children may even take photographs of each other or film one another dancing, singing, or engaging in some other activity. Some even created fictions (comic strips, storyboards, etc.).

The study also found that older students also share downloaded images and movies, circulated using memory sticks, which they then watch alone or in groups. These include images of cars, football, stars (e.g., singers and footballers), women, and landscapes, with the focus squarely on the iconography of popular European and American culture. The participants reported, with some degree of embarrassment, that they enjoyed looking at images of foreigners. A small number of erotic and pornographic images were also found in files on several computers.

Discussion

There has been little research to date on technology use among children outside a school setting, particularly in low-income countries and Africa. This study provides a systematic insight into the everyday uses of laptops by children in a village in southern Africa four years after the introduction of the computers. The mixed method applied in this study highlights the variety of laptop uses and situates these uses in the children's everyday lives.

The results of the quantitative and qualitative analyses converge, showing that in the year preceding the study a significant number of applications were used. The most widely used applications were those used to take photos and videos, followed by educational games and various applications promoted by teachers in class (Speak, calculator) or by volunteers (Fototoon). Differences according to gender and level of education were found. In fourth and fifth grades, children were found to consult more digital books and to share images and videos more frequently with friends, and were also more likely to use their computer for school work. These uses take place in class and at home, but also in other places where children and teenagers meet to play.

These uses align for the most part with existing practices. In class, computers are used to work on curricular knowledge and skills; the available activities (educational games, information research using available resources) allow for greater student engagement and autonomy in learning (Nogry, 2014). However, laptop uses are mainly focused on drill and practice rather than on production of materials. Indeed, the Malagasy education system promotes direct instruction that places the students in a receptive role and fosters repetition. Thus, to grant more autonomy to pupils and provide

creative activities using ICT requires rethinking teaching practices. That change is difficult for teachers with weak training; it should be done with support. Our results also converge with the findings of the studies carried out in low-socioeconomic-status (low-SES) schools: In this context, teaching practices with ICT are focused on drill and practice (Warschauer & Matuchniak, 2010; Dolan, 2016; Hohlfeld, Ritzhaupt, Dawson & Wilson, 2017).

Not unlike in countries in the north, outside of school computers are used to listen to music and watch videos, and are also used to play games, share content, and do homework. In Madagascar, with household appliances and equipment being limited, computers are also often used to perform everyday routines (such as using a laptop as a hair mirror or a pocket light). These uses differ from those observed in Ethiopia (Hansen et al., 2012), where reading and writing activities tend to prevail. By contrast, there were similar findings in Niger during a study conducted on the use of tablets among teenagers (Baron, Zablot, Combemorel-Pauty & Le Quentrec, 2015). The uses highlighted here are thus not specific to XO laptops; their specificity nonetheless limits wear and tear and offers more educational games.

Computers need to be seen, exist, and be used within the context of existing social relations among siblings, family, and peers and appear to contribute to strengthening these bonds, notably through reciprocal gifts of images and videos, a sign of shared interests. Furthermore, as in Western countries (Stevenson, 2011), use within families is a negotiated practice, with parents claiming to establish rules designed to structure the role of computers in the home.

Computers also offer children new and previously inaccessible possibilities such as photography and video-making, giving them the tools to photograph themselves and their daily lives, but also their family, their friends, and their living environment. These uses are similar to the uses of mobile phones in northern countries, as reported by Bationo and Zouinar (2009, p. 147):

> Mobile photography is far more focused on what is happening in the present moment, since the aim generally is to view and, above all, share immediately what has been photographed. There is thus a strong tendency toward instantaneous sharing via mobile phones of photographic images, whether produced or received.

Photography is thus used for the purposes of creative self-expression and presentation. These functionalities are used to record oneself (songs/dances) and to listen to or watch oneself again, acting, in short, as a tool for self-reflection that help children to increase their self-understanding and families to create traces, such as through a family photo album.

It is also important to note that the choices made in the design of the XO laptops and the deployment principles of the OLPC project are explicitly designed to bring about changes by promoting the development of autonomy, creativity, and collaboration. Some applications are designed to promote the release of creative skills such as the organization of ideas, artistic expression, digital thinking, and storytelling, with a view, more generally, to fostering personal expression and the production of original projects that make sense to learners (Urrea & Bender, 2012). Yet analysis points to a discrepancy between the uses envisaged by the designers and real activity in practice. While certain applications aimed at fostering creativity are used (word processing, storyboard, Turtle art), the production of original projects or artifacts is generally limited and was driven by teachers and volunteers. In this context, the role of educators is crucial for the development of creativity skills.

Another principle of having every child owns his or her computer is to promote autonomy, individual use, and self-expression. However, computer use tends to be a collective rather than an individual practice. Gathered around the same computer, children of all ages will typically play together, give advice to one another, and support one another. In the village in question, children are rarely alone (given, e.g., their many siblings and the community games within the village) and are taught from a young age to adopt a prosocial attitude and to collaborate (Martins, Haun & Wilfing, 2015).

Methodological Implications

The demonstration of the discrepancy between the uses anticipated by the designers and real uses was made possible by the analysis of productions and interviews with the children who participated in the study. The methodology must combine different sources of information—traces of use, productions, interviews, tests—in order to document the range of applications used, the type of uses, and the social practices in which these uses take place. Various limits were nonetheless encountered. Not all the applications were traced and the frequency of use was not always available. In addition, the need for an interpreter restricted the extent to which children could be questioned about their experience using computers.

To conclude, the OLPC project was a pioneering program in the field of ICT for development. While no evidence was found of the impact of the project on the development of basic skills (numeracy, literacy), the use of computers in low-income countries supports formal and informal learning activities, providing easy access to information, educational games, and tools for self-expression; it tends to change the relationship children have with the media and introduces them to new literacies in which image plays a significant part and to new forms of self-expression—provided they are supported and accompanied along the way.

The digital environments available in low-income countries are evolving rapidly at present, access to the Internet is becoming widespread, low-cost smartphones are becoming widely available, and endowment programs for the provision of tablets are becoming increasingly common. Given this, it is critical to understand how children take ownership of these technologies and incorporate them into their everyday activities and social practices by characterizing the continuities and ruptures they introduce.

Acknowledgments. The authors are grateful to the Région île de France for funding the PICRI UOPO project and thank the OLPC France and "We work, it works" associations, without which this research would not have been possible. This work was supported by grants from the Paris Region (program PICRI, région Ile de France). We thank the associations "We work, it works" and Gducoeur, which hosted us in the village and gave us access to the project. The quantitative data were collected with the support of OLPC France members and analyzed in collaboration with Abdallah Abarda (statistician). We thank Françoise Decortis, Anne Bationo-Tillon, and the research group C3U (Conception, Création, Compétence, Usage–Paragraph Lab), who provided helpful advice and commentaries about the qualitative research method and the results of this study. We are grateful to Georges-Louis Baron, who provided positive support to our work, as well as to the two anonymous reviewers and the editorial board, who provided helpful comments on the content and the form of this article. We are also very grateful to teachers, parents, and children who agreed to participate to this study.

Received: 8 August 2017
Revised: 27 September 2017
Accepted: 2 October 2017

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