The Value of Non-Instrumental Computer Use:

Skills Acquisition, Self-Confidence, and Community-Based Technology Teaching

Beth Kolko, Robert Racadio, Kate Deibel, Kristina Krause, & James Prempeh

With contributions from Judith Yaaquobi, James Humphrey, & Karen Saville

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THE GLOBAL IMPACT STUDY

This research was conducted as part of the *Global Impact Study of Public Access to Information & Communication Technologies*, a five-year (2007–2012) project to generate evidence about the scale, character, and impacts of public access to information and communication technologies. Looking at libraries, telecenters, and cybercafés, the study investigated impact in a number of areas, including communications and leisure, culture and language, education, employment and income, governance, and health. The Global Impact Study was implemented by the **Technology & Social Change Group at the University of Washington Information School** with support from Canada's International Development Research Centre (IDRC) and a grant to IDRC from the Bill & Melinda Gates Foundation. Learn more at **globalimpactstudy.org**.

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CONTACT INFO

University of Washington

Department of HCDE

428 Sieg Hall

Seattle, WA 98195

TEL: +1.202.543.2567
WEB: HTTP://WWW.HCDE.WASHINGTON.EDU/

ABOUT THE AUTHORS

Beth Kolko is a Professor of Human Centered Design & Engineering at the University of Washington where she heads the Design for Digital Inclusion group and co-directs the Tactile and Tactical Design Lab.

Robert Racadio is a PhD candidate in Human Centered Design & Engineering at the University of Washington.

Kate Deibel completed a PhD in Computer Science & Engineering at the University of Washington and works at the Center for Engineering Learning and Teaching at UW.

Kristina Krause received a Master's degree in Human Centered Design & Engineering at the University of Washington and is currently a User Researcher at Aditi Litehouse.

James Prempeh is an interaction designer based in Seattle, Washington.

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ABSTRACT

This study focuses on the usefulness of "playful" computer activities, such as social networking and gaming. When venues prioritize activities like word processing or spreadsheets while restricting gaming or social networking, they limit expectations of appropriate technology use and good stewardship of public monies. The quantitative and qualitative data in this study demonstrate that people who primarily use computers for non-instrumental purposes are generally as capable with computers as those who use them for instrumental purposes. It also illustrates that people who largely use computers for non-instrumental purposes gain skills that help them perform instrumental tasks. This suggests that embracing gaming and other leisure activities will allow novice users to acquire the experience necessary to build a range of computer competencies. Most important for computer skill acquisition is the variety of activities users engage in, not their formal training, and not whether they perform instrumental or non-instrumental activities.

KEYWORDS

public access, information and communication technologies, ICT, ICTD, ICT4D, cybercafés, internet cafes, games, social networking, non-instrumental, playing, computer skills, Brazil, youth, libraries, internet

130-CHARACTER SUMMARY

Time to stop kicking kids off computers for goofing around. Turns out games and social networking improve computer skills.

RECOMMENDED CITATION

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TABLE OF CONTENTS

LIST OF TABLES & FIGURES

GLOSSARY

- **Computer-based exercises (CBEs):** Moderated exercises that are conducted on a computer and used to evaluate participants' technological proficiency at specific skills.
- **Cybercafé**: A site that provides internet access to the public.
- **Gaming:** The act of playing a game in an online or computer-based (LAN) setting.
- **Information & Communication Technologies (ICTs):** The integrated technological systems that allow for information gathering and communication.
- **Instrumental use:** Related to use of technology for educational or professional purposes.
- **LAN House:** Similar to a cybercafé, but predominately used for entertainment and gaming purposes. LAN is derived from "Local Area Network," when co-located computers are connected to one another, but not necessarily to the internet.
- **Library:** A free access point for the internet, and a well-known source of a vast array of information.
- **Non-instrumental use:** Related to use of technology primarily for personal or entertainment purposes. Can include games or social networking sites, as well as use of other software or services.
- **Public access venue(s):** Publically and privately owned venues for public access to the internet. Often government-sponsored and free.
- **Social networking:** The act of using social network sites, such as Orkut or Facebook, for communication and entertainment purposes.
- **Telecenter:** A public space for people to access the internet and other digital technologies to allow for learning or use of such technologies.

EXECUTIVE SUMMARY

The Non-Instrumental Uses of Technology in-depth study was originally proposed because researchers throughout the world have noted significant amounts of gaming activity among users, including at public internet and computer access facilities. The scope of the study was expanded to include social networking and other 'playful' uses of technology. The goal of the study was to provide empirical evidence about whether such "playful" computer activities, including social networking site usage and gaming, in public access venues, had an impact in the core areas of the Global Impact Study, particularly employability

We based the structure of the study on current research on games, drawing especially from the "serious games" and "games and learning" communities and associated research that shows the potential value of not just of educational games, but of so-called commercial-off-the-shelf (COTS) games. Since gaming and social networking are prevalent throughout public access sites, this research sought to understand the role of non-instrumental usage as people gain competency with computers. . It is our intention that this research provides evidence-based findings to help institutions and policy makers create informed and useful guidelines for public venues, such as libraries and schools. In particular, the findings are meant to provide empirical evidence for conversations that generally privilege instrumental use and often ban non-instrumental use.

The study uses a combination of qualitative and quantitative research methods. The analyses recognize that the terms "instrumental" and "non-instrumental" are rough approximations of usage that is often nuanced and complex. To that end, the research uses a careful approach that creates categories of "instrumental" and "non-instrumental" that are grounded in the data and recognize the difficulty in drawing boundaries and labels for information and communication technology (ICT) activities.

Our methods include a qualitative interview study and a quantitative, computer-based exercises (CBE) study. These two research activities gathered information about how people first learned to use computers and how important a public venue and a non-instrumental activity were to those learning experiences, as well as about how well differing populations—instrumental versus non-instrumental users—would perform on key computer tasks. For the latter, we were especially interested in getting beyond self-reporting of skill level and, instead, looking at actual performance measures.

Our qualitative findings have shown that the Brazilian public, in general, has not embraced formal education as a means for gaining computer knowledge and skills. Instead, many pick up this knowledge from other resources, including friends, neighbors, and family, or most commonly, in the LAN houses. While individuals indicate an eagerness to gain new skills, many prefer to learn through technology exploration and engagement within the context of their immediate social network, rather than through a pedagogy of learning for its own sake.

The body of quantitative data provides evidence that people who largely use computers for non-instrumental purposes are generally as capable with the computers as those who use them for instrumental purposes. It also illustrates that people who largely use computers for these non-instrumental purposes are gaining skills that translate to instrumental tasks. This suggests that making public access venues more available can help non-instrumental users gain the exposure needed to perform non-instrumental tasks. What we find is that what's most important is the variety of activities users engage in, not their formal training, and not whether they perform instrumental or non-instrumental activities.

Finally, given the strong evidence that primarily doing social networking or gaming activities for fun can still provide users with skills that transfer into core computer usage tasks, we would recommend that public access venues support so-called non-instrumental activity in order to encourage multiple pathways to gaining digital literacy.

INTRODUCTION

The Non-Instrumental Uses of Technology study was designed to provide empirical evidence regarding the usefulness of "playful" computer activities, such as social networking site use and gaming. The study builds on findings from the "serious games" and "games and learning" communities, and it takes a broad perspective on technology use and everyday life. In particular, this study was conducted recognizing that non-instrumental activity compromises a significant portion of people's online time in public access venues. As such, it seeks to understand the role of non-instrumental usage in public access venues and the impact these venues have on users. This is to provide evidence-based findings that can help institutions and policy makers to create informed and useful guidelines for public computer usage, whether in libraries, schools, or other public facilities.

This study has been framed with a recognition that the terms "instrumental" and "non-instrumental" are coarse approximations that do not capture the nuance of people's actual ICT usage. As is made clear in the Results section, rather than generating external labels to apply to study participants, we created categories emergent from the data itself, using responses about why people use certain ICT programs or their abilities to identify categories of users, against which we then measured performance.

Telecenters, libraries, schools, and other public venues often make information and communication technologies (ICTs) available to the public based on preconceived norms about which ICT uses are worthwhile. In particular, such venues often privilege instrumental uses—when people use the technology as an instrument toward productive goals, such as applying for a job or training for future employment. Precise definitions are elusive: Communication via email is "good," especially if used to send that job application to a potential employer, but communication via chat or Orkut is often scorned as play or banned as disruptive. Yet users do not necessarily make such distinctions. Further, the playful uses are often those that first attract them to computers, in turn leading them to other uses.
When public venues value activities like word processing a job application or creating spreadsheets for budgeting, but not gaming or social networking, they create specific expectations of what constitutes an appropriate use of technology and good stewardship of public monies. The goal of this study has been to investigate assumptions about instrumental versus non-instrumental uses, and to collect data to address the following research questions:

1. Do people gain any ICT skills (i.e., keyboarding skills, knowledge of operating systems and file structures, etc.) through non-instrumental uses of ICTs in public access venues?

2. Are any skills that are gained through non-instrumental uses transferable to other (instrumental) uses of ICTs (like searching strategies, information evaluation, synthesis, and summary)?

3. Do non-instrumental uses constitute an important motivation for non-users to start using computers? If so, does that non-instrumental "first touch" then lead to instrumental usage?

4. How do the characteristics and consumption patterns of non-instrumental use differ between public venues and private venues? That is, what are the types of activities users perform, with what frequency, and where?

5. How do users' understandings of and attitudes toward ICTs differ between public access venues where the emphasis is on consumption of information versus the creation of content/multimedia?

6. How do the characteristics of users (gender, age, socioeconomic level) affect skill level and activity choice in public access venues?

To accomplish this, we conducted a qualitative interview study, and a quantitative computer-based exercises (CBE) study. These two research activities gathered information about how people first learn to use ICTs and how important a public access venue and a non-instrumental activity were to those learning experiences, and about how well differing populations—instrumental versus non-instrumental users—would perform on key computer-based tasks. For the latter, we were especially interested in getting beyond self-reporting of skill level and, instead, looking at actual performance measures.

With respect to the research interest areas of the Global Impact Study, the non-instrumental study addresses:

- Reach of public access venues to understand where people first access and learn how to use technology;
- Public access venue services and operations to identify the scope of services that would be of most benefit to users, including better support for non-instrumental activities; and
- Usage data of public access ICTs describing user's activities and their reasons for doing them.

The hypotheses for this study were drawn from exploratory work about games and ICT usage in public access venues, including privately-owned venues. We hypothesized that:

1. Novice and experienced users engage in a mix of instrumental and non-instrumental uses of ICT—in both public and private venues.

2. Because of the surveillance aspects of public use, as well as policies that are in place at certain centers that may encourage or discourage non-instrumental use, the types of non-instrumental uses may differ (with respect to frequency, volume, visibility, patterns of non-instrumental use—single or multi-user) in public versus private venues.

3. Engaging in communication and entertainment activities results in users gaining computer skills, cognitive abilities, content knowledge, and other potential skills.

4. The computer skills gained through non-instrumental uses transfer to instrumental uses of ICTs.

5. People initially attracted to ICTs for non-instrumental uses often subsequently explore instrumental uses.

6. Public engagement with ICTs for non-instrumental uses leverages collaborative shared space, and thus emphasizes specific kind of skills—skills that transfer to other areas of life, including those domains mentioned in the Global Impact Study (GIS) project.

7. Having an opportunity to create multimedia gives people different skill sets than just consuming media, and it also gives them a different sense of themselves as agents and participants in a knowledge/technological society.

8. Some demographic characteristics may affect skill acquisition.

There is a robust academic community dedicated to exploring the connection between games and learning, drawing heavily from research in both education and psychology. Games are an increasingly central topic in educational research, with scholars researching games as part of informal learning (Stevens, 2007), key skills like collaboration that people learn while playing multiplayer games (Nardi & Harris, 2006), psychological and reaction-time skills gained from games (Green & Bavelier, 2003), and the creation of actual educational games designed to teach complex skills (Dubbels, 2003; Garris, 2002; Gee, 2003; Holland, Jenkins, & Squire, 2003). A similarly growing literature explores the connections between social networking and learning (Boyd, 2002; Ito, Baumer, Bittanti, boyd, Cody, et al., 2009), and digital media production and learning, work that builds on the extensive education literature demonstrating the importance of learning communities.

As a companion piece to academic work, significant attention and dollars have been targeted at exploring the issue of games and informal learning in the United States (e.g., the MacArthur Foundation's 5-year, $50 million project on Digital Media and Learning, and the Robert Wood Johnson Foundation's $8.25 million program in Health Games Research). There are also organizations dedicated to NGO-like activity around games, including the Serious Games initiative, Games for Change, and Games for Health; these groups focus on developing games with explicitly pro-social goals in mind.

Much of the research in the games and learning area has focused on the learning that occurs while people engage with games. Developing world initiatives include work by groups such as the South Africa-based Mindset Network, which has developed mobile phone-based games to teach math skills to girls (Mathstermind and Fashion Network), and the literacy and numeracy games for disadvantaged youth developed by Pratham in India. These specific, pro-social gaming projects similarly focus on in-game content and what people can learn as a direct result of playing (Ito et al., 2009).

This project, however, is more interested in how engagement with games serves as an entry point for ICT use (Kolko & Putnam, 2009). In other words, we are interested not only in what people learn because of a *specific game*, but rather, what they learn because of the *specific activity of gaming*. To that end, this research looked at a variety of games and other non-instrumental uses of technology to better understand issues of 1) skill acquisition through play and playful activity, and 2) transfer of those play-acquired skill sets to other, more instrumental, domains. The transfer of skills is a key component of this research, because it is through the act of transfer that we can begin to see impact in the overall Global Impact Study domains.

The research situates questions related to the effect of non-instrumental use within a theoretical framework tied to cultural theory that investigates issues of identity and agency. Generally, cultural theory provides another lens through which we can view the importance of digital artifacts that transcends their literal or functional meaning (Wise, 1997). Again, in the most broad terms, such cultural theorists as Bruno Latour (2007) provide a framework against which we can examine technological artifacts not for what they are, but for what they enable. That is to say, games and non-instrumental uses of technology are important not (only) because they teach people to collaborate or improve language skills, but, as our body of data demonstrates, because they provide an alternative mechanism by which many people experience their first "touch" of a computer.

LITERATURE REVIEW

The conceptualization of the "digital divide" has shifted focus in recent years. What was originally conceived of as a largely binary physical gap between having or not having access to information and communication technologies (ICTs) has become a discussion centered on the varying sociotechnical factors that affect access to technology. The digital divide is now discussed as a complex continuum on which the notion of "access" is situated, where studying patterns of technology diffusion across diverse communities can highlight design, policy, and other issues that are key to integrating technologies effectively into everyday life (Barzilai-Nahon, 2006; Dijk & Hacker, 2003; Mehra, 2004; Nardi & O'Day, 2000; Selwyn, 2004; Tibben, 2007; Warschauer, 2002).

Originally, bridging the gap in physical access to ICTs was expected to change peoples' lives. The claim was that ICTs make available information that can result in improved education and job prospects, a greater voice in government, and access to better healthcare information. National governments focused on improving access to ICTs as a way to empower marginalized communities, both in developed and developing countries.

Development language permeated much of the early efforts to make ICTs available, and it continues to have a significant influence. However, as time passed and technology became more widely diffused, it became increasingly clear that interventions focused on providing access to core technological artifacts were failing or achieving unintended consequences (Gichoya, 2005; Hosman, Fife, & Armey, 2008). These technology access projects were sometimes deployed without ongoing support, or their intended functions were hampered by being placed in contexts outside their initial development specifications. Many projects were created with a general user profile of "developing nations" in mind, rather than a particular location (Brewer, Demmer, Du, & Ho, 2005; Heeks, 2008). Moreover, it became difficult to correlate economic and social development with technology use, and impact metrics became increasingly complex. It also became clear that just having access to an ICT did not result in direct benefit, and that access itself did not cause linear change. This shift in understanding, in addition to ICTs becoming more integrated into doing business within many of the domains associated with development (health, government, education), has resulted in less emphasis being placed on ICTs themselves, although targeted efforts to ensure technology remains accessible across communities are continuing.

Telecenters, libraries, and other public venues commonly make ICTs available to the public using policies based on preconceived notions about which ICT uses are beneficial, often banning activities that may be considered "play." In particular, the rules generally promote instrumental uses, where the ICTs are used as a tool to achieve a commonly defined productive goal. Such centers often consider activities such as word processing for a job application or creating spreadsheets for household budgeting to be legitimate uses. In contrast, gaming is seen as illegitimate because it's considered a waste of time (Hansson & Mozelius, 2010), it can be distracting to other patrons (Yi & Schweppe, 2012), or it is considered an unfair use of a limited resource (Nicholson, 2009; Pulliam, 2011). Additionally, activities like blogging and social networking are banned, ostensibly to protect a patrons' privacy (Barnes, 2006) or to protect them from illicit content (Amadeu, 2008). Precise definitions are elusive for instrumental use: Communication via email is "good," especially if it is being used to send a job application to a potential employer, but communication via chat or Myspace are often scorned as play or labeled as disruptive to other patrons, leading venues to ban these activities. In contrast to LAN houses, which usually allow "non-instrumental" activities, the public access venues directly funded by the Brazilian government often discourage or outright prohibit gaming and social networking because these are seen as frivolous activities that, essentially, "waste" the ICT resource.

Yet, novice users do not necessarily make such distinctions, and they are often initially drawn to computers for non-instrumental activities. Efforts to diffuse ICTs broadly in a population by creating public access venues, then, potentially do themselves a disservice by cutting users off from the very activities that bring them through the door (Gomez & Gould, 2010). Further research in younger population groups has also shown that informal learning activities lead individuals to create a knowledge base surrounding technology that allows them to conceptualize potential uses in other technologies, expanding upon and increasing their technological skill base (Sefton-Green, 2004). Moreover, part of making the successful transition from non-instrumental ICT use and skills to instrumental use is having greater societal support and recognition that knowledge learned in non-instrumental scenarios is, in fact, useful.

In other words, most literature that emphasized the importance of ICTs for development in the previous decade focused on their usefulness for things like education and employment—instrumental uses. However, when people gain access to ICTs, they put them to all sorts of uses, intended and unintended, instrumental and non-instrumental (Burrell, 2008). While the definition of non-instrumental use is continually shifting, our research follows an understanding of non-instrumental technology use as activities that do not directly result in the production of artifacts for formal (e.g., academic or professional) use. Within this framework, non-instrumental use encompasses gaming, social networking, and other activities that use ICTs in ways not tied to economic and other development models. It is important to note that non-instrumental use is not tied exclusively or even predominantly to specific kinds of software or computer applications. Rather, non-instrumental refers to a user's articulated purpose in engaging with the technology. The Brazilian LAN houses are an important site of negotiation among these instrumental and non-instrumental uses.

Taking Play Seriously

There is a robust and active community of researchers studying the productive uses of computer games. Journals, conferences, and an entire research community acknowledge the value of non-instrumental use of computers. Part of this research community excludes commercial, off-the-shelf games and concentrates on learning games, but other researchers focus on skills like collaboration and cooperation that people gain through playing games (Chen, 2005; Squire, 2010). It is important to note, this research has existed largely independent of the digital divide and access literature. This means that a parallel conversation about the value of non-instrumental technology uses has not been able to be leveraged by the communities studying the importance of ICT public access.

Ito et al. (2009) describe gaming as a domain of interest-driven learning that has low barriers to initial entry; the authors describe a path that starts with casual social gaming, then leads to exploration and knowledge seeking, and can eventually result in more intensive forms of knowledge exchange and production. Ito et al. claim that gaming can become an entry point for a wider range of technical and interest-driven practices and literacies, such as hardware hacking, video production, design, and coding (ibid.).

Kolko and Putnam (2009) found that games constitute a significant portion of the ICT ecology in resource-constrained environments. In longitudinal work in Central Asia, they used ethnographic work to show the breadth of gaming activity, along with survey data to demonstrate that games provide an alternate pathway for users to become introduced to ICTs. They demonstrate that users with higher levels of education and English language ability are typically introduced to computers through internet use, but people with lower levels of education and less English ability can still become ICT literate through engagement with computer games. Their work suggests, therefore, that gaming makes ICTs accessible to a wider segment of the population. The authors make the claim that playful uses are an important pathway to people's "first touch" of a computer.

Johnson, King, and Hayes (2008) report from the Tech Savvy Girls project, a program that explores the use of commercial, off-the-shelf video games to help girls to develop IT fluency. They observe how participants, through informal "tinkering" activities, develop life-long meta-skills, or skills that extend beyond the limits of traditional schools' definitions of mastery of software packages.

Other studies on children's computer use in public spaces confirm the importance of the social factor; Sandvig found that computers in libraries are used to play and to communicate with others (Sandvig, 2001). He describes how novice users often stood by and observed more skilled users, adopting successful internet search strategies and noting interesting URLs. Additionally, his research shows how multiple children often used one computer at the same time, sharing the keyboard and mouse, which required discussion and goal setting.

Overall, then, research on gaming and learning demonstrates, across multiple domains, that non-instrumental ICT use can lead to informal education and more in-depth engagement with technology. We can better support this transfer of knowledge from non-instrumental to instrumental use with further research on both how this transfer occurs, and how individuals' level of digital or information literacy is changing. As our world becomes more and more technology-based, we will be forced to encounter and learn to use varying technology on a daily basis. Thus, limiting ICT use to instrumental purposes also limits individual understanding of what is possible with technology, thereby potentially limiting technological interaction and skill-use in varying scenarios due to lack of self-efficacy (Bawden, 2001; Kennewell & Morgan, 2006; Willett, 2002).

PUBLIC ACCESS ICT CONTEXT FOR THIS STUDY

Part of the reason we conducted this study in Brazil is because concurrent political and economic shifts have increased the prevalence of public access venues and encouraged public use of computers. Brazil also has an interesting two-track model of access: publicly funded venues and privately funded LAN houses. Brazil's government has been successful in making ICTs available to a broad population. For example, in recent years a federal program called "computers for all" offered credit lines to low-income Brazilian citizens to purchase computers (Schoonmaker, 2009). This helped to bring household computer ownership to 54% in 2009 (Barbosa, 2009). Additionally, the Brazilian government established the Association of Telecentre Networks (ATN) in 2006 to help raise the profile of telecenters as public spaces that provide services and skills for community development.

In addition to these efforts to provide access to ICTs through public funding, in 2004, the Brazilian government inadvertently assisted in the establishment of a large number of privately-owned LAN houses. This was a partial side-effect of the previously mentioned "computers for all" program. Several people took advantage of the program to obtain multiple computers, placing them in a single location to be used predominately for gaming (Lemos & Martini, 2010).

Dubbed the "LAN House Revolution" by Brazilian journalist Paula Góes (Góes, 2009) these LAN houses became a key factor in the growth of ICT access in Brazil. As Góes writes:

> [A]cross the country, the majority of Brazilians accessing the internet today do so through Local Area Networks (LAN) [houses]. These have become a phenomenon especially in poorer and smaller communities, where computers and broadband connection are beyond the reach of the population. (ibid, p. 1)

These LAN houses are responsible for 64% of the internet access in lower-income communities (Barbosa, 2009), which makes them a tremendously important piece of the access picture.

In Brazil, LAN houses provide access, but they do not dictate what people do with that access. As a result, there is a significant amount of game playing and social networking software use in the LAN houses, which is at odds with the goals of the well-meaning development efforts stretching back to the early digital divide initiatives.

According to the Brazilian Association of Digital Inclusion Centers, about 85% of LAN houses are unlicensed (Brazilian Association of Digital Inclusion Centers, n.d.). Also, they are under close scrutiny from lawmakers and the court of public opinion because of the heavy usage of games and social networking in these venues. According to Góes, the main activity for 42% of the users is playing video games, although patrons of LAN houses are expanding into other uses, like cultural activities, access to websites, and social networking. Passos (2010) confirms that what was previously an exclusive gaming space is now being used for communication activities, paper printing, job searching, and other activities, even though gaming still accounts for the majority of access in LAN houses.

Between Public Policy and Legislation: A Look at Telecenters and LAN Houses in Brazil

In the current Brazilian scenario, there are tensions between those who see LAN houses as a multi-functioning location for educational and cultural activities, and those who have negative conceptions of the spaces. The Brazilian law 4.782/06 (repealed in 2011), which prohibited the installation of internet cafes within 1 km of schools and education centers, represents the second point of view. This ban identified LAN houses as a negative element in relation to the goals of teaching and education.

According to an analysis by Brazilian lawyers who investigate issues relating to new technologies and contemporary society, there is a gap between justice and society in the legislative framework that affects LAN houses. As one legal scholar writes:

> There are some measures somewhat disproportionate that are in the judiciary system, which I think should lead the judiciary to update itself in technology matters. It is natural that mismatches always exist, and society needs to be all the time pressuring so that such mismatch do not create a wide gap (prohibition and banning of LAN houses, fines, etc.) because ultimately it prevents children and teenagers from accessing technology. They do not learn to use the

> computer and will have to enter the job market in 10, 15 years without knowing how to use such resources because there is a judge wanting to protect them from the technology world. (Passos 2011, p. 134)

In response to arguments like this one, Rio de Janeiro's state secretary of culture recently prepared a series of proposals to encourage LAN houses, framing them as a space for collective production, and not only as just an internet access point. In April 2011, the Brazilian House of Representatives voted in favor of a law that would allow LAN houses to become centers for digital inclusion. This law, which has yet to be voted on by the Brazilian Senate, would allow LAN house owners to access credit lines for the purchase of equipment and to become "multi-purpose-providers" by providing media production, electronic arts, training with emphasis on free software, and game clubs. As Brazil is still a location where access is held by those with higher socioeconomic status, those with lesser status who desire to achieve access will be given more opportunities through this aid (Gomez, 2009). Whether or not this law is passed, the continued negotiation at the governmental policy level reflects the continued negotiation of public access venues as both instrumental and non-instrumental spaces.

METHODOLOGY

This study had both qualitative and quantitative components. The qualitative work formed the basis for the quantitative elements and informed the creation of study instruments and the data collection procedure.

Qualitative Methodology

Our qualitative findings and results come from three data sets:

1) Ethnographic observations during a field visit to the Brazilian states of Rio de Janeiro and Rio Grande do Sul in September 2010,
2) Semi-structured interviews conducted in Rio de Janeiro state in March and April 2011, and
3) Ethnographic investigation of two LAN houses in the favelas of Rio de Janeiro since 2009.

The interview scripts were designed by a team at the University of Washington. Instruments were tested in Brazil in September 2010 and revised based on results of the field trial. Local researchers conducted the interviews.

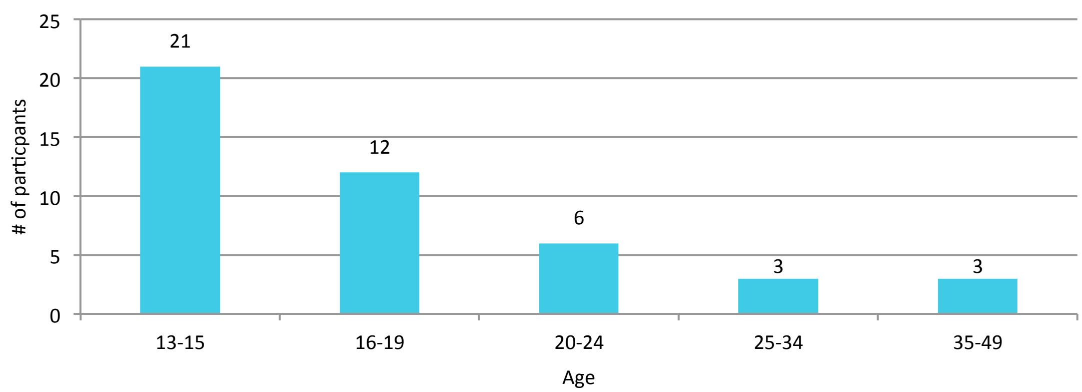
The interviews were conducted in locations selected because they were public internet access venues known to have a higher level of non-instrumental usage, such as LAN houses. These selections were made based on interviewers' knowledge of the area gained through the Global Impact Study's previously conducted large-scale social survey of internet access venues and users in those venues. A total of 30 respondents were interviewed in urban areas and 15 respondents in more rural areas of Rio de Janeiro state. The sample included one telecenter and nine LAN houses. The public access venues were located in both neighborhoods with low social indicators, including the district with the lowest human development index in the city of Rio de Janeiro, and neighborhoods considered middle-class and upper middle-class.

The semi-structured interviews with 45 public access venue patrons ranged from 20–50 minutes. The participants were recruited through convenience sampling in the public access locations described above. The interviews were conducted in Portuguese. Participants were included if they indicated being a user of public access venues, were at least 13 years old, and lived in the state of Rio de Janeiro.

The interviews focused on how people were first exposed to technology in general, how and where they have continued to use it, and the role it plays in their lives. Participants were also asked if they had completed formal computer training and how they had acquired technology skills. The interview included both open-ended and close-ended questions.

The interview sample was drawn from users of public access sites, with 39 male and six female respondents. Figure 1 shows the age distribution of the participants. Thirty-two interviewees were students; 12 had entered the work force, either part-time or full-time.

Figure 1: Age distribution of interview participants



Note: n=45

The responses to the interviews were first translated from Portuguese to English, then back-translated to check accuracy. The research team approached the analysis from a grounded theory perspective to "derive our analytic categories directly from the data, not from preconceived concepts or hypotheses" (Charmaz, 1995, p. 32). The researchers discussed specific experiences that respondents reported and then "developed progressively more abstract conceptual categories to identify patterned relationship with in the data" (ibid.). Data was initially coded by the research team using printouts of transcripts in order to derive initial categories for analysis. Then, responses to the open-ended questions were uploaded to the web-based qualitative data analysis application Saturate. Multiple researchers coded each interview transcript. The close-ended parts of the interviews were analyzed in Excel by members of the research team to create descriptive overviews of some of the data. In addition, questions created to gauge respondents' socioeconomic status were aggregated into an SES score to provide a big picture of the sample.

The longitudinal ethnographic investigation followed LAN houses in two favelas in Rio starting in 2009, and it still continues today. In addition to mapping and analyzing the daily lives of these LAN houses, that work also intervenes in such spaces by offering workshops and participating in activities in an action-research based approach. Data is collected in the form of recorded activities or filmed materials.

Quantitative Methodology

For the quantitative component, a series of computer-based exercises (CBEs) were created to accompany a brief interview script that mirrored many of the questions in the qualitative script (see

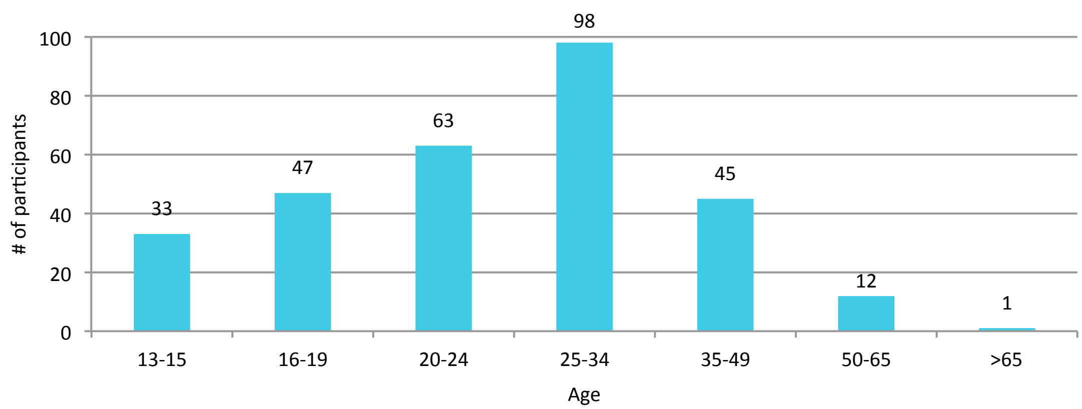
Appendix B). In particular, questions designed to establish how both instrumental and non-instrumental users are categorized were included in both scripts.

The CBEs borrowed from usability testing methods in order to measure the levels of difficulty a respondent had in completing a task, and also to catalog the most common errors. In addition, the CBE included a section where respondents self-reported their skill levels and their knowledge of less common ICT terms.

Participants were asked to identify what activities they did on a computer, as well as whether they did it for instrumental purposes (for school or for work), or for non-instrumental purposes (for fun or personal use). These activities were selected based on a digital literacy study conducted as part of the Programme for International Student Assessment (PISA), an effort run by the Organization for Economic Co-operation and Development (OECD, 2011). That study identified five high-level ICT activities on which we based several of the CBEs. The study also identified several leisure activities that people did on computers.

In the same general locations of the qualitative study (Rio de Janiero and Porto Allegre), 303 respondents at 17 public access venues were administered the CBEs. Also like the qualitative study, participants were recruited and evaluated at public access venues known to have a high level of non-instrumental usage, such as LAN houses. Each interview and test took about one hour, and respondents were free to end the study at any time.

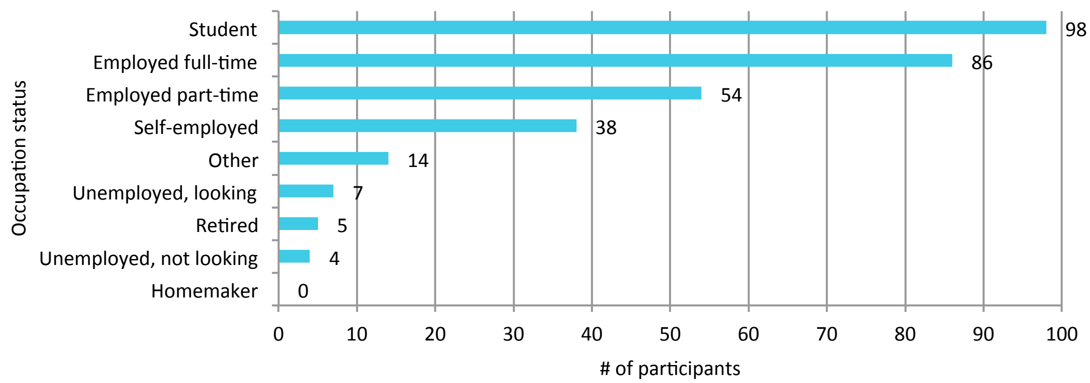
Figure 2: Age distribution of computer-based exercise participants



Note: n=299

The age distribution of the CBE respondents is less skewed to young people than the interview respondents; this is largely because the interview respondents were recruited at places where our local researchers knew there were a large number of gamers. The majority of respondents in the qualitative study were students, compared to those in the quantitative study (see Figure 3).

Figure 3: Occupation status for CBE participants



Note: Participants could select more than one; n=303

RESULTS

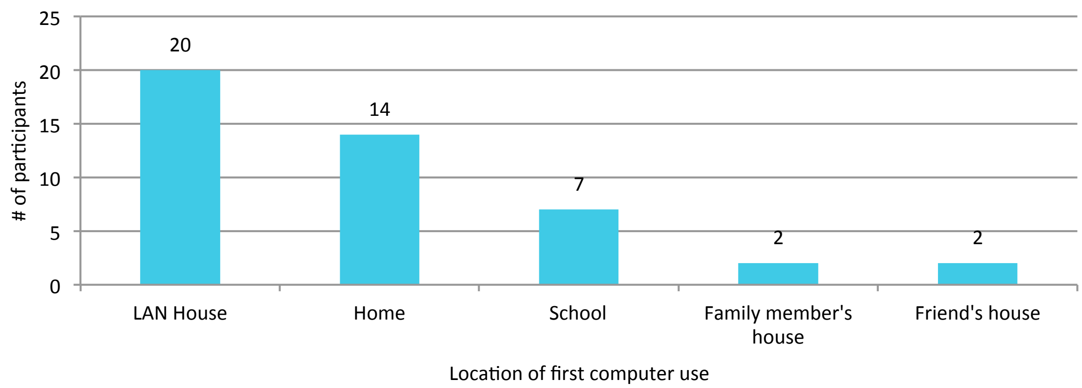
The first section of the results describes findings from the interview study. This study looked to collect qualitative responses to understand how public access venue users are motivated to use and learn about technology. The second section of the results describes findings from the computer-based exercise study in which we evaluated how users at public access venues performed different activities on the computer.

Results from the Interview Study

Family, Friends, and Fun Entice Participants into First Using Computers

There is strong evidence for the role of community in introducing participants to technology. Most of our participants, including those who had received some formal instruction, reported friends and family as the vector through which they were first exposed to technology. Nearly 60% of respondents reported that close family members like cousins, parents, or siblings introduced them to the computer. “When I was 7,” explained one teenage participant, “I got my first computer. My godmother gave me a game.” Another girl claimed, “I wanted to learn how you got on that thing, on the computer, but I didn’t understand what it was. Then my cousins showed me.” Still others benefited by proxy from the education of family. As one respondent said, “My sister, who was taking a class, [taught me] to get on, connect the computer and access internet pages that I didn’t know.” What is notable about these results is that even among our youngest participants, most of whom had the opportunity to have computer training at school, close family members, though not exclusively parents, were the means by which they were introduced to technology.

Figure 4: LAN houses are important locations of computer first-use. Responses indicate where participants first used computers



Note: n=45

Regardless of who introduced our participants to technology, the majority of them were initially drawn to computers for fun. More than 20% of respondents started using computers to play games, and approximately 35% used them for social networking sites such as blogs, Twitter, Orkut, or email. When asked why he first started using computers, one respondent answered, "I thought it was cool. My brother would come a lot to the LAN house, and then I started to play CounterStrike [a first-person shooting game] and I got interested." Another confirmed, "It was with games, on the day when they opened the LAN house 3 years ago." Even older participants who came of age prior to the boom of online gaming indicated that it was the appeal of gaming that first attracted them to technology. One respondent, age 35, gestured around the LAN house where he was being interviewed and, referring to the number of gamers around him, explained, "I'm of a certain age . . . at that time there was nothing like this, it was Atari."

Social networking plays an even more prominent role in attracting Brazilians to technology. One 15-year-old male said, "The first day I went in [to the LAN house] and my brother created an Orkut account for me. I didn't know how to get on." Likewise, a 20-year-old participant explained, "A friend of mine called me to go to the LAN house, there wasn't even Orkut, it was still Yahoo. So I started, from then I would go. I did Orkut, MSN, Facebook, Myspace, Twitter." For younger users, social networking is attractive not only because it's engaging, but also because it holds a "coolness" factor: "My friends told me about cool stuff to access . . . YouTube, Orkut." Notably, there was a significant difference across gender lines in terms of the appeal of social networking software: Four of the six (67%) female interviewees indicated that they use social network sites, while only 55% of males indicated that they use social networking.

Age is also a significant factor in how Brazilians adopt technology. While the majority of our participants were teenagers, more than one-third were between the ages of 20–50. For these older participants, their first brush with technology was a novel experience. One 19-year-old respondent reported, "I remember that at the beginning, people would have to leave [my home town] and go to the LAN house [in a nearby city] to access the internet, because there wasn't one here. Funnily it was almost an event; people would get a van for everyone to go to . . . the LAN house."

Unlike their older counterparts, younger Brazilians' initial exposure to technology was more incidental. One participant reported learning by watching her aunt use the internet. Another teenager first experienced getting online at a friend's house, and yet another learned at a telecenter when he followed his friends there to play games. Younger participants also equate computers with the internet; computers are primarily a medium to access online games, do research, and use social networking sites.

Social Relationships Motivate Continued Computer Use

No matter their age or level of exposure, our participants were inspired to adopt technology by the potential it held to enhance their academic, social, and professional lives. Ten percent of participants were first encouraged to use technology for school—teachers and course instructors taught them to complete schoolwork and perform research using Yahoo and MSN. Several respondents noted that they started going to the LAN house to "research about studying, things about school." Another participant explained, "I needed to get online because of the university—to search the library, make presentations, and use email." Others learned to find jobs online. These instrumental users held a wider view of technology: "We need to [access the internet] in the globalized world, in order to do everything in life," explained one college student. "Technology is entering more and more into life, at least for someone who lives in the city."

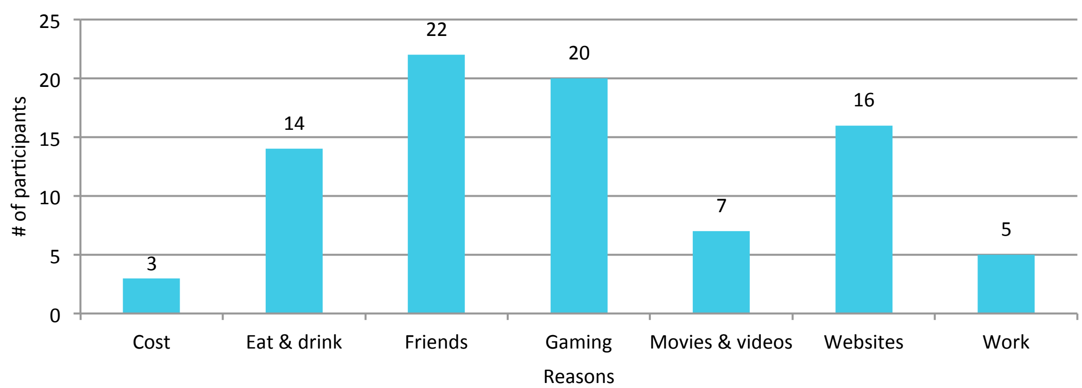
Yet many more remain engaged with technology for social reasons; it is online and in LAN houses where many Brazilians meet and play with their friends and family. Currently, more than 46% of respondents play games, and 55% use computers to access social networking sites and email. Still others are keen to learn about the world—several participants indicated that they wanted to research contests online, and that "MSN . . . taught [them] everything." Friends and relatives regularly introduced participants to technology by helping them to open Orkut or webmail accounts, showing them how to play games, and teaching them to surf online, thus expanding their social networks and incorporating them into a community of technology users.

Finally, our participants continue to engage with technology because of the sense of connection and belonging it provides them. In response to a question about how their relationships with others would be affected if they suddenly had no access to computers, fewer than 30% of respondents indicated that this would have no impact on their lives. Ten participants referred to the importance of their online friends, with one commenting, "Everyone gets worried [that they may suddenly have no access to the internet]. Online, you make a friendship that can last the rest of your life." Another male interviewee explained, "Sometimes your virtual friend is more of a friend than your real one." Many others indicated a need to have contact with friends and family in remote areas of the country. One respondent reported that, "without internet, the world would end! I have many friends and many contacts in every corner of Brazil." One of the teenage participants said that, without the internet, "I would not exist. I am about to start working and the internet and the cell phone are indispensable." One participant went as far as to claim that not having access would cut off his contact with the world entirely: "It would be bad, it would be very boring, I would stop talking with other people." These comments, given primarily by younger LAN house users, provide some insight into the value and importance of the internet in their lives.

Users Go to LAN Houses for Social, Rather than Technical Reasons

Although the city of Rio de Janeiro has seen a dramatic increase in at-home internet access, the city's LAN houses continue to be heavily frequented. Initially, we hypothesized that Brazilians might be drawn to a LAN house by the presence of advanced technologies, including more powerful computers and enhanced access. However, when asked directly about this issue, less than half of our participants indicated that technology was better in public places. Of our respondents, 65% reported having computers at home, and just over 50% reported also having internet access at home. In many cases, these individuals use the public internet for social reasons, or because it offers faster access to the internet. "It's closer and cheaper, because sometimes my computer is slow," claimed one participant. "[The LAN house] is a good place for meeting other people," explained another. As Figure 5 illustrates, most respondents don't think the technology in the LAN house is necessarily better than what they could access elsewhere, including at home. And yet, they choose to spend their time and money at the commercial access point.

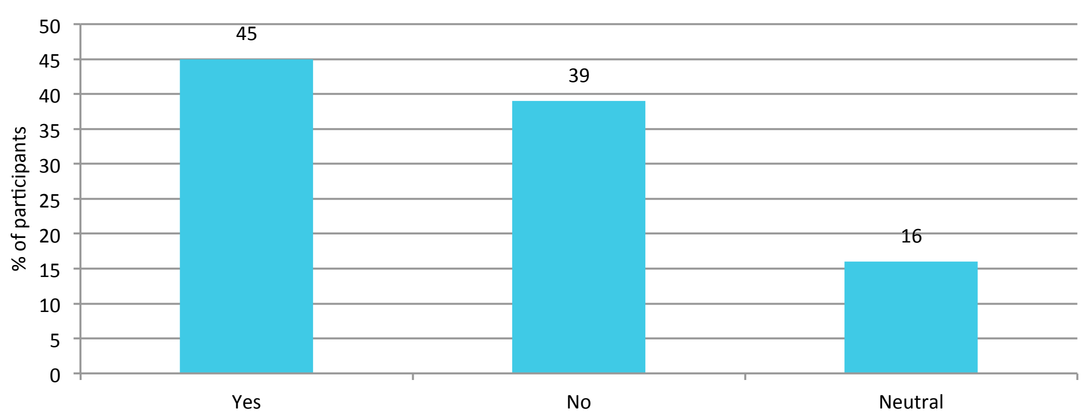
Figure 5: Reasons for being at the public access venue



Note: n=45

We also suspected that participants might be deterred from using LAN houses because of privacy issues. When asked if privacy mattered, some respondents were very emphatic that privacy was important. One woman complained, "There is always someone watching what you're doing, what you're on, it's uncomfortable." In addition, some participants felt self-conscious about how their technology use might be perceived: "In public you lose privacy because of the people that are around you. And in private spaces you don't have any unwelcome people and no one criticizes you about how you should type."

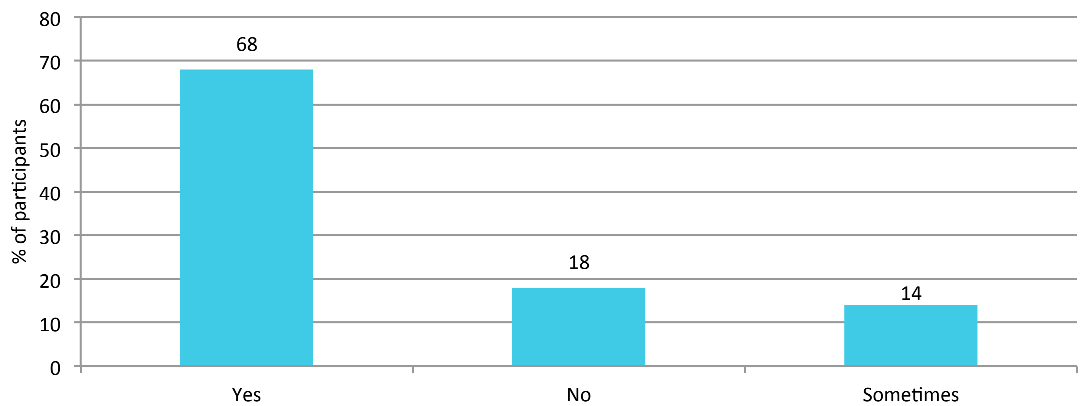
Figure 6: Respondents were split when asked whether using technology in public is better than at home



Note: n=45

However, Figure 7 also shows that some people are ambivalent about privacy and even describe it negatively. One youth disliked the isolation that came with privacy, claiming that privacy matters because, "In the LAN house, sitting next to each other, it's important for you not to feel alone." Some saw privacy as indicative of antisocial behavior: "Because everything I play in the LAN house, I'm not hiding anything from others; I'm not doing anything wrong." Likewise, a number of participants indicated that privacy was a barrier to self-expression. When discussing whether they preferred to use computers at home or in the LAN house, one explained, "I want to express myself and here I can." Another youth said, "At home, I am alone, and I don't feel the way I do here. Here I act crazy."

Figure 7: Responses to the question: Does privacy matter?



Note: n=45

The demand for LAN houses in nearly every neighborhood indicates the changing role of technology in the social lives of Brazilians; it appears that technology has become a reason to meet, play games, see old friends, and make new ones. When asked their reasons for being at the LAN house, the interviewees responded with a number of choices, but the vast majority referred to the importance of friends. "I would go to there every day . . . those were my first friends."

Respondents in the sample also indicated that the LAN house was their escape from boredom at home. One teenage male respondent said, "I stay here as long as I want, there is nothing to do at home, nothing in the street." Similarly, another participant said that she came to the LAN house "because I don't like to be at home." Ten references in the data refer to the importance of the LAN house as a venue to play games with friends. Another teenager explained, "It's different, because when you at home, you have to be typing to talk to people and that slows the game down. Now, like this it's better because you can talk, play, tease your friends."

The ethnographic observations conducted by our research team during the 2010 field visit confirmed the social aspect of the LAN house. In various LAN houses, people came and talked to others, often simply observing what friends were doing, but not accessing the computers themselves. In one LAN house, a group of children played on locked computers, joking and trying to open a page on a locked computer. Often, the LAN house owners knew customers by name, and one owner reported that parents would communicate with him about when their children should leave to go home or do schoolwork.

Limitations and Challenges of the Study

Not all members of our team had knowledge of Portuguese. As such, it was necessary to undergo several translations during this study, first to convert our interview script to Portuguese for use by our local research partners, and then to have the responses translated back into English for analysis. While great care was taken to ensure with as much confidence as was possible that translations were accurate, the possibility of translation errors cannot be overlooked. In some instances, responses to questions or notes made by the interviewers regarding each participant indicated that participants may have misunderstood the questions.

In some cases, interviewers were unable to help a participant understand the meaning of a translated question in Portuguese, and were forced to move on without obtaining a response to certain questions. This has left us with gaps in some narratives about ICT use, an effect which has impacted our ability to analyze some participants' growth in their use of ICTs for instrumental and non-instrumental use.

While our interview script was designed to elicit a complete narrative from participants about their personal history of technology in general, in addition to computer and internet use, we found that, in reality, many participants (especially younger participants) did not distinguish between the internet and computers as distinct experiences, leading to some contradictory explanations of participants' first exposures to each ICT area.

Finally, defining what types of activities constitute instrumental or non-instrumental use was more challenging than it would appear. While it would seem as simple as defining entertainment-type tasks like games or social networking as non-instrumental, and activities such as word processing or email as instrumental, we realized that all of these activities could actually be undertaken in ways that would fit them in either category.

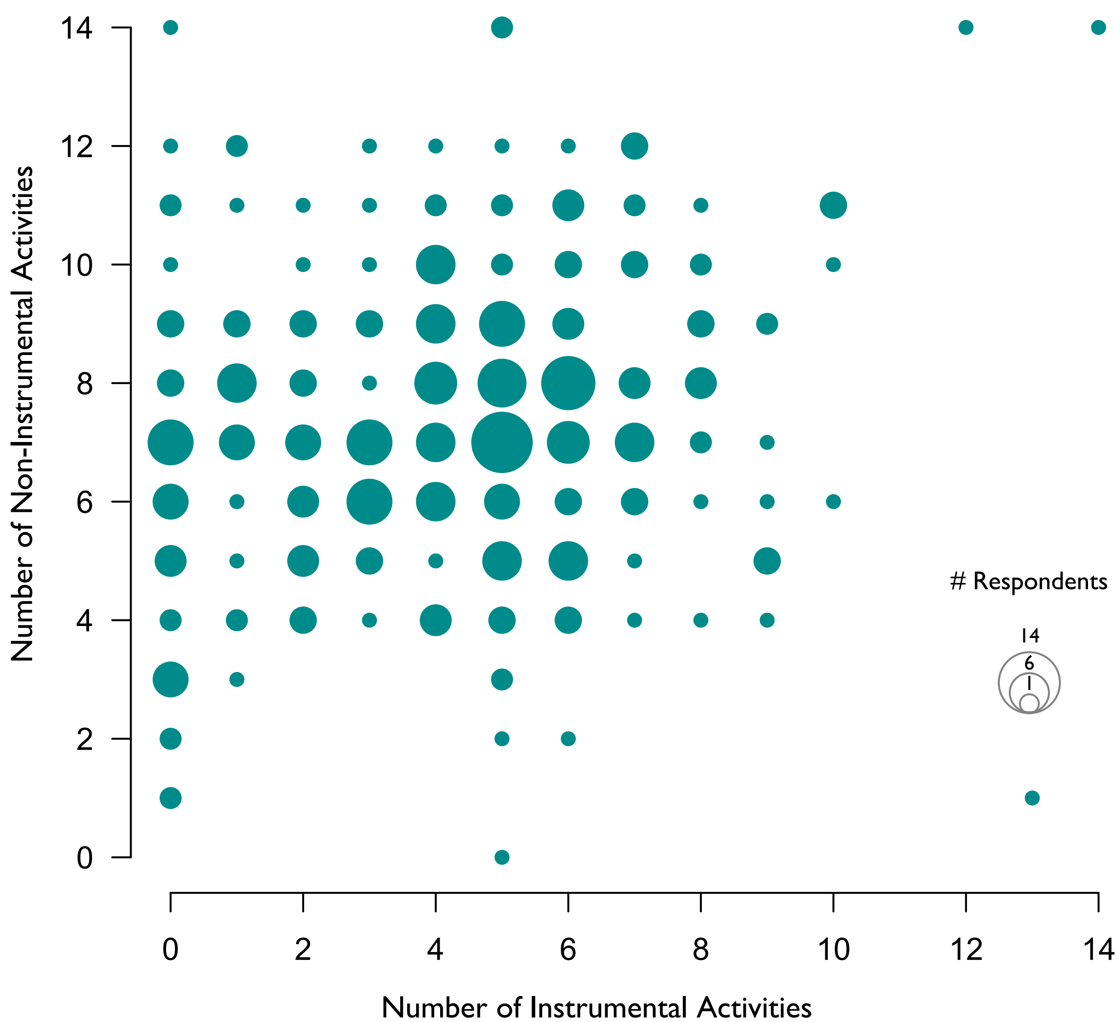
Results from the Computer-Based Exercises (CBEs)

Our goal with the CBE study was to provide empirical evidence regarding whether people who spend more time playing games and doing social networking have better or worse computer skills than those who do largely productivity-related tasks when they spend time on a computer.

Our first challenge was in determining how to categorize respondents in order to measure their performance. It was clear that easy distinctions were impossible. Most people who use email use it for both instrumental (messages related to work or school) and non-instrumental (communicating with friends or family) purposes. Similarly, people who do web searching will often do it for tasks related to their work or school, as well as for personal interests. Our solution to the categorization challenge was to create a question within the instrument that would ask respondents to essentially provide a profile of their own use in terms of the relative weight of instrumental versus non-instrumental usage. The tool we created is imperfect; it asks about whether they do certain activities, not how much time they spend doing them. However, we believe there is integrity to this categorization scheme, because it is based on the lived experiences of our respondents. See Appendix A for the questions we used to create the categories.

In Figure 8, you see the scatterplot we created based on people's responses. The x-axis represents instrumental activities (e.g., using email for work or school), and the y-axis represents non-instrumental activities (e.g., emailing friends or family). We performed a count on the number of instrumental and non-instrumental activities in which each person engaged and plotted them on the graph. The size of each circle represents the relative number of respondents at that point on the graph; i.e., the larger the circle, the more respondents.

Figure 8: Participants range widely in the types of activities they do. Scatterplot of instrumental versus non-instrumental use



Note: n=303

To gauge the distribution of our instrumental and non-instrumental counts, we calculated both the mean and median counts of activities. For the count of non-instrumental activities, the mean was 7.3 and the median was 7.0. For instrumental activities, the mean was 4.4 and the median was 5.0. The split points for both the mean and median had no functional difference in our later statistical calculations, and we proceeded to use the mean.

Activities Have Different Degrees of Instrumentality

We also used the counts for each activity to construct an instrumentality index. We calculated this by taking the ratio of the number of respondents who do an activity for work or school to the number of respondents who do an activity for personal use or fun. Scores greater than 1 indicate activities that were done more for instrumental purposes than non-instrumental purposes. Scores less than 1 indicate activities that were done more for non-instrumental purposes than instrumental purposes. Finally, scores equal to 1 indicate activities that, for those who did them, satisfied instrumental reasons as often as non-instrumental reasons. Table 1 shows the index.

Table 1: Overview of instrumental and non-instrumental uses for activities

		Of those who do the activity:		
	# Who do activity	**# (%) for Instrumental reasons**	**# (%) for Non-Instrumental reasons**	**Instrumentality Index**
Create computer presentations	207	192 *(93%)*	46 *(22%)*	4.17
Create or use spreadsheets	189	171 *(90%)*	58 *(31%)*	2.94
Create documents with a word processor	229	198 *(86%)*	104 *(45%)*	1.90
Search for information online	291	219 *(75%)*	245 *(84%)*	0.89
Create content for the web, such as a blog, wiki, or website	80	41 *(51%)*	55 *(69%)*	0.75
Use email	293	194 *(66%)*	268 *(91%)*	0.72
Create multimedia files	116	52 *(45%)*	81 *(70%)*	0.64
Participate in online discussions	117	45 *(38%)*	93 *(79%)*	0.48
Chat online	203	64 *(32%)*	193 *(95%)*	0.33
Watch videos online	268	65 *(24%)*	259 *(97%)*	0.25
Buy merchandise online	148	26 *(18%)*	142 *(96%)*	0.18
Use social network sites	269	32 *(12%)*	259 *(96%)*	0.12
Listen to music on the computer	264	25 *(9%)*	260 *(98%)*	0.10
Play computer games	165	10 *(6%)*	161 *(98%)*	0.06

Note: Notice that each activity had respondents who did them for instrumental reasons

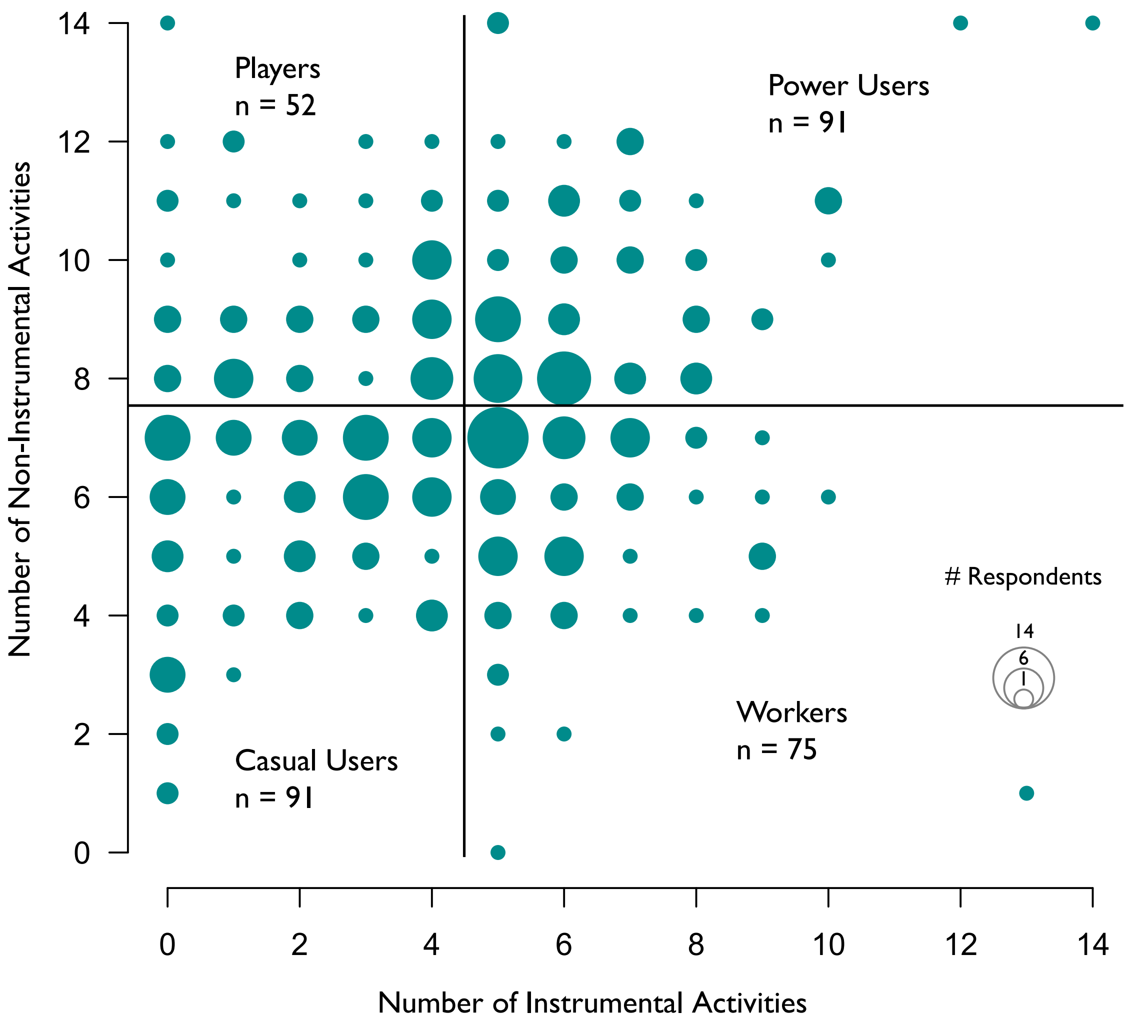
Activities such as creating computer presentations, using spreadsheets, and creating documents ranked as being primarily used for instrumental purposes. This validated our choice that using spreadsheets and doing word processing activities would be central to the computer-based exercises because of their primarily instrumental nature.

It's worth noting that none of the activities were either strictly instrumental or non-instrumental. Even activities that ranked low on the instrumentality index, such as playing computer games, still had some respondents saying that they performed those activities for work or school purposes.

Segmenting Participants Based on Instrumental and Non-Instrumental Activities

In Figure 9, you see our labeled scatterplot with the four categories of users we derived from the data: 1) *casual users,* 2) *players,* 3) *workers,* and 4) *power users*. *Casual users* were those who simply didn't do many activities on the computer; they were below the mean for both instrumental and non-instrumental activities. *Players* were respondents who reported above the mean level of non-instrumental use and below the mean for instrumental use. *Workers* were respondents who reversed that pattern and reported above the mean for instrumental use and below the mean for non-instrumental use. *Power users* were those who reported above the mean levels of both non-instrumental and instrumental use; we classified them as people who engaged with computers often, and we predicted that they would have the best performance measures on the skills test.

Figure 9: Respondent categories for calculating relative skill levels.



Note: n=309

We further broke these groups down by several demographics, including age, education, and gender, shown in Table 2.

Table 2: Demographic breakdown for each user group

	User Groups				
	Casual users	**Players**	**Workers**	**Power users**	**Total**
Gender	**n = 87**	**n = 52**	**n = 75**	**n = 85**	**N = 299**
Male	55 (*63%*)	38 (*73%*)	42 (*56%*)	52 (*61%*)	187 (*63%*)
Female	32 (*37%*)	14 (*27%*)	33 (*44%*)	33 (*39%*)	112 (*38%*)
Age	**n = 87**	**n = 52**	**n = 75**	**n = 85**	**N = 299**
13–15	17 (*20%*)	7 (*14%*)	5 (*7%*)	4 (*5%*)	33 (*11%*)
16–19	17 (*20%*)	9 (*17%*)	4 (*5%*)	17 (*20%*)	47 (*16%*)
20–24	17 (*20%*)	15 (*29%*)	17 (*23%*)	14 (*17%*)	63 (*21%*)
25–34	14 (*16%*)	18 (*35%*)	28 (*37%*)	38 (*45%*)	98 (*33%*)
35–49	14 (*16%*)	3 (*6%*)	18 (*24%*)	10 (*12%*)	45 (*15%*)
50–65	7 (*8%*)	- (*0%*)	3 (*4%*)	2 (*2%*)	12 (*4%*)
> 65	1 (*1%*)	- (*0%*)	- (*0%*)	- (*0%*)	1 (*0%*)
Education level	**n = 83**	**n = 52**	**n = 75**	**n = 85**	**N = 295**
No formal schooling	4 (*5%*)	- (*0%*)	1 (*1%*)	- (*0%*)	5 (*2%*)
Grade school	30 (*36%*)	10 (*19%*)	4 (*5%*)	8 (*9%*)	52 (*18%*)
High school	32 (*39%*)	30 (*58%*)	28 (*37%*)	26 (*31%*)	116 (*39%*)
Vocational or trade school	2 (*2%*)	6 (*12%*)	4 (*5%*)	8 (*8%*)	20 (*7%*)
College/university or higher	14 (*17%*)	6 (*12%*)	38 (*51%*)	44 (*52%*)	102 (*35%*)
Unknown	1 (*1%*)	- (*0%*)	- (*0%*)	- (*0%*)	1 (*0%*)

Age

Table 2 shows the age distribution for each group. A higher proportion of *casual users* and *players* were 24 years or younger (60% for both *casual users* and *players*) than of either the *workers* or *power users* (35% of *workers*, 42% of *power users*). A Pearson chi-square test shows that the differences between each user group are significant ($X^2(18, N = 299) = 46.689, p < .001$).

Education

The largest number of participants had attained a high school education (39%), followed by college or university (35%), grade school (18%), vocational/trade school (7%), and no formal schooling (2%).

One notable difference is between the *players* and *workers* groups. In the *players* group, 57.7% of participants had, at most, attained a high school education, while in the *workers* group, 50.7% of respondents had, at most, attained a college or university education. A Pearson chi-square test shows that the differences between the user groups are significant ($X^2(15, N = 296) = 73.280, p < .001$).

Gender

Of all the participants, 63% were male and 38% were female. A Pearson chi-square test shows that the gender differences between the user groups is not significant ($X^2(3, N = 299) = 3.415, p = .332$). In other words, the user groups are roughly similar in gender composition.

Technology Access at Home

Table 3 shows how prevalent computer and internet access at home were for our participants.

Table 3: Technology access at home by user group

	User groups				Total
	Casual users	**Players**	**Workers**	**Power users**	
	n = 90	**n = 52**	**n = 75**	**n = 85**	**N = 302**
Computer at home	60 (*67%*)	46 (*89%*)	69 (*92%*)	82 (*97%*)	257 (*85%*)
Internet at home	37 (*41%*)	41 (*79%*)	58 (*77%*)	75 (*88%*)	211 (*70%*)

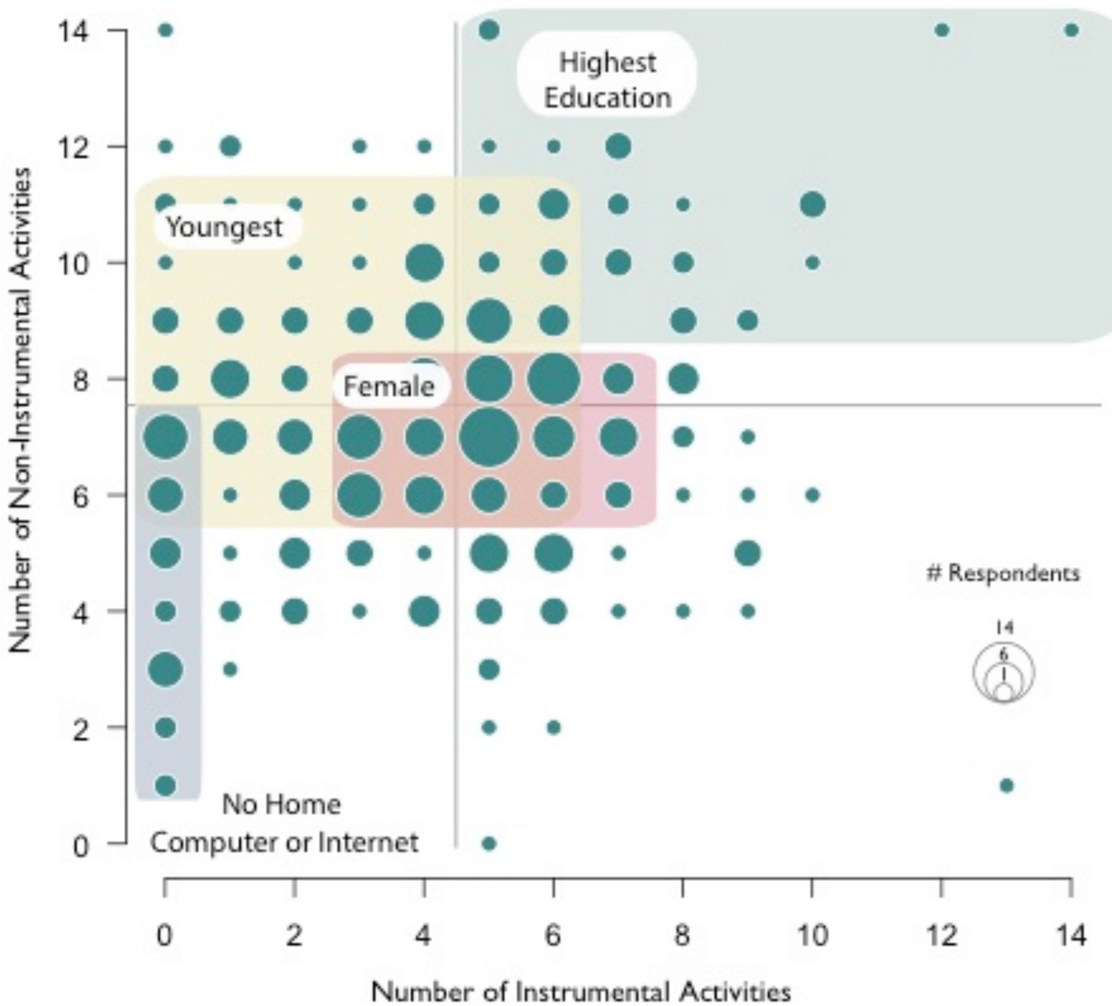
Many participants had access to computers at home, and a smaller number also had internet access at home. Despite having access to both, participants still visited public access venues for some of their activities. *Casual users* had the lowest rates of access at home for both computers and internet, while *power users* had the highest rates for both.

Overall, the demographics of our participants were similar to those of the Global Impact User Survey participants, even though we intently recruited from locations known to have high rates of non-instrumental usage, such as LAN houses.

User Groups Characterized by Different Demographics

Figure 10 summarizes where some key demographics are located in relation to the four user groups. In the *power users* quadrant, we find many of the most highly educated participants (vocational school, university, or higher). Female participants tended toward the middle, straddling across the *casual users* and *workers* groups, indicating that they tend to do fewer non-instrumental activities. The youngest participants (aged 13–19) constituted most of the *players* group, indicating a higher degree of non-instrumental activity and a lower degree of instrumental activity. Finally, the users who lacked home access to the internet or a computer constituted a narrow subset of the *casual user* group who engaged *only* in non-instrumental activity.

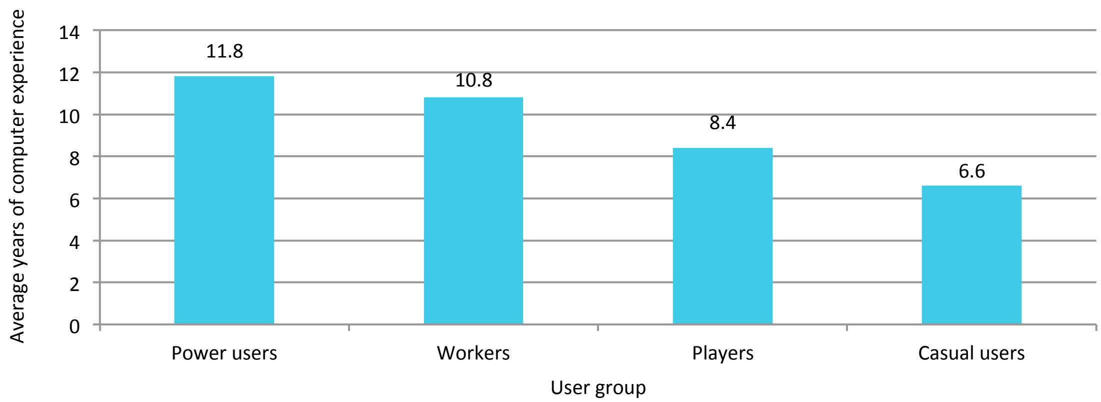
Figure 10: User groups show patterns of demographics.



Years of Computer Experience

Figure 11 shows the average years of computer experience for each group. *Casual users* had less experience (6.6 years) than *players* (8.4 years), *workers* (10.8 years), and *power users* (11.8 years).

Figure 11: Years of computer experience by user group



Note: n=302

Training

Table 4 shows what percentage of all users received formal or informal training for several activities.

Table 4: Training received for activities by all participants

	Formal training	Informal training	No training
Typing	27%	69%	4%
Use email	19%	75%	6%
Chat online	14%	69%	18%
Search for information online	17%	74%	9%
Create content for the web, such as a blog, wiki, or website	19%	35%	47%
Watch videos online	12%	77%	11%
Listen to music on computer	13%	76%	11%
Participate in online discussion	13%	52%	36%
Buy merchandise online	13%	53%	34%
Create documents with a word processor	33%	48%	19%
Create or use spreadsheets	34%	43%	23%
Prepare computer presentations	31%	46%	23%
Create multimedia files (movies, music, etc.)	20%	42%	39%
Play computer games	13%	59%	28%
Use social networks sites like Orkut, Facebook, etc.	12%	75%	14%
Protect computer from viruses, spam, phishing	26%	58%	16%

Note: n=303

Across all activities, informal training from friends and family was the most prevalent type of training that participants had received. A few activities stood out: Participants were more likely to receive formal training in certain skills, such as using a spreadsheet (33%), creating documents (34%), or preparing presentations (31%). They were more likely to be informally trained in other skills, such as watching videos (77%), listening to music (76%), using email (75%), or using social network sites (75%). Email and typing, skills important for a number of instrumental activities, were primarily learned through informal training.

Table 5: Players are the most likely to receive any informal training

	Any formal training	Any informal training	Any self-training
Power users	38.5%	40.0%	74.1%
Workers	48.1%	36.0%	72.0%
Players	26.9%	65.4%	80.1%
Casual users	11.0%	51.6%	70.3%

Table 5 shows what percentage of each group received formal, informal, or self-training for at least one activity. *Workers* (48.1%) were the most likely to receive formal training, followed by *power users* (38.5%), *players* (26.9%), and *casual users* (11.0%). *Players* (65.4%) were the most likely to receive informal training, followed by *casual users* (51.6%), *power users* (40.0%), and *workers* (36.0%). Finally, *players* (80.1%) were the most likely to self-train, followed by *power users* (74.1%), *workers* (72.0%), and *casual users* (70.3%).

Task Performance

We ran contingency table analyses across the 16 different tasks in the CBE. These tasks included opening a file in a word processor, conducting a web search, manipulating a spreadsheet file, and other similar core computer tasks. We did two versions of the comparisons. The first comparison involved the four levels (*casual users*, *players*, *workers*, and *power users*) versus the completion status of the task (completed versus failed). Note that exercises that were marked as "completed" or "completed with effort" were pooled together, as the latter group showed commonly small values that cause irregularities in contingency table analyses. The second comparison looks only at the *workers* and *players* versus the completion status. We chose to look at these two groups because we were interested in seeing how the performance of those with a high count of non-instrumental activities might compare to the performance of those with a high count of instrumental activities.

For the contingency table analyses, the primary tests were either a Pearson chi-squared test (all four user types) or a Fisher exact test (*workers* versus *players*). This gives a standard p-value for analysis. Additionally, a Cramer's V test of association was performed for all tests. This test measures the degree of association between the rows and columns of the tables. Ranging from 0 to 1, this can be interpreted as a measure of correlation. If the *workers* all completed and the *players* all failed, this would be an association of 1, a perfect correlation. The V values also come with a p-value for determining significance.

The contingency analyses also include standardized residuals for each cell in the tables. This value gives an indication of how much the cell's count deviates from the expected value. A residual of 0 (zero) would be no deviance. Negative numbers indicate that the value is smaller than expected, while positive numbers indicate that the value is larger.

Table 6 summarizes the results of this analysis.

Table 6: Significance testing results for each task, all participants

	N	$\chi^2(3)$	*p*	Cramer's V	*p*
Open word processor	290	29.482	0.000	0.319	< .001
Open file in word processor	288	16.886	0.001	0.242	< .01
Copy text in word processor	271	13.325	0.004	0.222	< .01
Cut text in word processor	264	29.113	0.000	0.332	< .001
Change font size in word processor	270	26.946	0.000	0.316	< .001
Run spellchecking in word processor	266	25.69	0.000	0.311	< .001
Save file in word processor	264	28.031	0.000	0.326	< .001
Minimize word processor window	266	16.368	0.001	0.248	< .01
Find picture on the web	273	15.066	0.002	0.235	< .01
Bookmark a web page	213	38.335	0.000	0.424	< .001
Replace a picture in word processor	269	46.52	0.000	0.416	< .001
Send email for picture permission	266	26.625	0.000	0.316	< .001
Find a room entry in spreadsheet	279	13.934	0.003	0.223	< .01
Change format in spreadsheet	223	14.589	0.002	0.256	< .01
Save changes in spreadsheet	273	22.571	0.000	0.288	< .001
Email with an attached flyer	273	50.317	0.000	0.429	< .001

Table 7: Standardized residuals for completion of the open word processor task, by user groups

		Casual users	***Players***	***Workers***	***Power users***
Open word processor	Completed	-1.7	-0.1	0.6	1.1
	Failed	4.0	0.2	-1.5	-2.7

Note: Residuals that have a magnitude greater than 1.65 are significant at the p = .05 level

How Did the Four Groups Perform?

Analyses involving all four of the user groups were all significant, and the measures of association were at least 0.22 and significant, suggesting a low to moderate association of user group with performance. This suggests that how a participant performed is related to which user category they belonged to.

Analyses of the residuals for each group suggest that the significance of these results is driven primarily by two trends. First, the casual users are more likely than other groups to fail at tasks. Second, the power users are more likely than other groups to successfully complete the tasks. This can be seen in the example of Table 7 which shows the standardized residuals for the Open word processor task. The casual users show a large positive residual in regards to failure, while the *Power Users* have a large negative residual for failure. This means that the *Casual User*s showed a stronger than expected tendency to fail the task, while the Power Users showed a stronger than expected tendency to not fail it. Given that these two groups had widely divergent performance results, we decided to remove their influence on the data by repeating the analyses with just the Players and the Workers.

Players Performed Comparably to *Workers*

When looking at just the *players* and *workers*, the two groups were found to perform equivalently on most of the tasks (i.e., no significant result as determined using the Fisher's exact test), as is shown in

Table 8. However, there were significant or trending differences on five of the 16 tasks. The cut text (p = .07), use spell check ($p < .05$), find item on spreadsheet ($p < .05$), change spreadsheet formatting ($p < .10$), and email an attachment ($p < .05$) tasks did show significant or trending differences (trending means $p < .10$).

The standardized residuals of these tasks suggest two patterns, as is shown in Table 8. First, in some cases (e.g., cut text), both the *workers* and *players* have large positive residuals in the failed cells. This means that both groups were less likely to complete such tasks. The second pattern is seen with the find room tasks. In such cases, *players* were more likely to fail to complete the tasks, while *workers* were more likely to succeed.

Table 8: Significance testing results for each task, players vs. workers

	n	Fisher's exact	Cramer's V	*p*
Open word processor	124	0.25	0.11	*n.s.*
Open file in word processor	123	0.55	0.06	*n.s.*
Copy text in word processor	119	0.44	0.09	*n.s.*
Cut text in word processor†	115	0.09	0.17	< .10
Change font size in word processor	118	0.40	0.10	*n.s.*
Run spellchecking in word processor *	117	0.03	0.23	< .05
Save file in word processor	115	0.11	0.16	< .10
Minimize word processor window	114	1.00	0.03	*n.s.*
Find picture on the web	119	1.00	0.02	*n.s.*
Bookmark a web page	92	1.00	0.02	*n.s.*
Replace a picture in word processor	117	0.60	0.05	*n.s.*
Send email for picture permission	116	0.41	0.09	*n.s.*
Find a room entry in spreadsheet *	119	0.03	0.22	< .05
Change format in spreadsheet †	95	0.10	0.18	< .10
Save changes in spreadsheet	116	0.16	0.15	*n.s.*
Email with an attached flyer *	120	0.02	0.22	< .05

Note: For Fisher's exact test, *significant at p < .05; †significant at p < .10

Table 9: Standardized residuals for completion of the tasks, players & workers

		Players	Workers
Cut text in word processor†	Completed	-1	-1.6
	Failed	0.9	1.6
Run spellchecking in word processor *	Completed	-0.9	-1
	Failed	1.6	1.9
Find a room entry in spreadsheet *	Completed	-1.3	-1.3
	Failed	1.3	1.4
Change format in spreadsheet †	Completed	-1.1	-1.4
	Failed	0.6	0.9
Email with an attached flyer *	Completed	-0.8	-0.4
	Failed	1.7	0.6

Note: Residuals that have a magnitude greater than 1.65 are significant at the p = .05 level. For Fisher's exact test: *significant at p < .05; †significant at p < .10

However, it still stands that the *players* and the *workers* showed no significant differences in completion of most of the tasks. This finding that *players* perform similarly to *workers* suggests that engaging in non-instrumental activities can improve a user's performance on instrumental activities. Moreover, the cutoffs for determining non-instrumental and instrumental uses are different, with the cutoff for non-instrumental use being nearly twice as large as the instrumental cutoff (7.3 versus 4.4). This suggests that more non-instrumental experience is needed to equal instrumental experience.

How Do Participants Who *Only* Do Non-Instrumental Activities Compare to Those Who Do Both?

In addition to the four groups initially identified by the data, we decided to look at the performance of participants who reported doing only non-instrumental activities (those sitting along the y-axis). Because they had fewer than four instrumental activities, these participants were originally members of the *casual users* and *players* groups. Those solely non-instrumental users who were part of the *casual users* group were placed into a new group—*low non-instrumental-only*. Those solely non-instrumental users who were part of the *players* group were placed into a new group—*high non-instrumental-only*.

Low Non-Instrumental-Only* Users Perform as Poorly or Worse than *Casual Users

Low non-instrumental-only users (n = 21) were compared to the remaining members of the *casual users* group ($n = 61$) to see if there were any differences in performance. Overall, the two groups performed equally (i.e., there was no significant result as determined using the Fisher's exact test) in most of the tasks, as is shown in Table 10. However, there were six tasks that showed either significant ($p < .05$) or trending ($p < .10$) differences in which the *low non-instrumental-only* group performed worse than the *casual users* group. These tasks were open file in word processor ($p < .01$), minimize word processor window ($p < .10$), and email with an attached flyer ($p < .05$).

These results indicate that the fewer activities one performs on computers, the more limited one's computer skills will be. Since the *low non-instrumental-only* group has some of the most limited engagement with computers, it is not surprising that they perform at an equal or lesser level when compared to the *casual users* group.

Table 10: Significance testing results for each task, casual vs. low instrumental-only users

	n	Fisher's exact	Cramer's V	*p*
Open word processor	82	0.28	0.14	*n.s.*
Open file in word processor *	81	< .01	0.34	< .05
Copy text in word processor	70	0.21	0.18	*n.s.*
Cut text in word processor	69	0.11	0.21	< .10
Change font size in word processor	71	0.78	0.07	*n.s.*
Run spellchecking in word processor	69	0.23	0.17	*n.s.*
Save file in word processor †	70	0.06	0.24	< .05
Minimize word processor window †	70	0.05	0.25	< .05
Find picture on the web	72	0.50	0.07	*n.s.*
Bookmark a web page	58	0.55	0.09	*n.s.*
Replace a picture in word processor	70	0.39	0.12	*n.s.*
Send email for picture permission	71	0.25	0.15	*n.s.*
Find a room entry in spreadsheet	79	0.12	0.19	< .10
Change format in spreadsheet	60	0.67	0.12	*n.s.*
Save changes in spreadsheet	76	0.24	0.16	*n.s.*
Email with an attached flyer *	74	0.02	0.29	< .05

Note: For Fisher's exact test: *significant at $p < .05$; †significant at $p < .10$

High Instrumental-Only Users Perform Comparably to _Workers_

High instrumental-only users ($n = 6$) were compared to the *workers* group ($n = 74$) in order to see if the findings would be similar to the comparison between *players* and workers. Overall, there were no significant ($p < .05$) or trending ($p < .10$) differences between *high instrumental-only* users and *workers* on any of the tasks. This finding differs from the comparison between *players* and *workers,* where significant differences were found for six of the tasks.

This suggests that users who engage *exclusively* in non-instrumental activities at a high level can develop performance skills at least as good as those who have a high level of instrumental engagement. In other words, non-instrumental uses can boost computer skills in a way that it similar to how instrumental uses can. However, these differences may be the result of the relatively small sample size of the *high instrumental-only* group, and the resultant findings should be considered preliminary.

Table 11: Significance testing results for each task, workers vs. high instrumental-only users

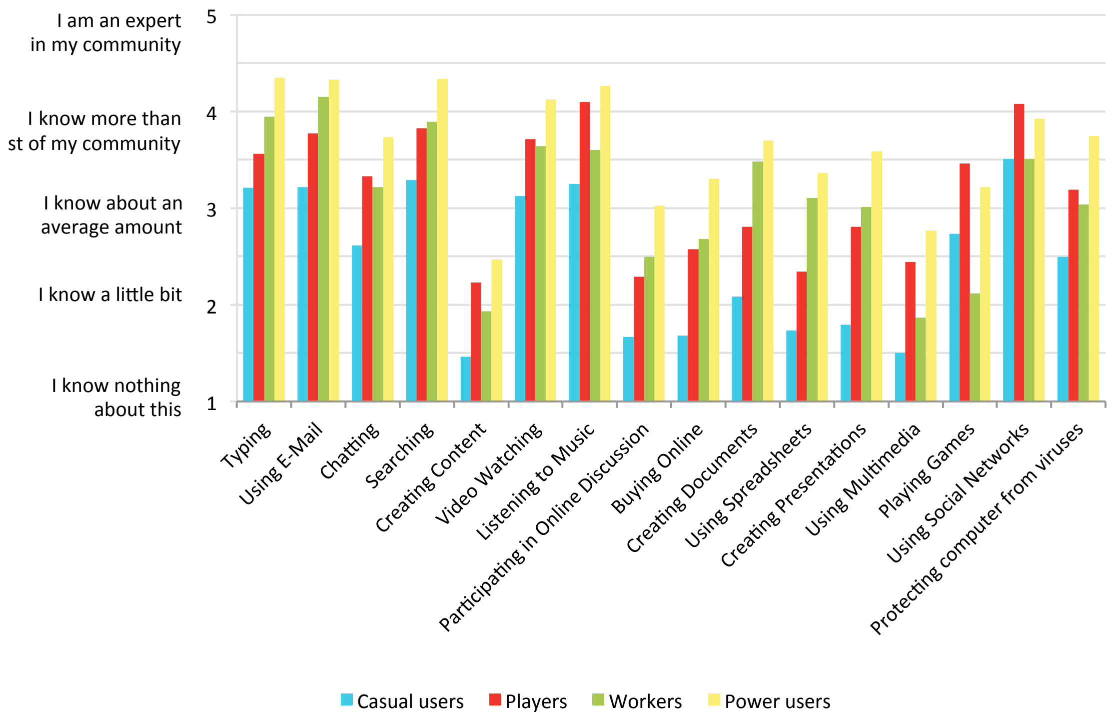
	n	Fisher's exact	Cramer's V	*p*
Open word processor	70	0.43	0.08	*n.s.*
Open file in word processor	79	0.44	0.08	*n.s.*
Copy text in word processor	76	1.00	0.05	*n.s.*
Cut text in word processor	73	0.67	0.07	*n.s.*
Change font size in word processor	76	0.44	0.08	*n.s.*
Run spellchecking in word processor	74	1.00	0.11	*n.s.*
Save file in word processor	74	0.11	0.23	< .05
Minimize word processor window	73	1.00	0.05	*n.s.*
Find picture on the web	76	1.00	0.07	*n.s.*
Bookmark a web page	59	1.00	0.03	*n.s.*
Replace a picture in word processor	75	0.52	0.05	*n.s.*
Send email for picture permission	74	0.57	0.14	*n.s.*
Find a room entry in spreadsheet	76	0.22	0.15	*n.s.*
Change format in spreadsheet	57	0.31	0.19	*n.s.*
Save changes in spreadsheet	76	0.12	0.22	*n.s.*
Email with an attached flyer	76	0.21	0.16	*n.s.*

Note: For Fisher's exact test: *significant at p < .05; †significant at p < .10

Self-Efficacy and Skill Level

One of the goals of this study was to examine the issue of self-efficacy, as well as skill level. Instruments measured this by asking respondents for self-assessment in addition to having them perform tasks to allow the interviewer to measure their skill level. As Figure 12 shows, the *players*' sense of competency outranks that of the *casual users*, and at some points, it even outweighs that of the *workers*.

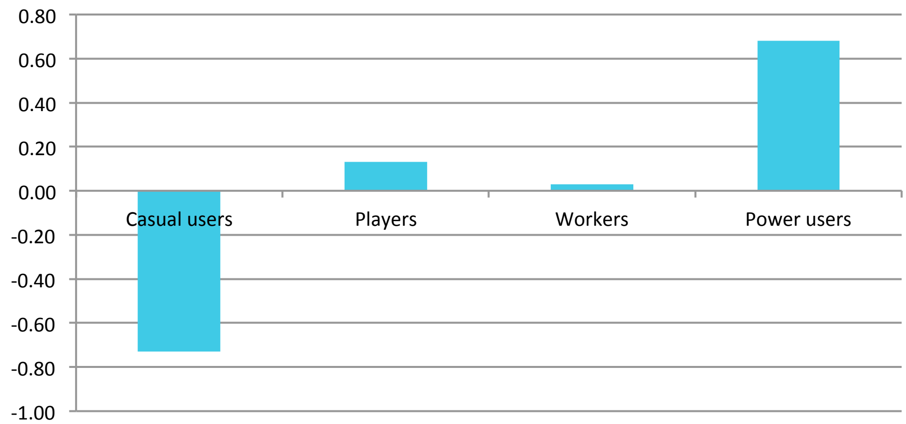
Figure 12: Self-reported skill levels of all four groups



To more clearly evaluate self-rating comparisons between each group, we calculated a composite self-assessment score for each participant. This was obtained by averaging the standardized self-assessment scores for each of the 16 activities, and then standardizing this value again for ease of interpretation. Chronbach's alpha for these 16 variables was high (α=.87), indicating that the values of these variables were consistent amongst each other and appropriate for creating a composite.

Figure 13 shows how many standard deviations away each group was from the overall mean. *Casual users* were .73 standard deviations below the overall mean, meaning that they rated themselves lower overall in their skills. *Players* were only .13 standard deviations above the overall mean, and *workers* were only .03 above the overall mean. The *power users* rated themselves above the overall mean, having a group mean that was 0.68 standard deviations above the overall mean.

Figure 13: Self-assessment scores aligned with their performance on the CBEs. Standardized composite self-assessment scores by user group.



Participants Were Able to Assess Their Own Computing Skills Accurately

Participants were asked to rate themselves a scale from 1 (I know nothing about this) to 5 (I am an expert in my community) in the following skills: typing, using email, chatting online, searching for information, creating web content, watching videos, listening to music, participating in online discussions, buying merchandise online, creating documents with a word processor, using spreadsheets, creating presentations, creating multimedia files, playing computer games, using social networking sites, and protecting a computer from viruses.

We wanted to see whether there was a relationship between how a participant evaluated their own ability to perform a skill and how they performed on the computer-based exercise. We compared how participants assessed themselves in their ability to create documents in a word processor with how they performed on word processing tasks. We also compared how participants assessed themselves in their ability to use spreadsheets with how they performed on spreadsheet tasks.
12 and Table 13 summarize these results.

Table 12: Completion rates for word processing tasks by word processing self-assessment score

	Open word processor	**Open file**	**Copy text**	**Cut text**	**Format Text**	**Use spellcheck**	**Save file**	**Minimize word processor window**
1	65.6%	71.4%	81.1%	32.1%	68.5%	60.4%	62.3%	81.1%
2	71.1%	78.4%	82.4%	23.5%	73.5%	63.6%	68.8%	90.6%
3	92.5%	91.0%	95.5%	55.6%	90.8%	80.3%	86.2%	93.9%
4	96.9%	96.9%	100.0%	72.1%	95.2%	88.3%	94.8%	100.0%
5	94.7%	93.0%	100.0%	64.2%	96.4%	88.9%	98.2%	98.2%
n	291	289	271	265	270	267	264	267
$X^2(4)$	39.31	23.92	26.67	32.84	29.05	21.01	37.07	19.19
p	< .001	< .001	< .001	< .001	< .001	< .001	< .001	< .01

Note: Percentages represent completion rates for all respondents who selected a given score

Table 13: Completion rates for spreadsheet tasks by spreadsheet self-assessment score

	Find room	Change format	Save file
1	41.5%	9.1%	64.9%
2	58.8%	19.1%	84.0%
3	54.0%	30.0%	89.2%
4	59.6%	52.6%	95.6%
5	66.7%	45.5%	94.4%
n	279	223	273
$X^2(4)$	8.57	28.97	28.20
p	$< .10$	$< .001$	$< .001$

Note: Percentages represent completion rates for all respondents who selected a given score

In general, participants who assessed themselves as being more skilled at an activity were also more successful at the computer-based exercises based on that activity. Additionally, while rating oneself lowly on an activity was related to having poorer performance, it did not necessarily mean that a participant was unable to complete a task in that activity. This could be due to the fact that some tasks, such as opening a file or copying text, are carried across multiple activities.

The Impact of Instrumental and Non-Instrumental Use on Success

We evaluated the type of impact that doing an activity for instrumental or non-instrumental reasons might have on task success. Table 14 shows the success rates at the word processing tasks for those who had not done the activity previously, for those who had done the activity only for non-instrumental reasons, for those who had done the activity only for instrumental reasons, and for those who had done the activity for both non-instrumental and instrumental reasons.

Table 14: Word processing success rates, by type of use

	Open word processor	Open file	Copy text	Cut text	Format Text	Use spellcheck	Save file	Minimize word processor window
Had not done activity	58.2%	66.7%	76.8%	28.6%	59.6%	50.0%	52.7%	76.4%
Had done activity only for non-instrumental reasons	93.1%	86.2%	92.3%	45.5%	84.0%	73.1%	84.0%	96.2%
Had done activity only for instrumental reasons	91.1%	91.8%	97.5%	54.7%	92.4%	86.1%	93.2%	98.3%
Had done activity for both instrumental	97.2%	97.2%	98.6%	68.6%	98.6%	87.1%	91.0%	97.1%

and non-instrumental reasons								
n	291	289	271	265	271	267	265	267

For all the word processing tasks, those who had done the activity for only non-instrumental reasons performed better than those who had not done the activity. Those who had done the activity only for instrumental reasons performed better than both those who had not done the activity and those who had done the activity only for non-instrumental reasons. Those who had done the activity for both instrumental and non-instrumental reasons did better than all the other groups in all tasks, except saving a file and minimizing the window, where they performed slightly poorer than those who had done the activity only for instrumental reasons.

Table 15 shows the success rates for the spreadsheet tasks for those who had not done the activity, for those who had done the activity only for non-instrumental reasons, for those who had done the activity only for instrumental reasons, and for those who had done the activity for both non-instrumental and instrumental reasons.

Table 15: Spreadsheet success rates, by type of use

	Find room	Change format	Save file
Had not done activity	41.0%	11.4%	68.4%
Had done activity only for non-instrumental reasons	52.9%	23.1%	86.7%
Had done activity only for instrumental reasons	62.6%	35.9%	91.1%
Had done activity for both instrumental and non-instrumental reasons	57.5%	37.9%	94.7%
n	280	224	274

The overall results are similar to the word processing tasks, as those who had done the activity only for non-instrumental reasons performed better than those who had not done the activity, those who had done the activity only for instrumental reasons performed better than both those who had not done the activity and those who had done the activity only for non-instrumental reasons, and those who had done the activity for both instrumental and non-instrumental reasons performed better than all the other groups in all tasks but find room.

Sharing Expertise with Others

In addition to asking participants to rate themselves across the 16 activities, we also asked them whether their friends sought their expertise, whether they shared their expertise with people they didn't know, and whether they taught workshops in the area. We evaluated whether there was a correlation between self-assessment ratings and propensity to share expertise. We first used the composite self-assessment scores found in Figure 12. Next, we created three composite variables measuring the participants' propensity to share their expertise with others. These were calculated by taking the count of activities that participants shared 1) with friends, 2) with strangers, or 3) at workshops.

Table 16 shows the correlations between self-assessed skills and the number of activities for which respondents shared their expertise.

Table 16: Correlations between self-assessment skills & number of activities shared

	M	*SD*	*n*	1.	2.	3.
1. Standardized Composite Self-Assessment	0.00	1.00	302	--		
2. # Activities Sharing Expertise with Friends	4.23	5.73	302	.33 ***	--	
3. # Activities Sharing Expertise with Strangers	1.41	3.90	303	.21 ***	.23 ***	--
4. # Activities Sharing Expertise at Workshops	0.20	1.71	303	.12 *	-.09	-.04

* $p < .05$, ** $p < .01$, *** $p < .001$.

These findings show significant correlations between participants' self-assessment scores and the number of activities that they shared with friends ($r = .33$, $p < .001$), with strangers ($r = .21$, $p < .001$), and at workshops ($r = .12$, $p < .05$). Though these correlations are modest, they suggest that those with higher self-assessment scores are also most likely to share their expertise.

In general, respondents shared their expertise most often with their friends, shared less with strangers, and only rarely shared their skills at workshops. For all three ways of sharing, most participants did not share their expertise.

Looking at the average number of activities shared by group, we find that *power users* shared the most activities (average = 6.3), followed by *workers* (average = 4.8), *players* (average = 4.1), and finally, *casual users* (average = 2.2).

Table 17: Power users & players most likely to share their expertise in at least one activity

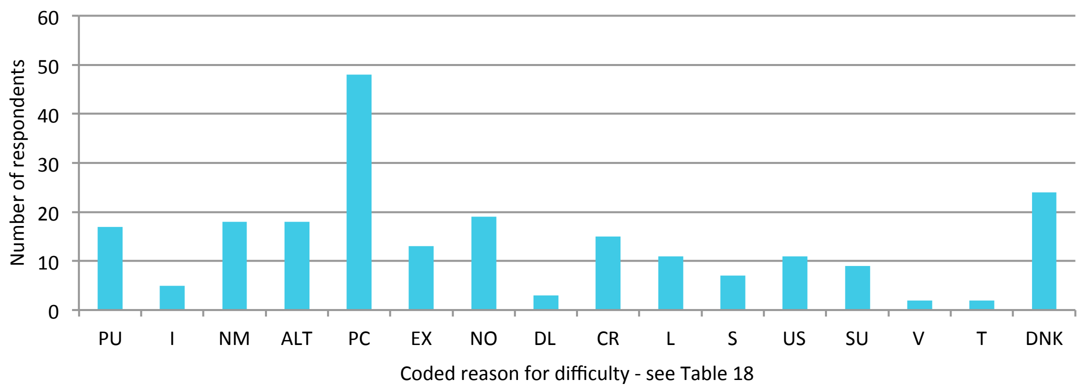
	Shares any with Friend	Shares any with Strangers	Share any at Workshops
Power Users	61.2%	24.7%	3.5%
Workers	49.3%	17.3%	1.3%
Players	57.7%	26.9%	3.8%
Casual Users	35.2%	11.0%	0%

Table 17 shows what percentage of each group shared their expertise on at least one activity with friend, with strangers, or at workshops. The results show that *power users* (61.2%) were the most likely to share their expertise with friends, followed by *players* (57.7%), *workers* (49.3%), and *casual users* (35.2%). *Players* (26.9%) were the most likely to share with strangers, followed by *power users* (*24.7%), workers* (17.3%), and *casual users* (11.0%). Finally, *players* (3.8%) were most likely to share their expertise at workshops, followed by *power users* (3.5%), *workers* (1.3%), and *casual users* (0%).

Interestingly, in the distribution for those who shared with friends, there are two peaks—one at sharing zero activities, and the second at sharing all 16 activities. This indicates that there is a small, but important, group of participants who share their expertise across the whole range of activities. Specifically, 17% of *power users* and 11% of *workers* share their expertise in all the activities, compared to only 4% of *casual users* and 4% of *players.*

Issues in Task completion

Figure 14: Issues in task completion



The CBEs also contained qualitative components which were designed to help better illuminate the types of problems people had completing the tasks. This open-ended data was taken in Portuguese on-site and then translated either using Google Translate or by the PI; given the shortness and directness of statements, we did not back-translate the responses. Next, this data was read through several times, with notes taken on various issues participants were having in completing the competency tasks. These recorded problems in task completion were then synthetized into single codes that covered the whole of the qualitative data for the competency tests. Each case's data was then coded, and the problem instances were simply counted to get the totals shown in Figure 14.

The biggest reason for issues with the competency tests was the participant simply not completing the entire task (PC), potentially a result of a lack of knowledge or simply not knowing they had not completed the task to its fullest extent.

Following that, and also relating to the number of incomplete tasks, is that the participant simply did not know what to do (DNK). The participants in these cases were not familiar enough, or at all, with the software, to be able to complete the task that was given to them.

On the whole, this data simply shows us that participants had trouble with tasks largely because they were unfamiliar with the technology or what they were supposed to do with it. The next largest number of problematic responses related to not knowing the program at all (PU), not knowing that the correct options existed (NO), wanting to use an alternative option because they did not want to complete the given task (ALT), and simply not remembering what to do next (CR). Additionally, because so many people simply did not know the program or did not know what to do, it makes sense that there were low numbers in not knowing terminology (T), not liking the program (DL), and not being familiar with a particular version (V). If participants were not familiar with the technology at all, there would not have been any reason that they would know the terminology, have reason to maintain strong likes and dislikes for a particular technology, or have strong opinions on versions.

Table 18: Issues in task completion codes & definitions

Code definition	Code shorthand description	Code abbreviation
Does not know the program at all	Program unknown	PU
Interviewer has to show	Interviewer	I
Not interested or motivated to complete task	Not motivated	NM
Uses or wants to use alternative avenue to complete task	Alternative	ALT
Task partially completed	Partially complete	PC
Does not use internet or software often, lacks experience	Experience	EX
Unaware of necessary option or path for task completion	Necessary option	NO
Does not like the software	Dislike	DL
Cannot remember, but used to know	Cannot remember	CR
Gets lost in task, but manages to complete	Lost	L
Computer or internet is slow	Slow	S
Unable to start task	Unable to start	US
Uses software choice or path that is unexpected for interviewer	Software unexpected	SU
Not familiar with particular version	Version	V
Unfamiliar with terminology	Terminology	T
Simply does not know what to do	Does not know	DNK

DISCUSSION OF RESULTS

The results of the interviews, surveys, and computer-based exercises suggest that being able to perform activities for both instrumental and non-instrumental reasons has shown to be important in gaining computing skills. Additionally, the informal learning environment of public access venues helps users to better share and acquire those skills.

The Boundary between Technology Use for Work and Play is Blurred

Our instrumentality index shows that each of the activities we identified had some level of instrumental value for our participants. This underscores the fact that the boundary between using technology for work or play is blurred, supporting our approach to address instrumentality as reason-for-use, rather than delineating activities as being strictly instrumental or non-instrumental. As mentioned previously, our participants were introduced to technology in a variety of ways, and they have also continued to use technology in a variety of ways: 62% of participants indicated that they use the internet for more than just games. Frequently mentioned activities were research for school or work, email and social networking, and chatting online.

Although participants started using technology for certain reasons, many expanded their skills for new purposes. One participant explained that "schoolwork ended up demanding [that I use computers] and I began to learn more games." Inversely, another participant was first interested in technology "for gaming, but today it's more for studies." Another participant blurred the lines between instrumental and non-instrumental use, explaining that she simultaneously "learned to install games, get on the internet, and type." The diversity of experiences and different means of progressing to different uses indicate that users in Brazilian LAN houses have an expanding relationship with technology; they are initially exposed to it for certain reasons, but then they gradually expand their knowledge to engage in many different uses. This is also suggested in the quantitative data: The groups with either more activities or the most years of experience (*players*, *workers*, and *power users)* were generally older than the group with the fewest activities and least years of experience (*casual users).*

Non-Instrumental Use Transfers into Broader Computer Skill Development

The results from the computer-based exercises provide evidence that people who largely use computers for gaming and social networking are generally as capable with computers as those who use them for instrumental purposes. They also illustrate that people who largely use computers for these non-instrumental purposes are gaining skills that translate to common instrumental tasks. Although for some tasks, there was discrepancy between the *workers* and *players* groups, they performed equally well on the majority of tasks, with the *power users*—those who engage in heavy computer use for both instrumental and non-instrumental purposes—predictably performing best on all tasks.

Additionally, in the word processing and spreadsheet examples we analyzed above, those who had performed an activity for non-instrumental reasons did better than those who had not before done the activity. Further, those who had done an activity for both non-instrumental and instrumental reasons performed better than those who had done an activity for only instrumental reasons. In these two cases, we see that adding non-instrumental use (or play) translated into greater skills. These results suggest that disallowing non-instrumental activities may leave some impact on the table in terms of helping public access venue users to gain proficiency with computers.

With respect to different public access models and what they provide their communities, our overall work demonstrates that public access venues which allow community members to engage *frequently* with computers, irrespective of the *nature* of their online activity, are the facilities most likely to provide the opportunity for people to gain the skills most commonly associated with employability. Policies that restrict certain activities, such as gaming or SNS use—most common when facilities are busy—are in fact interfering with skill acquisition that translates to instrumental use. Loosening these restrictions in such public access venues as telecenters, where policies tend to be stricter than in LAN houses and cybercafés, could potentially facilitate skill acquisition by a broader number of users.

Informal Learning in Public Access Venues is Key to Engaging Novice and Young Users in Technology

With respect to the **direct and indirect impacts of public access**, our data demonstrate that public access venues perform an important function in *their social nature*, *which contributes to informal learning*; in their *bridging function*, *which allows early users to gain more experience*; and, for the spaces that allow gaming and social networking, in their *attraction and stickiness for people to engage in non-instrumental use*, *which can transfer to instrumental skills*.

Increasingly, Brazilians in the state of Rio de Janeiro are developing computer skills outside of formal education. Participants reported diversity in the locations where they had first used computers. Although some participants did say that they had first learned to use a computer in school, just under half of the participants were first attracted to technology by LAN houses, while another 40% had learned to use computers at home or in the neighborhood, or at publicly funded telecenters. Less than 10% of our sample indicated that their first contact with technology was in school. As computers become more ubiquitous in Brazil, it appears that individuals are drawn to technology at multiple points, often gradually discovering new computer activities in different locations, and then exploring how they might be adopted into daily life.

Our study also suggests that social networks are paramount to transferring computer knowledge. First, informal learning from friends was the most prevalent mode of training across all the activities included in our survey. Second, those participants who shared their expertise with their friends often did so across a whole range of activities and were typically more advanced users. Together, these findings underscore not only the importance of informal social learning, but also how those who share their expertise are willing to do so across both instrumental and non-instrumental activities.

Looking more closely at each of the groups, we find that the *players* group (participants who reported a high degree of primarily non-instrumental activity) in particular benefitted most from informal learning environments. This group was the most likely to learn computer skills informally, as well one of the most likely groups to share their expertise with friends (after *power users*), and the most likely to share their expertise with strangers. It seems that, for members of this group, a public access venue which provides a sociable computing environment would be the most supportive for developing their computer skills.

Formal Courses Do Not Meet Users' Needs

Participants were asked if they had received formal computing education, and if they responded yes, they were encouraged to explain more about the education. Twenty-seven of our participants indicated that they had received some form of instruction, either as part of a regular school curriculum or in extracurricular computer classes. Seven of our interview respondents said that they did not have the opportunity, interest, or financial means to pursue formal computing education.

For those who did learn their technical skills in computer classes, nearly half found the course content boring or too simple. Participants who chose not to complete classes gave responses like, "It was last year, a week right here in [our neighborhood] . . . I didn't learn anything . . . except the shortcut keys." Another said, "I started a class . . . I knew a little bit more than what they were teaching me, so it got boring and I quit." Others who had completed formal IT education described their course work as basic, boring, and simple. As one participant who often went to LAN houses to play games with his friends explained, "I was never interested [enrolling in courses], I can learn everything that interests me here [the LAN house]."

This trend exists in a similar research study done in two Brazilian favelas. In that study, researchers conducted a series of three workshops in LAN houses in Rio de Janeiro. Registration was free. The skills taught included those that participants claimed they wanted, including how to use Orkut, YouTube, Twitter, and blogs. While workshop leaders taught tools like email, internet search sites, and Microsoft Office tools, all the instruction was tied to the object of the participants' interest: social networking.

The results reported from this workshop are in line with the findings from our interviews. Questioned about why some people did not want to attend formal classes, one participant answered, "They teach what we already know—to turn off the computer and connect these things." This indicates that, while participants have a desire to learn, they seek instruction tailored to the reality of their personal use.

First Use of Technology Emerges from Social Interaction and Collaboration

As mentioned elsewhere in the report findings, the initial introduction to the technology was almost always social. Usually, people did not start out exploring on their own; they were introduced and guided by a socially significant other. In order words, initial use emerged in the context of a social interaction, such as in school, LAN houses, or other public access venues. What is striking, though, is that this situation cut across domestic, public, and educational settings.

It should be noted that we are referring to technology use that is *physically* social and collaborative at the same time, such as when two people sit together behind the screen to use a single or multiple workstations. This use may be slightly different from the use of public access venues as meeting places between friends. For example, Lucas "uses the [LAN house] as a meeting point [but] uses the computer alone." Also, for Ikben, "sometimes it does [matter whether others are co-present], because sometimes, you're not playing, you don't have anything to do, so you have to talk with the people next to you." Such uses of the public access venues are social, but not an instance of the physically collaborative use that is of interest here.

In addition to the basic social function, such use seems to have a role in the initial and continuing use of computers in LAN houses. For example, for almost 10% of respondents, their initial experience of computing was in the context of collaborative use in a LAN house. Of these respondents, 40% initially started using computers together with someone else, right in the LAN house.

This phenomenon has implications for the design of public access venues, as these places are often structured as solitary spaces, with physical barriers erected between users and each cubicle designed as something meant for only one person. Thus, collaborative use of the facilities is not explicitly banned, but the design of the space and certain policies (such as discouraging the sharing of purchased time) discourage such. As one respondent (Varden) said, "It's different [at LAN houses] because if there is a person close to the chair, there cannot be two persons together, because if you move you have to give the computer to a single person. If a person wants to access, they have to access with their own chair. . . . [A] person sitting with one another does not work."

Our interviews therefore suggest that, in addition to the other issues mentioned, paying attention to the design of public access venues (such as LAN houses), and to how their designs can impede or assist the venues with being real-life physical collaborative computing interaction spaces, may be important. Of course, concerns about privacy were important to some participants, but in a closed circle of friends, people may trust collaborative use.

For further research, it will be interesting to investigate these issues against other variables, such as the physical interactional design of the public access venue, demographics, how such behavior develops over time, and so on. Also, can such collaborative use be classified as non-instrumental, irrespective of the content of the use?

CONCLUSIONS AND RECOMMENDATIONS

Knowing how and where citizens first experience technology allows us to be sensitive to rapidly changing trends in Brazilian society and community life, informing policy makers, educators, and social scientists alike. This research reveals the complexity of public life and internet access in Brazil. Citizens access technology at increasingly diverse points, gaining and sharing technical knowledge along the way. Most important, technology adoption is based in social interactions—it is the community life which drives individuals to the nation’s LAN houses, where many are incidentally exposed to a variety of technologies.

Similarly, our findings have shown that the Brazilian public, in general, has not embraced formal education as a means for gaining computer knowledge and skills. Instead, many pick up this knowledge from other resources, including friends, neighbors, or family—but most important, they learn in the LAN houses. While individuals still do indicate an eagerness to gain new skills, many prefer to learn through technology exploration and engagement within the context of their immediate social network, rather than learning for its own sake. Consequently, venues may seek to provide spaces that support collaboration and learning from peers.

Formal learning seems to be less successful because users find the content of those opportunities to be either redundant or less relevant. But in the computer-based exercises, we found that respondents who rated themselves highly at word-processing were consistently the most successful, showing that they were accurately aware of their own computer skills. Venues or organizations that are interested in providing formal training opportunities might better serve their users by asking the users to self-assess their knowledge about certain topics and then catering the teaching accordingly.

Additionally, the results of the instrumentality index illustrate how activities are neither strictly instrumental nor strictly non-instrumental, but instead, exist on a continuum. By implementing a similar metric for their own patrons, public access venues could better understand how to best serve the needs of their patrons and develop appropriate usage policies that avoid wholesale banning or filtering of certain types of activities.

Finally, given the strong evidence that primarily doing social networking or gaming activities for fun can still provide users with skills that transfer into core computer usage tasks, we would recommend that public access venues support so-called non-instrumental activities in order to encourage multiple pathways to gaining digital literacy. While certain types of activities better afford instrumental uses over others, the findings of this study suggest that exposure to a variety of activities is also important for computer skill acquisition. What this means is policies that ban certain activities, such as gaming or social networking, could be limiting users' skill acquisition.

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