Chapter 11
Community Networks as Sustainable Infrastructure for Digital Skills

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Introduction

Digital skills are part of the broader concept of digital literacy or digital *literacies,* as some authors prefer since it encompasses different approaches and solutions (Lankshear and Knobel 2008). Some authors define digital skills as capabilities one must master to obtain a particular result in the digital sphere, whereas digital literacy involves critical thinking skills when using the same tools (Bali 2016; Neumann 2017). It is possible to state that digital skills and digital literacy are connected and cannot be seen separately; digital skills compose some of the key measurable aspects of the broader concept of digital literacy. Both concepts are used in public policy planning for education and development on national and regional levels while also being studied by scholars in education, development, and technology areas; the variety of theoretical approaches and goals ended up providing a wide range of definitions of the terms showing some overlap but no consensus (Tinmaz et al. 2022).

A community network is a concept less present in academic research; it is a term that refers to different ways of developing and appropriating digital and communication technologies by local communities, from community radios to intranet networks, to villages connected to the Internet via optical fiber to mesh networks. Different technologies serve different needs, demands, and profiles; a

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community network in urban New York City differs significantly from one in a rural area in Brazil or an indigenous community in a remote area of Mexico—different human contexts also bring other funding models to these initiatives, generating a variety of results (Belli and Hadzic 2021).

Global partnerships between industry and international agencies target Latin America to increase digital literacy. Digital literacy remains a problem despite many of these initiatives mobilizing significant resources. The region presents a combination of low scores in international education rankings combined with a constant increase in the adoption of digital technologies for communication (International Telecommunication Union 2021; GSMA 2021). The International Telecommunication Union and the United Nations have tracked the development of connectivity worldwide and stated that low digital literacy is one of the main reasons for the current digital divide in developing countries (UNESCO 2018). According to the ITU's research (ITU 2020a), many people do not use the Internet or limit its use to chat apps because they do not know how to take advantage of what it can offer.

According to Radovanovic et al. (2020), there are three levels of the digital divide: the first level is the lack of Internet access or, as currently defined by the UN and the ITU, universal and meaningful connectivity (2022), the second level is the lack of digital literacies and competencies, and finally, the third level is the divide in life opportunities and benefits gained from the first two levels.

As a possible response to previously presented challenges, this chapter focused on *if* and *how* bottom-up solutions developed by local communities can offer a more suitable approach to overcome the digital divide in areas with limited to no Internet connectivity and low digital literacy and economic income. To achieve this goal, we carried out three case studies in different rural contexts in Brazil and Mexico, trying to find out lessons that could be learned from those initiatives.

To achieve the above-mentioned goals, we carried out three case studies in different rural contexts in Brazil and Mexico, trying to find out lessons that could be learned from those initiatives. These case studies were selected because they exemplify different scales and ways non-formal education projects connect with institutionalized sectors: *Art and Computation at Schools* have limited to no funding and rely on student scholarships when available. It is a case study about digital skills focused on basic programming and not Internet literacy skills (Timnaz et al. 2022); it was chosen because it represents a community-led alternative to leveraging people's appropriation of digital tools. *Community Provider Barra do* Açú is a community-led ISP aiming to become autonomous with a non-profit model based on Internet users' contributions. *Techio Communitario* is part of a network of programs and initiatives recently winning awards and grants and can keep its sustainability also by sharing its knowledge in courses for communities. In 2018, they were invited by the International Telecommunication Union (ITU), the multilateral agency responsible for managing and coordinating telecommunication on a global level, to offer specific courses on digital skills to Indigenous communities. All three case studies are located in rural or remote areas have a predominance of onsite training, and provide a bottom-up approach to digital skills learning in spaces where megaprojects from national and international commercial agreements have

disrupted the environment and social tissue of local communities. Rather than rejecting digital technologies, these projects reappropriated them for the benefit of the community and proposed concrete alternatives for digital literacy training.

This chapter is organized as follows: section "Introduction" introduces discussed topics; section "Literature review" presents the literature review; section "Digital literacy in Latin America: where theory meets praxis" presents an overview of the leading digital literacy theories from Latin America; section "Methodology" introduces the methodology; section "Case studies" describes selected case studies in Brazil and Mexico, and section "Results" brings the paramount results; section "Discussion" presents the final discussion, and section "Limitations and future directions" provides the conclusions and some indications for future studies.

Literature Review

In order to map the research connecting community networks and digital literacy, a database survey was carried out on the most extensive academic research database in education, development, and technology. Articles, books, and chapters in English and Spanish on community networks and digital literacy were searched in the local and online University of Barcelona library repository; the Directory of Open Access Journals (DOAJ), JSTOR, SCOPUS, IEEE Xplore, Education Resources Information Center (ERIC), and Web of Science during the first half of August 2021.

The database search showed that digital literacy is briefly mentioned as one of the benefits of developing community networks in publications aimed at policymakers (APC and IDRC 2018). Still, practically no academic research focuses on the connection between these two concepts. From that point, it was decided the approach of the study presented in this chapter would be to analyze some of the digital literacy projects developed by the main actors in the field, public, and private sectors, and on the other hand, explore some cases studies of community networks with different constitutions and goals to see if and how digital literacy and skills are approached there.

Given the existing literature gaps, a literary review was conducted to understand digital literacy approaches by leading institutions that promote global digital literacy programs: international organizations, multilateral agencies, and the telecommunications industry.

International bodies and the industry often regard Information and Communication Technologies (ICTs) as an economic development tool. ICTs are a factor that would put countries ahead in the race for development. Reports published by the World Bank (2017), the Organization for Economic Co-operation and Development—OECD (2020), the United Nations (2018), and the Global System for Mobile Association—GSMA (2020) show the concept of ICTs and more specifically, digital technologies, associated with notions of competition between nations. This approach tends to reflect on ideas of digital literacy and skills as specific abilities required for the traditional labor market but often does not encompass broader

skills, such as critical thinking and creativity. Moreover, this mainstream approach to digital literacy does not consider local communities' needs and knowledge systems.

The discourse of "being left behind" about digital technologies is frequent in Latin America and other Global South areas (Chan 2013). ICTs, particularly the Internet, are perceived as mere development tools and a straightforward way to shape the workforce to adapt to the market. The developmental approach to the Internet stems from its origins in telecommunication infrastructure. It stood out as a broader policy strategy in the early 2000s when the World Summit of Information Society (2003) coupled the concept of the *knowledge economy* with constant innovation through competitive skills. This concept was framed by the idea of Information and Communication Technologies for Development, or ICT4D (Heeks 2009). It was suggested that development via digital technologies could solve issues such as poverty, unemployment, and exclusion. It relates to the notion of *techno-solutionism*, where a few unique technological tools could be applied everywhere to solve different social and political problems (Chan 2013).

Educational projects initiated by the industry and international funding agencies, including the World Bank (2017), followed the same logic, framing digital literacy in a developmental narrative that includes it as part of a plan for countries to become economically competitive. UNESCO defined Digital literacy as "the ability to access, manage, understand, integrate, communicate, evaluate, and create information safely and appropriately through digital devices and networked technologies for participation in economic and social life (UNESCO 2018, p. 21). The private sector also measures digital literacy with specific digital skills, such as the GSMA's Digital Literacy Training Guide, which comprises a manual on using mobile technology resources for financial transactions (GSMA 2020).

Brown (2017) offers a detailed analysis of different digital skills proposed by international and multilateral agencies. The author concludes that, although it is essential to have clear indicators to measure progress in state actions and programs, too specific or narrow skills can become quickly outdated or irrelevant, challenging the achievement of meaningful and longstanding digital literacy results. It is in line with the OECD outcomes (2015) from interviews with professionals in innovative environments. The research aimed to understand which skills they think are the most useful, and the answers were: "coming up with new ideas and solutions," "a willingness to question ideas," and "the ability to present new ideas or products to an audience." Answers refer to critical and creative thinking rather than specific programs or software. Suppose digital skills indicators do not incorporate critical thinking, especially when measuring digital literacy in the Global South; in that case, there will always be a race toward the "digital future" that might seem near but impossible to achieve.

Moreover, it is not sustainable to train workers in the world's poorest regions to conform to the current system that has historically excluded and exploited them (Oxfam 2017). Some reports from multilateral agencies recognize the relevance of people's participation and the limits of one-size-fits-all solutions. The ITU (2020a, b) states in its report on sustainable connectivity (including digital literacy) that a

participatory approach can be helpful in any situation. There are no fixed rules for determining each locality's actual or potential usage levels. Years before, the World Bank (2000) published a report stating that no development could be sustainable if the communities were not involved in the strategies. Radovanovic et al. (2020) highlight the discriminatory aspect in the framework used in high-income countries compared to what is used in middle- to low-income ones; while the first "incorporates multiliteracies/multimodal dimensions—which are the technical, cognitive, and social-emotional dimensions (…), most national frameworks in the low- and middle-income countries like India and Kenya conceptualize digital literacies only around the idea of competency and skill, which is too narrow a set of competencies(…)."

Digital Literacy in Latin America: Where Theory Meets Praxis

One of the issues with discriminatory standards for implementing digital literacy projects in the Global South is the misconception that there is no critical mass in these places to develop its own digital literacy process (Chan 2013). One of the most influential education theorists, Paulo Freire, and later, Mario Kaplún—to mention just a couple—focused on the use of media literacy and communication in the region in "a strict relationship between theory and practice, a strong critical and political commitment (…), and a profound rupture with the dominant positivism and functionalism in the emerging communication sciences." (Barranquero 2011).

Freire actively took part in the beginning of the leading political movements of the left in Brazil in the last years of military dictatorships, such as the Landless Movement (MST), the Worker's Party (PT), and the Central Workers Union Confederation (CUT). In most of these groups, Freire's popular education was implemented as a model for teaching and learning. Kaplún worked in the training of more than one hundred communicators for popular education, especially in rural areas, throughout 16 countries in Latin America (Kaplún 2002).

Freire proposed to teach using the context already known to the student rather than using outside information that can be too abstract (1968). This way of thinking critically about education and considering the immediate context when sharing knowledge has influenced a series of community-led initiatives. Most of the current community networks in the region inherited a particular approach that began with broadcasting media, particularly the community radios that have their roots in the 1940s. The 1960s and 1970s started the open spectrum activism in the region—the idea that the media should be available to all and not just a few actors authorized by the government (Freire and Guimarães 2012; Machado 1986), something many community networks in the regions still fight to achieve. The idea of community radios and community-led means of communication are directly aligned with this

contextually focused approach and critical use of the media proposed by Freire (Freire and Guimarães 2012).

Methodology

The research on local communities' digital literacy processes started when one of the authors of this chapter worked together with computer scientists and digital media trainers to develop media and digital skills extension programs between 2013 and 2017. The targets were students from public schools, Landless Workers Movement members (MST), and Indigenous communities in rural areas of Brazil, aged between 13 and 18 years old. This research phase and an analysis of similar initiatives were published in Renno (2013; 2015; 2016). The participatory stage allowed to follow the development of the student's digital literacy, and there was the idea to study other cases to see how different contexts might generate similar positive results.

The three selected projects for the case studies were (i) a university extension program conducted in secondary schools in Northeast Brazil called *Art and Computation at Schools*; (ii) a community network in the state of Rio de Janeiro called *Community Provider Barra do Açú*, and (iii) a community radio and mobile communication initiative in Mexico called *Techio Comunitario*.

The case study of the extension program *Art and Computation at Schools* focused on the methods developed by project coordinator Jarbas Jácome, a computer scientist and lecturer from the *Universidade Federal do Recôncavo* da Bahia in the rural area of northeast Brazil. The case study was conducted via direct observation in the field between 2015 and 2017 while one of the authors was lecturing in the same area, following four in-training college students assisting Jácome at the school activities, and an in-depth video call interview with Jácome in February 2022.

The case study of the community provider Barra do *Açú* included an in-depth interview with Pedro Henrique Gomes Rodrigues, the project's Tech Coordinator, and Marcelo Saldanha from *IBEBrasil*. Both video call interviews were conducted in January 2022. For *Techio Comunitario* in Mexico, one of the project's coordinators, Carlos Baca-Feldman from Redes AC, was interviewed via video call in February 2022. The data was combined with desk research on the project's extensive documentation.

The 1.30 h in-depth interviews with coordinators of the three case studies aimed to understand how those projects started, which issues were addressed, and some of the outcomes achieved in digital skills. They were also asked about the interest, needs, and suitability of replicating the method in other contexts. The interviews were recorded via audio and transcribed; after the transcription, common elements from the plans and projects were highlighted so we could find the main concepts that would allow a comparison between the three cases (see Table 11.1) and list the replicability opportunities and challenges mentioned by the respondents. The method used to analyze the interviews was discourse analysis. This approach was

Table 11.1 Common attributes in the case studies

	Computer art at schools	Community provider Barra do Açú	Techio comunitario
Project started/ replicated by the community	Y: Trained students later become trainers	Y: Self-proposed project	Y: Self-proposed project
The community decides the project goal(s)	N: The project is proposed by a teacher to achieve a learning goal	Y: The project solves a community need	Y: The project solves a community need
Training process adaptable to context changes	yes	Yes	Yes
Projects focus on digital divide levels 1, 2, or 3	Levels 2 and 3	Levels 1, 2 and 3	Levels 1, 2 and 3
Tech learning by project	Y: Gamified projects for students	Y: Connect communities	Y: Connect communities
Tech skills learned return to the community	Y: Provide math and programming skills	Y: Self-sufficient community network	Y: Self-sufficient community radio/ network

chosen based on what is outlined by Tonkiss (2004), allowing the researcher to showcase the most relevant themes that appear in the sources. After the transcription, common elements from the plans and projects were highlighted so we could find the main concepts that would allow a comparison between the three cases (see Table 11.1). The process in this case involved organizing, pruning, and filtering information to identify possible categories for the data. The information was grouped into themes using the inductive method. The codes were grouped so we could find the main concepts that would allow a comparison between the three cases (see Table 11.1) and list the replicability, opportunities, and challenges mentioned by the respondents.

The case studies present evidence from small self-organized initiatives in Latin America that aim to overcome various levels of the digital divide using their own method and have no ties to international digital divide projects that have been implemented in different countries of the Global South for many decades. Although there is no official map of these initiatives due to reasons that go from their informal aspect to their choice to remain undetected in areas where there are direct conflicts with farmers and the local leadership, we know they exist all over the continent. Nevertheless, due to time limitations, we could not visit initiatives in other countries and interview the involved community. Our choice was to focus on small case studies that showed a variety of learning methods and development stages to see *if* and *how* they achieved their digital literacy goals.

Case Studies

Community Provider Barra do Açú, Brazil

Established in 2019 (with delays due to the COVID-19 pandemic in 2020), this community network provides Internet access via radio waves to the Barra do Açú district in Rio de Janeiro state. Connection via radio waves is a technological alternative in many rural areas where fixed Internet is transmitted via Wi-Fi in the absence of cable connections. The district is in the *Açú Superport* region of Rio de Janeiro state. Spanning 90 km^2, the port is one of the largest in the world, created by the Chinese government. The port facilities have led to internal displacements among the local population, severely polluted the air and soil, and reduced ecological and hydrological social-economic tissue, among other issues (Ejolt n.d.; Phillips (2010, September 15)). New traffic infrastructure that prioritizes the flow to and from the superport has disconnected the district of Barra do Açú from the city center. This disconnection caused by the port increased the prices of products and services, including the Internet. The port promised economic development and job opportunities, but the only jobs available to locals were temporary construction work that did not pay sufficiently.

A few individuals from a group that started a community Internet provider in a nearby neighborhood proposed to help create the provider in Barra do Açú. From the beginning, the idea was to provide capacity building through technical training to the local community to run the provider themselves. The Internet provider has a non-profit model, where a higher number of paying users would lower the cost for everyone. One of the first results of community organizing was that they started to feel more potent as a group and could negotiate with the public and private sectors on their terms. The community itself produces and manages the equipment and technology. The Internet provider organizers offer training on essential network management and software programming. The activity attracts people from the district as few vocational training opportunities are locally available.

The flexible operation of the group also allows members to change roles and try new tasks if desired, making the technical training more horizontal and diverse. The group recycles and uses DIY techniques, including building their transmission tower and recycling an old one with the help of the local blacksmith. Not only is the project replicable (it will be the second community provider in the area), but it is also part of a network of different community networks implemented in several small rural and remote communities across the country with the support of local NGOs. The *Barra do Açú Community Provider* is currently supported by NGO IBEBrasil, one of the most active in the field, and the local Federal Technical School with the idea of becoming financially autonomous soon with their non-profit model.

Techio Comunitario, Mexico

Redes AC is a collective that works in different areas: promoting small traditional producers, social tourism, urban agriculture, and participatory community development. Following Freire's ideas, it includes the right to media communication and autonomous technologies, so the collective offers training in telecommunications for Indigenous people based on their own choices and needs, including community radio, intranet, and community Internet service provider.

Baca-Feldman, interviewed for this research, is one of the coordinators of *Techio Comunitario,* a project focused on training Indigenous people to develop local digital media technologies. The word *tequio* is a Mexican term referring to the community effort to build something; the adaptation to *techio* connects with technology. The first phase of *Techio Comunitario's* work or "generation," as the organizers refer to it, occurred in 2006, and the second in 2012. It started with courses on the basics of digital technology. Later, the group created a specific course for community radio. The next step currently in progress is the development of community mobile communication providers. The project evolved into a network of local experts to share knowledge across different projects. In collaboration with many organizations and communities, they searched for ways to transform technologies and use them based on community principles and expertise to mitigate the risks they might entail. It is the way to weave a path towards technological autonomy collectively.

For the communities they worked with, connectivity is not an end in itself; "it is about implementing a communication project that helps to strengthen identity, autonomy, defense of territory and life." It starts by identifying a technological model contributing to achieving community goals and dreams.

In 2018, the ITU invited *Techio Comunitario* to develop an online on-site course on the ITU academy platform titled "Training technical promoters in Indigenous communities for the generation, development, and maintenance of communication and broadcasting network technologies." The course is currently supported by the ITU and the Fund for the Development of the Indigenous People of Latin America and the Caribbean (FILAC), ISOC, Frida, NIC Mexico, and *Rhizomatica.* It gathers people from 12 Latin American countries in the region each year. The course shows how the proposed method can be replicated and adapted to include participants from different countries in a hybrid format.

Techio Comunitario's successful work with the ITU proves that high-level agencies can develop partnerships with local initiatives and community-led efforts. Context-based education, respecting the communities' differences and needs, does not need to be at odds with the global step towards improving digital literacy.

Computer Art at Schools (Arte e computação nas escolas), Brazil

This digital literacy project was developed in a rural area of Bahia, where 96% of the population is of African descent, with around 15% of inhabitants in situations of extreme poverty and 80% at risk of poverty (MDA 2015). The oil industry has had an environmental and social impact on the greater area and negatively affected the local economy and society in the last decades, concentrating jobs in the oil processing area, bringing experts from outside the community while damaging the ecosystem where local communities used to live from (Fonseca 2007; Brito 2008). Lecturer and computer scientist Jarbas Jácome started the project Computer Art at Schools from 2011 to 2020 to teach programming logic to local schools. He noticed the basic math level among students was deficient and developed a method to make math concepts more applicable to students aged between 15 and 17 via the development of digital skills.

Jácome developed methods for teaching computational skills offline since there was no Internet access in the school (Jácome 2013). Together with his group of undergraduate students who assisted him in the project, he realized that the participants were more involved in activities that started with hardware. According to Jácome's experience, "if we start from basic electronics, then move to physical computing, and only then to actual software, we have a more engaging process, slowly raising the learning curve that is needed for harder programming." Students started by understanding what is a computer *bit* by touching an object that represents and acts like one crafted with their own hands, welding wires to produce sound, or watching the *bit* turn on a LED light.

A severe problem that affected the project was the cut of monthly support for students in 2020 and the pandemic. Individual financial support was the only possible way to participate in the project for many of them due to their low socioeconomic backgrounds, otherwise, they had to find unskilled jobs to support their families.

The lack of financial support is part of the country's general cut in education funding during the 2018–2022 federal policies. In terms of concrete results for the involved students, it was clear the project's outcome was very positive: students learned math by also understanding the basics of programming logic. The project provided digital literacy competencies and professional opportunities for the participants who managed to be financially supported throughout the learning process. Some students and local community members engaged in the project by becoming trainers. The trainers could replicate, adapt, and change the methodology in other places in the region after they finish school and college studies.

Results

The case study of *Community Provider Barra do Açú* addresses the first level of the digital divide, according to Radovanovic et al. (2020), aiming to bring connectivity to a community on its terms in a project managed by the same community. *Techio Communitario* addresses levels two and three, creating different communication channels and generating technological and media autonomy for the Indigenous communities. *Art and Computation at schools* also focused on levels two and three, teaching math and programming while allowing some students to become project replicators in other schools.

All three projects started from local ideas and methods directly influenced by popular education, especially Freire's critical pedagogy according to the interviews with the coordinators. The projects were developed to respond to the community's needs and demands, and the positive outcomes show how communities and perfectly capable of developing and replicating their own methods.

In all case studies, there are common elements (Table 11.1):

- The initiative starts with a small group meeting frequently onsite; everyone shares cultural codes and languages, making it easier to develop trust networks in the community of practice.
- There is no separation between skill learning and critical thinking. All three case studies start with a general proposition, but the end result comes from a joint decision of the group and reflects their needs or inputs; they know *why* they are doing the project, and the trainer guides them through the skills needed to achieve the goal;
- The tradition of popular education and media training are entangled;
- No method proposed in the three case studies is rigid: changes in the group and the context might require the training processes to be re-adapted.

There are some challenges to the projects, as well. At least in the first years of implementation, the financial support makes the projects possible. These communities in rural and remote areas do not have access to the economic system urban areas tend to offer; schools face inconsistent funding; youth migrate to bigger cities or work in jobs with low qualifications before finishing school. Scholarships and financial support can keep the project alive; in the case of community providers and community radios, it requires small financial support before it becomes sustainable and creates its funding mechanism.

Discussion

The case studies analysis in this chapter showed how community-led practices allow a broader, context-based, and adaptable understanding of digital skills and technology. The research showed solutions for different digital divide levels using a

collaborative and critical approach (Bidwell 2021). It shows middle- and low-income countries can adopt indicators that prioritize critical and creative thinking and capacity to solve problems instead of limiting it to simply mastering the software or a tool in a specific digital environment (Stanley 2003). Consequently, educational goals can become more ambitious. Still, it will also allow partnerships and collaborations with other initiatives if indicators are kept flexible enough to respect their methodologies. The idea is not to ignore the future but allow local communities to create bridges between the past, the present, and the future, finding ways to connect to digital technologies that are meaningful to them; this can allow the learning process to keep going and avoid outdating knowledge that often happens when the learning goal is focused on just a technical task (Baca-Feldman and Hinojosa 2020).

The case studies also showed that, although economic development is part of the problem that has led to low digital literacy in the region, focusing only on the financial limitations does not help explain the whole situation nor come up with practical solutions (Hardy et al. 2018). If digital literacy strategies respect the people's context and include knowledge available among the community, they can become long-term solutions.

Educators and trainers in the three case studies understood the media's role in everyday lives and used it as part of strategies to learn and improve the quality of life in remote and rural areas. Popular educators in the 1960s–1980s saw a context with low general literacy and high media use; teaching using the media, which combined the oral and visual language, was a way to bring the written language closer to people (Mateus and Quiroz 2017).

In 2022, we are facing a similar situation: high mobile Internet use in the region—73% mobile Internet users in 2021 and growing to about 80% in 2025, with half of the growth coming from Brazil and Mexico. (GSMA 2021) combined with low digital skills—both Brazil and Mexico have around 20% of the population with just basic digital skills. (ITU, 2020a). By ignoring this recent history, digital literacy projects outside the area lose a great chance to build on previous knowledge that would allow projects to succeed and the communities to develop digital skills with a critical and sustainable foundation.

Global agencies and local initiatives collaborations may seem antithetical initially, but embracing differences as an opportunity instead of obstacles can be the needed solution. Multilateral agencies have already produced or financed enough research from experts from around the world, including Latin America (UNESCO 1998), showing the way to a digital literacy approach that embraces complexity and critical thinking. With hands-on training, such as the partnership between *Techio Comunitario* and the ITU, there can be a clear path toward improving society's digital and media literacy in rural and indigenous communities.

In the case of *Barra do Açú Community Provider*, the project is already the second community provider in the area; it is also part of a network of different community networks implemented in several small rural and remote communities across the country becoming financially autonomous with their non-profit model. Other providers from the network have different financing models depending on their

location and community characteristics and the regulatory and financial support they manage to get from their local governments and civil and technical society.

On a more local level, even with the current financial constraints that put the *Art and Computation at Schools* on hold in the specific area where it was first implemented, the educators manage to share their ideas to be appropriated, adapted, and changed by other educators and digital artists working in an educational environment. The offline, DYI, and low-cost approach allowed it to be flexible enough to be widely shared among the wider academic community, including international ones, so the project continued in other schools.

Conclusion and Implications of the Study

Analyzing community networks under the digital literacy scope provides new light on the initiatives, limiting the risk of being restricted to its technical aspects and techno-cultural approaches, showing it can be a viable and effective bottom-up solution to overcome the lack of digital skills in areas with extreme social economic limitations. The multiple case studies analysis allowed the researchers to understand how diverse the learning methods and outcomes appear under the umbrella of digital literacy, confirming that the one-size-fits-all approach strategies and frameworks are not only insufficient but not suitable for understanding learning processes that are already taking place in different regions of the world.

In practical terms, this study implicates a broader understanding of how community practices could offer suitable answers to long-lasting digital literacy issues in rural areas with lower socioeconomic profiles beyond Internet access; it connects learning processes traditionally associated with female work with critical communication and digital technologies. When community networks are seen under the framework of digital literacy, they can become more than a low-cost alternative to Internet access and become a space for ongoing knowledge sharing in the digital field.

Limitations and Future Directions

The study was limited to three case studies and two countries in Latin America. Since there is a gap in academic studies evaluating the digital literacy potential of community networks, more studies should be carried out to map out more ways in which these initiatives develop their learning-by-doing methods, starting in Latin America, where the influence of critical pedagogy can be found and tracked in the communities, especially among community networks initiatives. It became clear that digital skills are developed at a broader level, not restricted to using a few tools or apps, allowing meaningful literacy to be achieved.

Future studies could cover other local initiatives, especially in different countries and regions. This can enrich the findings and add elements to sustainability solutions of community networks. Later, with a proper analysis corpus, mixed methods could be applied to find topics that would improve the assessment framework of digital literacy in the Global South, not limiting it to developmental or economic aspects but rather a multidisciplinary approach.

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References

Association for Progressive Communication and International Development Research Centre (2018) Global Information Society Watch – Community Networks. APC and IDRC. https://giswatch.org/sites/default/files/giswatch18_web_0.pdf

Baca-Feldman C, and Hinojosa D (2020) Propuestas metodologicas para disenar e implementar proyectos de comunicacion comunitaria. https://www.redesac.org.mx/_files/ugd/68af39_f3ccc6549625453ba8ef88a00b69f558.pdf

Bali M (2016) Knowing the difference between digital skills and digital literacies, and teaching both. https://www.literacyworldwide.org/blog/literacy-now/2016/02/03/knowing-the-difference-between-digital-skills-and-digital-literacies-and-teaching-both. Accessed 2 Sept 2022

Barranquero A (2011) Rediscovering the Latin American roots of participatory communication for social change, vol 8. Westminster Papers in Communication and Culture, p 154. https://doi.org/10.16997/wpcc.179

Belli L, Hadzic S (2021) Community networks: towards sustainable funding models. FGV Direito Rio, Rio de Janeiro. https://direitorio.fgv.br/conhecimento/community-networks-towards-sustainable-funding-models. Accessed 2 Sept 2022

Bidwell NJ (2021) Rural uncommoning: women, community networks and the enclosure of life. *ACM Trans Comput-Hum Interact 28*(3):19–50. https://doi.org/10.1145/3445793

Brito C (2008) A Petrobrás e a gestão do território no Recôncavo Baiano. EDUFBA. https://doi.org/10.7476/9788523209216

Brown M (2017) A critical review of frameworks for digital literacy: beyond the flashy, flimsy and faddish – part 13. *ASCILITE TELall Blog*. https://blog.ascilite.org/critical-review-of-frameworks-for-digital-literacy-beyond-the-flashy-flimsy-and-faddish-part-3/. Accessed 2 Sept 2022

Chan AS (2013) Networking Peripheries: Technological futures and the myth of digital universalism. MIT Press

EJOLT (n.d.) EJAtlas | mapping environmental justice. Environmental Justice Atlas. https://ejatlas.org/. Accessed 2 Sept 2022

Fonseca ÁCNdeO. (2007). Aspectos do desenvolvimiento regional no recôncavo sul baiano. https://www.semanticscholar.org/paper/Aspectos-do-Desenvolvimiento-Regional-no-Rec%C3%B4ncavo-Fonseca/a52df74db30a199646e27a922982b96147239780. Accessed 2 Sept 2022

Freire P (1968) Pedagogia do Oprimido. Record, Rio de Janeiro

Freire P, Guimarães S (2012) Educar Com a Mídia. Paz e Terra, São Paulo

Global System for Mobile Association (2020) Digital literacy training guide: a guide for mobile money agents and digital literacy change agents. https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/11/Digital-Literacy-Training-Guide.pdf

Global System for Mobile Association (2021) The mobile economy: Latin America. Global System for Mobile Association. https://www.gsma.com/mobileeconomy/wp-content/uploads/2021/11/GSMA_ME_LATAM_2021.pdf

Hardy J, Dailey D, Wyche S, Makoto N (2018) Rural Computing: Beyond Access and Infrastructure. In: Companion of the 2018 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '18). Association for Computing Machinery, New York, pp 463–470. https://doi-org.sire.ub.edu/10.1145/3272973.3273008

Heeks R (2009, October 29) The ICT4D 2.0 manifesto: where next for ICTs and International Development? SSRN Scholarly Paper, Rochester, NY. https://doi.org/10.2139/ssrn.3477369

International Telecommunication Union (2020a) Digital skills insights 2020 | ITU academy. International Telecommunication Union. https://academy.itu.int/itu-d/projects-activities/research-publications/digital-skills-insights/digital-skills-insights-2020. Accessed 2 Sept 2022

International Telecommunication Union (2020b) ITU, World Telecommunication/ICT Indicators Databa. ITU. https://www.itu.int:443/en/ITU-D/Statistics/Dashboards/Pages/Digital-Development.aspx. Accessed 2 Sept 2022

International Telecommunication Union (2021) Facts and figures 2021. International Telecommunication Union. https://www.itu.int/itu-d/reports/statistics/facts-figures-2021/

Jacome J (2013) Arte e Computacao nas Escolas. https://jarbasjacome.files.wordpress.com/2013/12/metodologias_utilizadas_v2.pdf

Kaplún M (2002) Una pedagogía de la comunicación: (el comunicador popular) ([Ed. rev.].). La Habana: Editorial Caminos

Lankshear C, Knobel M (eds) (2008) Digital literacies: concepts, policies and practices. Peter Lang, New York

Machado A, Magri C, Masagäo M, Guattari F (1986) Rádios livres: a reforma agrária no ar. Brasiliense, São Paulo

Mateus J-C, Quiroz Velasco MT (2017) Educommunication: a theoretical approach of studying media in school environments. Universidad de Lima. https://repositorio.ulima.edu.pe/handle/20.500.12724/4883. Accessed 2 Sept 2022

Ministério do Desenvolvimento Agrário (MDA) (2015) Perfil territorial Recôncavo Bahia, desenvolvimento territorial Sistema de Informações Territoriais. http://sit.mda.gov.br/download/caderno/caderno_territorial_187_Rec%C3%83%C2%B4ncavo%20-%20BA.pdf Accessed 4 Sept 2022

Neumann MM, Finger G, Neumann DL (2017) A conceptual framework for emergent digital literacy. Early Childhood Educ J 45(4):471–479. https://doi.org/10.1007/s10643-016-0792-z

OECD (2015) The innovation imperative: contributing to productivity, growth and well-being. OECD. https://doi.org/10.1787/9789264239814-en

OECD (2020) PISA 2018 results (volume VI): are students ready to thrive in an interconnected world? OECD. https://doi.org/10.1787/d5f68679-en

Oxfam International (2017, Jan 17) An economy for the 99%. Oxfam International. https://www.oxfam.org/en/research/economy-99. Accessed 2 Sept 2022

Phillips T (2010, Sept 15) Brazil's huge new port highlights China's drive into South America. The Guardian. https://www.theguardian.com/world/2010/sep/15/brazil-port-china-drive. Accessed 2 Sept 2022

Radovanović D, Holst C, Belur SB, Srivastava R, Houngbonon GV, Quentrec EL et al (2020) Digital literacy key performance indicators for sustainable development. Social Inclusion 8(2):151–167. https://doi.org/10.17645/si.v8i2.2587

Rennó R (2013) Aprender en las fronteras (o nadie educa a nadie): relaciones entre arte, ciencia y tecnología. Revista de Estudios de Juventud, 102. https://www.academia.edu/5708257/Aprender_en_las_fronteras_o_nadie_educa_a_nadie_relaciones_entre_arte_ciencia_y_tecnolog%C3%ADa. Accessed 2 Sept 2022

Rennó R (2015) Novos estudantes na velha sala de aula: o ensino da arte e tecnologia, entre institucionalização e mundos possíveis. Em Aberto 28(94). https://doi.org/10.24109/2176-6673.emaberto.28i94.1679

Rennó R (2016) Pinpinlab: Experimentações em arte, ciência e tecnologia DIY. LINKLIVRE. https://www.academia.edu/28835429/Pinpinlab_Experimenta%C3%A7%C3%B5es_em_arte_ci%C3%AAncia_e_tecnologia_DIY. Accessed 2 Sept 2022

Stanley LD (2003) Beyond access: psychosocial barriers to computer literacy special issue: ICTs and community networking. Inf Soc 19(5):407–416. https://doi.org/10.1080/715720560

Tinmaz H, Lee Y-T, Fanea-Ivanovici M, Baber H (2022) A systematic review on digital literacy. Smart Learn Environ 9(1):21. https://doi.org/10.1186/s40561-022-00204-y

Tonkiss F (2004) Analysing discourse. In: Seale C (ed) Researching society and culture. Sage, London, pp 245–260

United Nations Educational, Scientific and Cultural Organization (UNESCO) (1998) UNESCO and the development of education in Latin America and the Caribbean. In: Major Project of Education in Latin America and the Caribbean: bulletin, 45. OREALC, Santiago de Chile, pp 5–18. https://unesdoc.unesco.org/ark:/48223/pf0000262549. Accessed 4 Sept 2022

United Nations Educational, Scientific and Cultural Organization (UNESCO) (2018) Global framework of reference on digital literacy skills for indicator 4.4.2: Percentage of youth/adults who have achieved at least a minimum level of proficiency in digital literacy skill (Draft Report). Paris. http://uis.unesco.org/sites/default/files/documents/draft- report-global-framework-reference-digital-literacy- skills-indicator-4.4.2.pdf

World Bank (2000) Voices of the Poor. Can Anyone hear us? Narayan, D. World Bank. Oxford University Press. https://documents1.worldbank.org/curated/en/131441468779067441/pdf/multi0page.p

World Bank (2017) World Bank warns of "learning crisis" in global education. World Bank. https://www.worldbank.org/en/news/press-release/2017/09/26/world-bank-warns-of-learning-crisis-in-global-education. Accessed 2 Sept 2022