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Public action and community telephony for the digital inclusion of indigenous rural communities: the case of San Pedro el Alto, Zimatlán, Oaxaca

Acción pública y telefonía comunitaria para la inclusión digital de las comunidades rurales indígenas: el caso de San Pedro el Alto, Zimatlán, Oaxaca

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ABSTRACT

In the information society, the core that guarantees equal opportunities and rights is digital inclusion. However, in countries like Mexico, the digital divide prevents the insertion into the digital era of thousands of people from marginalized rural communities, a situation that produces multiple inequalities. The purpose of this document is to disseminate the results of a case study on digital inclusion through community celular telephony (CCT) in San Pedro el Alto, Zimatlan, Oaxaca, a pioneering in this initiative. The research is inserted in the framework of the public action theory, so a mixed method and a methodological triangulation strategy was applied that allowed combining documentary and empirical information to analyze: the enabling factors of the implemented public action model, the community context and the design, implementation and operation of this telephony services. The results show that social participation is the component that has the greatest impact on the implementation and operation of the CCT service. In this regard, it is concluded that this telephony model is an alternative, with political and economic viability, for digital inclusion of rural communities that have been excluded by the telecommunications market.

Keywords
Social inclusion; social change; ICT; digital policy; digital divide.

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RESUMEN

En la sociedad de la información, el núcleo que garantiza la igualdad en oportunidades y derechos es la inclusión digital. Sin embargo, en países como México, la brecha digital impide que miles de personas de comunidades rurales marginadas puedan integrarse a la era digital, situación que produce múltiples desigualdades. Este documento tiene por objeto difundir los resultados de un estudio de caso sobre la inclusión digital a través de la telefonía celular comunitaria (TCC) en la localidad de San Pedro el Alto, Zimatlán, Oaxaca, pionera en esta iniciativa. La investigación se inserta en el marco de la teoría de la acción pública, por lo que se aplicó un método mixto y una estrategia de triangulación metodológica que permitió combinar la información documental con la empírica para analizar: los factores habilitadores, del entorno y de la participación del modelo de acción pública adoptado, el contexto comunitario y el diseño, la implementación y la operación de este servicio de telefonía. Los resultados muestran que la participación social es el componente que tiene mayor incidencia en la implementación y operatividad del servicio de TCC. Al respecto, se concluye que este modelo de telefonía es una alternativa, con viabilidad política y económica, para la inclusión digital de comunidades rurales que han sido excluidas por el mercado de las telecomunicaciones.

Palabras clave
Inclusión social; cambio social; TIC; política digital; brecha digital.

INTRODUCTION

In contemporary societies, the massive use of information and communication technologies (ICTs) has a transforming impact on social cohesion. Today, a large part of human relations (social, political, commercial, labor, sentimental, etc.) make use of ICTs, since they enable real-time remote communication and interaction. ICTs occupy a central place in several daily activities, so their impact goes beyond the instrumental, i.e., they are no longer conceived only as communication tools, but are directly associated with socialization processes and political and economic power relations between different actors and sectors.

Digital inclusion –understood as access to and daily use of ICTs– opens up the possibility of relating, interacting and exchanging information and knowledge; in addition, technological tools create various virtual spaces that favor participation and social inclusion. This is why the digital divide –inequality in access to and use of technologies– generates marginalization and social inequity, since it does not allow access to the opportunities and benefits offered by digital technology.

Despite technological expansion, to date there has been no universal coverage that provides generalized access to telephony and internet services. This is the situation faced by several developing countries (such as Mexico), where there are major obstacles to achieve digital inclusion of all its inhabitants, and thus respect the right to equal opportunities and access to information.

It should be noted that several governments have promoted policies and strategies to achieve social inclusion and the transition to the Information Society (IS) (Lemmens, 2006); actions have been carried out to reduce the digital divide (Zambrano,

2009), achieve the expansion of broadband to improve connectivity (Jordán, Galperin & Peres, 2013), expand the supply of electronic services (Kvasnicova, Kremenova & Fabus, 2016), among other initiatives. Despite these efforts, rural communities in different countries continue to have disparities with respect to access to ICTs, which perpetuates problems of social inequality.

Based on this problem, a project was developed to investigate community cellular telephony (CBT) in the rural town of San Pedro el Alto, in the municipality of Zimatlán, Oaxaca, Mexico. In this work, within the framework of the public action theory of Lascoumes and Le Galés (2013), the digital divide was analyzed in the community context of the area, as well as the organized social participation and collaboration of social, public and private actors. Of the latter, the role of Rhizomática A. C., which participated in the design and implementation of CBT services for the digital inclusion of this district. The main objective of this document is to disseminate the results of this case study.

This research is based on theoretical arguments that ICTs have been a crucial factor in the emergence of a new social order: the IS, where the socio-cultural sphere and the economic system are underpinned by the massive use of technologies (such as computers, telephony and internet) and access to information and knowledge (Serrano and Martínez, 2003).

In Mexico, many rural areas in southern municipalities, such as Oaxaca, Guerrero and Chiapas, do not have access to ICTs. One of the reasons for this is that the providers of telephone and internet services are private companies governed by laws of supply and demand, and since these communities are sparsely populated, have low purchasing power and high poverty rates, they end up being marginalized by these companies and are unable to access the services they offer. Faced with this reality, on several occasions it is the communities themselves who seek strategic alternatives to reduce the digital divide they suffer.

The CBT in San Pedro el Alto is one of these measures, and it is particularly relevant to the project for three reasons: 1) it is a strategy that emerged from organized civil society; 2) it was implemented as a public action through community participation; and 3) it occurs in a community that is predisposed to participation and collaboration to obtain the provision of telephony and internet services.

The theoretical structure followed by the research is based on the foundations of social inclusion and cohesion, public action and social collaboration and their relationship with digital inclusion and potential solutions to the digital divide (to achieve equal opportunities). Likewise, the enabling, environmental and participation factors of the public action model adopted in the town of San Pedro el Alto, the community context and the design, implementation and operation of this telephony service were analyzed.

Theoretical references

Inclusion and social exclusion

Social inclusion and social exclusion are interlinked processes that cannot be separated, as their factors are interdependent. Carbajal (2009) points out that the concept of social exclusion refers to a situation in which insufficient material means, lack of participation in employment and the inability to access goods such as culture, education, health or housing are consistent. Travieso and Planella (2006) state that it is a multidimensional phenomenon that includes psychological, psychosocial and especially cultural factors.

Following this perspective, social exclusion can be defined as a social situation that prevents the achievement of a better social position, overcoming a disadvantaged situation or enjoying a right to which one should have access (Chuaqui, Mally and Parraguez, 2016). This multidimensionality proper to the term, according to Chuaqui, Mally and Parraguez (2016), includes aspects: economic (estate and income), territorial (the geographical context, infrastructure and technological means) and sociocultural (status, social roles, ethnic aspects and discrimination factors, among others).

Regarding social inclusion, Silver (2015) points out that it is a relational process that relies on social interaction and fosters solidarity, cohesion, mutual respect and a sense of belonging, as well as the improvement of capabilities, opportunities and living conditions in general. In other words, social inclusion is essential for social integration, understood as the set of factors with an impact on affective ties and the formation of social structures, such as culture, language, incentives, status and leadership (Blau, 1960).

Barba (2011) mentions that "social integration is the functional basis of social cohesion and the latter fundamentally underlies sociocultural aspects and normative formalization" (p. 71). The author takes up Durkheim's theories by pointing out that social cohesion can be seen as mechanical solidarity, founded on common beliefs and practices that strengthen identity, the perception of equality, collective consciousness and the construction of social institutions and structures.

In this sense, social inclusion is based on processes that bring together a set of collective efforts undertaken in a specific context to increase people's opportunities for integration into the social sphere. Inclusion and social cohesion are materialized from communitarianism, conceptualized as the set of norms and principles that determine behaviors, intra- and inter-group relations and ways of acting in everyday life: at work and in social, economic and affective relationships (Camas, 2014, p. 51).

Other fundamental aspects for social inclusion include social participation and public action, factors that are generally prevalent in rural communities. For example, when these populations face problems related to the poverty and marginalization they experience, and on their own initiative they organize to address them. This happened in San Pedro el Alto, where the inhabitants were forced to implement CBT to reduce the digital divide in which their community finds itself.

Public action and social participation

Public action is regularly associated with the State and the government; however, for Peters (2003) this idea moves us away from the original conception. Public is that which concerns the people; therefore, it has more to do with the collective and community than with the government. Thus, nowadays, the public must be related, at the same time, to the action of the State and to the collective interest (Garzón, 2003). The public is the world and the common space that arises when people are grouped and organized around discourse and action (Esteban, 2016), and is characterized, in essence, by inclusion and plurality, i.e., the coexistence of similarities and differences and the search for the common good.

With this in mind, public action implies joint government-society solutions and collective decisions to address problems of collective interest (Ruano, 2002). It is conceived as "the capacity to define collective goals, to mobilize the necessary resources to pursue them, to make the decisions required to achieve them and to assume the resulting consequences" (Durán, 1999, cited in Amaya, 2010, p. 45).

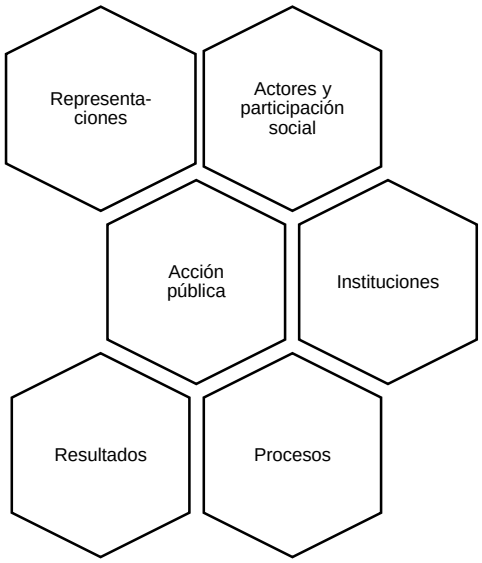
To Amaya (2010), social participation and collaboration comprise the essence and nature of public action, which is a strategically organized task, involving a number of actors and resources to solve a common problem. Thus, the theorists of public action first off consider the actors involved and their exchanges, which allows focusing on the importance of the individual in decision making, in the consequences of these and in the solution of a problem.

Public action involves the interaction of various actors, individual or collective[1], as well as the intervention of different sectors: public, social and private (Cabrero, 2009; Thoenig, 1997). This exchange has economic and political implications related to assets and resources, the exercise of power, institutional arrangements and the set of rules and procedures governing decisions, interactions and the action itself (Lascoumes and Le Galés, 2013).

In San Pedro el Alto, CBT was implemented based on the participation and collaboration of different actors (government figures, external agents and the inhabitants themselves); this takes part of the theory of public action to contribute to digital inclusion, both in the way of organizing and collaborating, as well as in the actions of those involved in this community process. For the research, an interactive model of public action was applied based on the historical or traditional model of Jones (1970) and on the pentagon of public action proposed by Lascoumes and Le Galés (2013), which considers the analysis of five interrelated variables: representations, actors, institutions, processes and results. In order to achieve a better understanding of community action, the factor of social participation was added to the actors' variable (see Figure 1).

[1] Uslaner and Conley (2003) point out that the problem of public action does not lie in the participation of associations or collectives, but rather in the capacity of these to house heterogeneous groups within them.

Figure 1. Public action model



Source: developed by the author with data drom Lascoumes & Le Galés (2013).

Representations are the cognitive frameworks that give meaning to individual and collective actions. Actors can be individuals or collectives that are part of the community and have certain material and symbolic interests, as well as resources (economic and political) and a certain autonomy to design action strategies and participate in them. Institutions are the frameworks for action, and are represented by norms, rules, routines and procedures that guide the interactions of the actors. Processes are determined by the combination of representations and institutions, while outcomes are the effects produced through public action, both on the organization and behaviors of actors, and the impact achieved on the problem (Lascoumes and Le Galés, 2013, p. 20).

With these details, social participation (added to the second variable) refers to the involvement of individual and collective actors in public action, from prior agreements –the contribution of knowledge and resources, and the work that is performed– to the implementation and operation of the CBT system.

In the case study, this participation is unconventional, because it is not subordinated to compliance with formal rules. The context of the community of San Pedro el Alto made the implementation of a collective action model possible, since this small rural town, although with serious problems of poverty and social backwardness, is characterized by having been historically governed by uses and customs, and by practicing social participation and collaboration as traditional mechanisms for solving community problems.

Digital inclusion and technological divide

Digital inclusion is a complex theoretical-conceptual construct, in which technological infrastructure, information, the economic system, culture and institutions play an important role. It focuses on taking advantage of the benefits of the IS and is conceived as a form of social inclusion. For the International Telecommunication Union (ITU), digital inclusion entails empowerment and gender equality (ITU, 2016).

Ramírez and Sepúlveda (2018) state that digital inclusion does not imply the adoption, access and use of ICTs, but rather it is a process that includes physical and intellectual access to them, whose social impact translates into equal opportunities for individuals and communities to participate, relate and take advantage of the benefits of IS in all areas, regardless of the conditions in which they find themselves.

To Thompson, Jaeger, Taylor, Subramaniam and Bertot (2014), digital inclusion is the result of processes undertaken by governmental and non-governmental entities to close the digital divide and digital literacy, because in developing countries the first obstacle to digital inclusion is precisely the technological divide –the lack of access to ICTs (Hargittai, 2003)– which translates into marginalization and inequality in access to and use of technologies.

To Keniston and Kumar (2003), there are four dimensions of the digital divide: a) economic, which underlies the lack of economic resources to acquire ICTs; b) linguistic, associated with the hegemony of dominant languages such as English; c) technological, related to the lack of access to the ICT industry and poor internet connectivity; and d) cultural, related to the dominant capabilities, skills and cultures in the IS.

In addition, Selwyn (2004) says that the digital divide is not a linear process and there are multiple disjointed lines, so it could be said that there are different digital divides: of effective access to ICTs at home, work and school; of ICT use, in terms of usefulness and relevance for the user; and of results and impacts, related to productive, social and political activities.

Community cellular telephony (CBT)

Although there is no generalized concept of CBT, Huerta and Lawrence (2017) propose a series of characteristics that allow differentiating this service from other modalities. Thanks to these, it can be said that CBT is a specific telephony model developed based on ITU recommendations for the development of public and ICT policies in rural and indigenous communities.

The model was designed by considering the socioeconomic levels of the users and is operated through a local network managed by a cooperative association of the communities themselves. “National calls are made through the internet, a service that is provided by a microenterprise, and voice over internet service (VoIP) is provided by a

small operator, which connects to the global telephony network" (Huerta & Lawrence, 2017, p. 8).

CBT comprises four elements: 1) the organizational base; 2) the technological base; 3) the economic base; and 4) the technical base. The first point corresponds to the community social part responsible for the administration and operation of the service; for its part, the second contemplates that the technology used be accessible in economic terms (for its acquisition), as well as to the technicians in charge of its operation and maintenance. The third element comprises the business scheme, in accordance with the economic conditions of the users; and the fourth integrates the material infrastructure and the technical knowledge of the personnel for the operation and maintenance of the service (Huerta and Lawrence, 2017).

Another important aspect for the authors is the regulatory framework made up of internal community guidelines (uses and customs, system of charges, community assembly, communal property, etc.) and external regulations that protect the rights and internal autonomy of indigenous peoples and communities –stipulated in the second article of the Federal Constitution, in Convention 169 of the International Labor Organization and in local legislation– as well as specific telecommunications regulations. These aspects together allow for self-management of the service.

The TCC model is deployed through a hybrid macro network integrated by three networks: a local community network, which operates in the 850 MHz band spectrum; a transport network, which contains a Wi-Fi remote link system belonging to the ISP; and the Internet Service Provider (ISP) link to the backbone network of a public telecommunications network concessionaire to which interconnection services must be paid (Huerta & Lawrence, 2017, p. 15).

Community Context: San Pedro el Alto, Zimatlán, Oaxaca

For more than two decades, Mexico has implemented public policies for digital inclusion. The National Development Plan 2001-2006 established the strategy of "expanding the basic infrastructure for digital transmission in order to extend its coverage to rural or urban localities of high marginalization", to reduce the digital divide and thus achieve social inclusion of the most underprivileged groups (Diario Oficial de la Federación, 2001).

Although the rural concept is difficult to define, because it involves several elements, a characterization of rurality can be achieved by considering the following factors: human settlements with low population density in a landscape dominated by natural elements, such as forests, mountains, meadows, jungle, desert, etcetera (Ashley & Maxwell, 2001), where the most important productive activity is agriculture or farm work (Abdulwakeel, 2017), and a home environment prevails based on ancestry, cultural heritage and, mainly, community life (Chigbu, 2013).

Other characteristics must be added to this; in developing countries, rural communities lack planning (Chigbu, 2013), so they remain territorially isolated. This causes problems of access to basic services, lack of non-agricultural employment opportunities and deprivation of infrastructure for communication, education, financial and health systems, among others.

According to the 2010 Population and Housing Census conducted by the National Institute of Statistics and Geography (INEGI), there were more than 50,000 rural areas in Mexico[2] that did not have access to telecommunications services, representing 16.42% of the country's total population (INEGI, 2013). In 2013 the Federal Government promoted new measures in the interest of decreasing this figure, one of them was to recognize access to ICTs and digital inclusion as constitutional rights (Alva de la Selva, 2015). These efforts have not been sufficient and the reduction of the digital divide has not been entirely effective, especially in regions with high poverty rates and marginalization, such as Oaxaca.

In 2010, Oaxaca had 4,132,148 inhabitants (3.3% of the country's population), 51% of which lived in a rural sector, a figure that contrasts with the national distribution, where 71% of the population lives in urban centers. The level of schooling reported by this municipality is 8.1 years, lower than the national schooling level of 9.7 years. In addition, 31 out of every 100 people are indigenous language speakers (INEGI, 2013).

According to statistics, in 2017 only 40.4% of Oaxacan households had internet access, and in 2018 just 29.1% owned a computer, a percentage that decreased to 8.2% in rural localities[3] (Instituto Federal de Telecomunicaciones, 2019). At the close of this year, while the average mobile teledensity (cell phone service lines per 100 inhabitants) nationwide was 96, Oaxaca (79), Guerrero (77) and Chiapas (73) reported the lowest figures (IFT, 2019).

In 2021, CIO Mexico magazine published a study on connectivity showing digital divide asymmetries. Mexico City, Baja California and Nuevo León are positioned as the entities with the highest internet connectivity in homes (76% in the first case and 70% in the other two), while Guerrero, Oaxaca and Chiapas occupy the last places, with 32%, 29% and 22% respectively (CIO Mexico, 2021)[4].

The rural town of San Pedro el Alto is located 29.3 kilometers from the municipal capital of Zimatlán de Álvarez, Oaxaca. By 2020 it had 925 inhabitants; 25.73% of the population was reported as indigenous and only 4.2% as illiterate. The average level of schooling is 8.5 years. In terms of the digital divide, the following

[2] In Mexico, rural localities are considered to be those with a population of less than 2,500 inhabitants (Soloaga, Plassot and Reyes, 2021).

[3] This contrasts with the percentage of Mexico City (66%) and the average that was registered at the national level (45%).

[4] Following this trend, the states with the lowest increase in computer availability between 2010 and 2020 were Oaxaca, Guerrero, and Chiapas, the first two with 20% and the last with 16%. From 2010 to 2020 the availability of computers in homes went from 29% to 38% on average in the country, but some entities reported a minimal increase: in Oaxaca it was barely 6%, in Guerrero and Tabasco 4% and in Chiapas of 3% (CIO, 2021).

relevant data were found: 4.31% of households have a computer, the same percentage that has a fixed telephone; in contrast, 42.58% of the inhabitants have a cell phone but only 8.61% have internet access (PueblosAmerica.com, n/d)[5].

Methodology

The research that was performed included an intrinsic case study of an exploratory type (Stake, 2005) that was developed under a mixed convergent design with an exploratory-descriptive scope, as it is a little explored phenomenon. Prior to the empirical research, a documentary study was carried out to establish the theoretical-conceptual bases; subsequently, a visit was made to the community to identify the actors and informants and, through observation, to gather information on the community context.

The influencing factors of this project were investigated through semi-structured interviews applied to six key actors (the selection of informants was made by convenience) (see Table 1).

A survey was also conducted to obtain quantitative data. The questionnaire consisted of ten questions organized in three sections: sociodemographic information of the respondent; the mechanisms of access and operation of the CBT; and information related to learning and development of ICT competencies. The instrument was validated by experts and a pilot test was applied to ensure that the questions were well structured.

Table 1. Actors and key informants

Key informants	Dependency
Informant 1. Administrative representative Informant 2. Technical spokeman	Rhizomática A.C.
Informant 3. Committee chair Informant 4. Office manager	Comité de Telefonía Celular Comunitaria
Informant 5. Municipal agent Informant 6. Agency secretary	Autoridades de San Pedro el Alto

Source: developed by the author.

Participants were chosen by simple random sampling; the population size was 130 people, which is equivalent to the number of CBT users, comprising men and women between 16 and 70 years of age. The confidence level was 95% and the margin

[5] These figures can be compared with data from 2010, when 6.21% of the inhabitants had a cell phone and only 0.56% had Internet access (PueblosAmerica.com s/f).

of error was 5%, resulting in a sample of 97 people. The sample size was determined based on Vallejo (2012), applying the following formula:

$$n = \frac{N * Z^2 * p * (1-p)}{(N-1) * e^2 + Z^2 * p * (1-p)}$$

Where:
N is the population size: 130
a_c represents the value of the confidence level (variance): 95
e^ is the margin of error: 5%

By substituting in the formula, the result is as follows:

$$n = \frac{130 * 1.96^2 * 0.5 * 0.5}{(130-1) * 0.05^2 + 1.96^2 * 0.5 * 0.5}$$

Finally, the CCT analysis was carried out with the variables of the public action, in order to know its design, implementation and operation, as well as its contribution to digital inclusion in San Pedro el Alto.

Results

Enabling factors

The data from the surveys show that 57% of CBT users are women, which indicates that there is no gender digital divide (see Graph 1). As for the age of the users, 33% are between 16 and 25 years old and 25% are between 26 and 35 years old, indicating that most of the users are young individuals, part of the productive sector of the community (see Graph 2). The same graph shows that, as the age range increases, the percentage of users decreases; for example, from 36 to 45 years old (17%), from 46 to 55 (15%), from 56 to 65 (8%) and 65 and over (2%).

Regarding occupation, it was found that the majority of users (40%) are people who have a paid job, either in health areas, in the Municipal Agency or in small businesses. Students are in the second place, with 36%, and day laborers the last (1%) (see Figure 3).

Environmental factors

In the analysis, the people or companies that offer telephone services in San Pedro el Alto, Zimatlán were considered as part of the environmental factors. In this regard, it was found that in the town there are some Telmex booths that offer pay-per-minute telephone services. Given the existence of these a first question arose: what were the

factors that gave rise to this telephony model as an alternative to contribute to digital inclusion? The municipal agent pointed out:

> In the community there are three Telmex booths where local or long distance calls can be made, but people do not feel comfortable because of the privacy. But there were not many options for us, to be able to choose from among existing companies, the ones that could provide a better service. That is why, since Telmex did not respond to us, we decided to see what would happen if we let the Rhizomatica organization support us in the installation of this community telephony. We found out about this type of telephony from a person here in the community (Whistleblower 5. Pérez, H., personal communication, March 10, 2020).

According to whistleblowers, the services in the Telmex booths in San Pedro el Alto are deficient, since the area does not have cell phone coverage, in addition to the fact that its price is high. With the intention of providing a solution to these problems, the population decided to promote CBT.

Participation factors

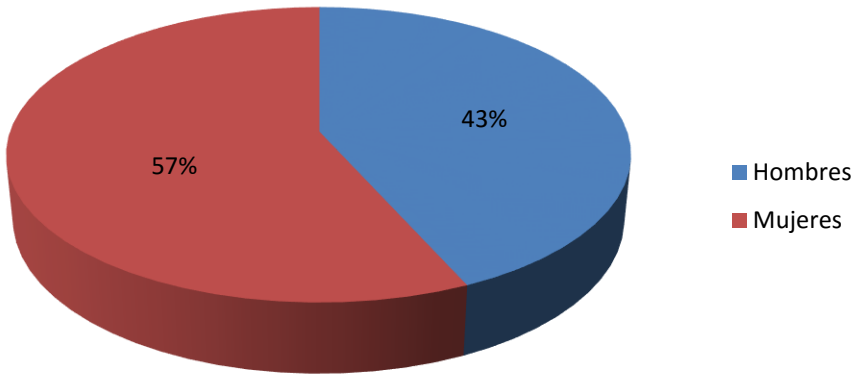
To learn about the factors of participation in the operation of CBT services, in the interviews we asked about the number of committee assemblies and the number of users involved in these assemblies.

> The committee does not really call its own assemblies, what happens is that the information is presented in the meetings called by the Municipal Agent. In fact, there are two mandatory assemblies per year; if it is necessary to attend to some specific issues, two intermediate assemblies are held, but the participation of the committee in these is very low. In the two mandatory meetings we do participate, as an established point in the agenda. Regarding the participation in the meetings, we only inform about the number of payments that have been made up to that moment and some of the recommendations given in the trainings we get in the city of Oaxaca (Informant 3, Zárate, C., personal communication, March 10, 2020).

The interviewees mentioned that information about the service and costs of CBT is provided in a personal manner, both to users and to people in general who are interested. When inquiring about the number of clients covered by the model, it was commented that "we do not have a specific number, but on average there are 130 users per month, since some of them unsubscribe or stop paying and others renew their payment" (Informant 4. Antonio, M., personal communication, March 10, 2020).

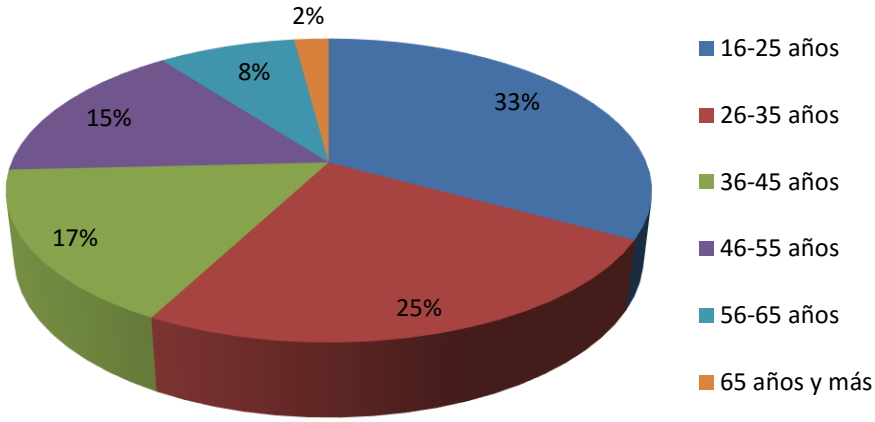
The responses obtained also hint at the need to improve the quality of service, as well as to work on the technical aspects of telephony, improvements that would have a positive impact on the demand for the service. "I think that the quality of the calls has a lot of influence; if there were coverage most of the day, more constantly, I think there would be more people registered as users, but sometimes the service fails a lot and that makes one dissatisfied" (Informant 5. Pérez, H., personal communication, March 10, 2020).

Graphic 1. Gender of CBT users



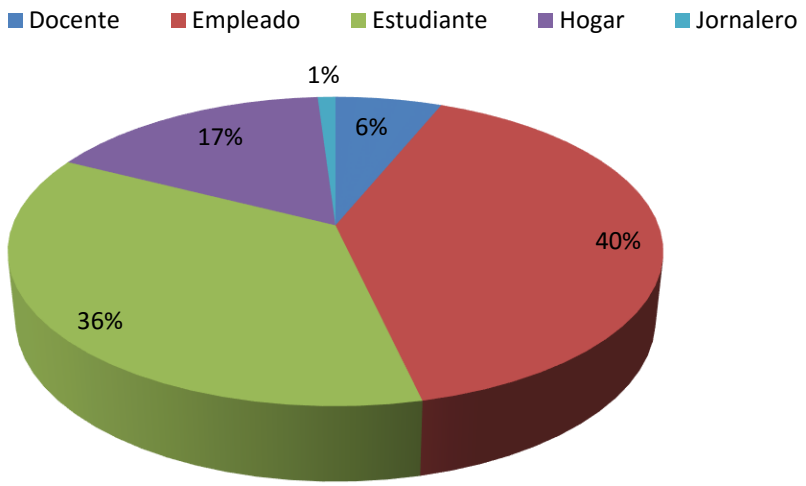
Source: developed by the author.

Graphic 2. Age range of CBT users



Source: developed by the author.

Graphic 3. Occupation of CBT users



Source: developed by the author.

One of the clarifications made in this aspect was that the type of technology used in the community does not allow connection to the internet, only to telephone services.

Public action

From the data obtained through the surveys and interviews, some of the variables of the public action pentagon proposed by Lascoumes and Le Galés (2013) can be analyzed. Because an important aspect of public action is institutions, it was inquired with informants whether there are internal rules, regulations or operating manuals of the committee on CBT, and whether they provide any advice for the use of the service's cellular devices.

> Within the committee there are no written regulations that could guide the activities performed, but we already know how we work. As for advice to users, this is available all the time, even outside working hours. We explain in detail how to use the telephone equipment and which keys to press when there are deficiencies in the calls. In case it is a person who does not know how to read, I do it myself at that moment, and if they come back, I do it again (Whistleblower. Antonio, M., personal communication, March 10, 2020).

In reviewing the criterion of representations, it is considered necessary to strengthen aspects of this telephony model. Although the San Pedro el Alto CBT committee regularly attends training given by Rhizomatica and provides advice on the use of telephone equipment, the delimitation of internal regulations, the processes of technical

advice, and the mechanisms for information and interaction with users need to be improved.

When asked about the attendance of the committees to the training provided by the organization, Rhizomatica's technical spokesperson stated the following:

> Most of the committees attend the trainings, those who for some reason cannot come, we send them information by alternative means, or we attend the community. In the particular case of the Sierra Sur committee, it is one of the committees that most attends the trainings that are scheduled. And, most of the times it is appreciated that San Pedro el Alto is one of the communities that reflects better organization (Informant 2. Orozco, R., personal communication, February 22, 2020).

In the process criterion, the decision-making of CBT users was considered, with special attention to the question of whether people feel that this service belongs to them. The CBT committee chair commented that:

> The people of the community were the ones who decided whether this telephony model would be implemented or not. Now they feel identified with this type of telephony. For example, regarding the infrastructure, people take care of it and respect the place where the antennas are located, [also] they agreed that a person should be appointed as a watchman to protect the things all day long. It is true that there are many failures in the service, but it is also true that this service gets many people out of trouble when emergencies arise (Informant 3, Zárate, C., personal communication, March 10, 2020).

According to evidence, it can be observed that deployment of the actors, as well as their exchange dynamics and their evolution, is consistent with what was proposed in the public action model. Over time, users take ownership of the service and take advantage of community meetings to deliberate and make decisions related to CBT. In addition, the work of the community authorities and the committee contributes to social integration, while at the same time providing solutions to the technical and administrative problems of the service.

Within the results criterion, and with the purpose of realizing what the reason was behind the adoption of CBT, the question was asked: what was the intention of implementing this telephony model in the indigenous municipalities of Oaxaca?

> This project did not arise with the desire to compete with the large companies that offer cellular telephone service. It arose with the idea of communicating to indigenous communities where this service is not available, [the CCL] represents an alternative for communities to have access to cellular telephony. There are other ways to do it, through a satellite or there are many communities that have fixed telephony, but the problem is that they would have to pay high costs to make their phone calls and [these] have a limited time.
>
> What we have sought is to develop a technology that allows lowering the cost of the service and contribute to the economy of the communities; in addition, community cellular telephony, unlike commercial telephony, belongs to the community, they buy their equipment by means of the municipal agencies or community authorities or between the two, [which] are generally divided, but in the end they work for the same purpose. What they do is that they get together, gather resources and organize themselves to purchase the equipment (Informant 2. Orozco, R., personal communication, February 22, 2020).

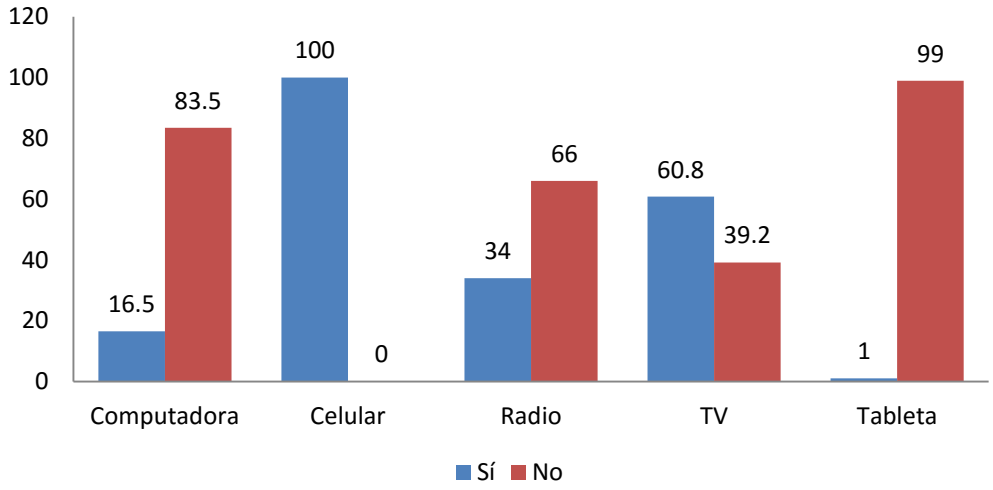
By generally reviewing the information obtained in the interviews, it is may be inferred that Rhizomatica finds that the results of CBT have been positive in the communities where the model has been implemented. The association's representatives said that they regularly visit the communities to provide advice to the committees and verify that the networks are in good condition.

Use of ICTs by CBT users

Survey results show a general overview of ICT access in San Pedro el Alto, Zimatlán. All the survey respondents have a cell phone, but only 16.5% have a computer; likewise, 34% have access to radio and 60.8% to digital television (see Graph 4). Those who said they did not have a computer, radio or television said that this was due to lack of economic resources.

In the area of communication, 83% of CBT users can make a phone call, 56% can send a text message, 54% can record audio and 58% can take a photo (see Graph 5). However, it is observed that users do not have the necessary skills to use digital technologies or to surf the net, which speaks of the existence of a cognitive gap and, therefore, of an opportunity for improvement in terms of digital literacy.

Graphic 4. Access to ICT for TCC users



Source: developed by the author.

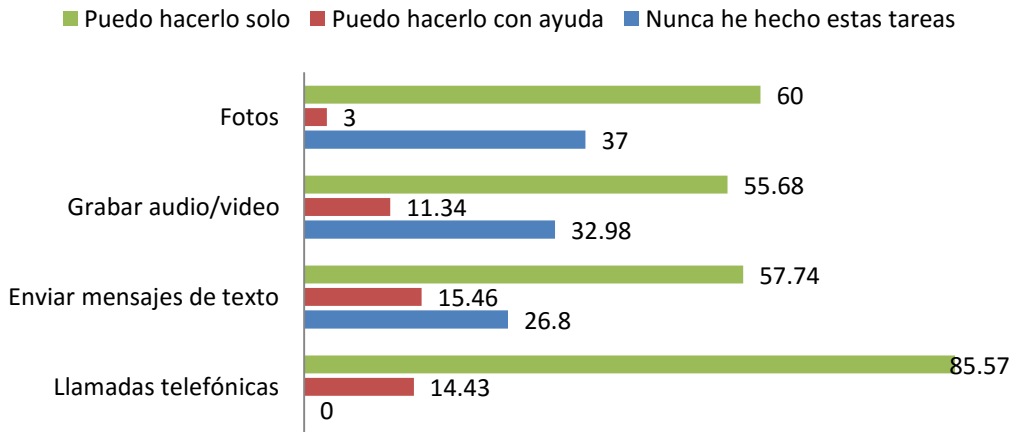
Regarding the effective use of CBT services, 36% of users said that they use them very little, 27% that they use them a few times a week, 18% that they use them a few times a month, and only 19% indicated that they use them every day (see Figure 6). This shows that there is no intensive use of CBT in the area.

Impact of CBT on users

When asked about the impact of CBT on the improvement of their quality of life, 17.53% of women and 28.87% of men considered that it contributed little to their lives. On the other hand, the perception that there was no improvement in their daily lives was minimal, with only 4.12% of men and 6.19% of women making this statement (see Figure 7).

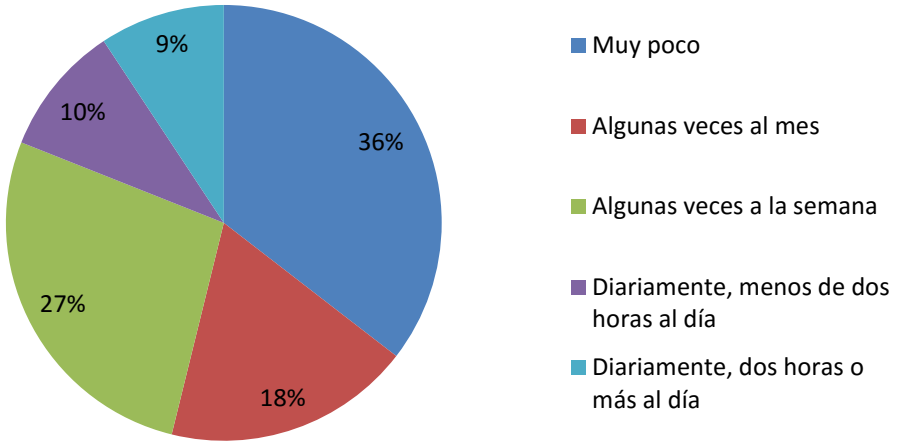
The level of education of users is relevant, as there is a direct relationship between this and the use of CBT. Most of the users only have elementary (41.18%) and secondary (36.78%) education. In contrast, high-school users (16.6%) and university students (2.2%) represent a minority. Figure 8 shows the frequency of CBT use by level of education; users who use it two hours or more per day have elementary and secondary education. Similarly, those who said that they almost never use CBT have only elementary (28.8%) and secondary (46.6%) education. Users with university studies (2.2%) reported using CBT a few times a week.

Graphic 5. Digital skills of CBT users



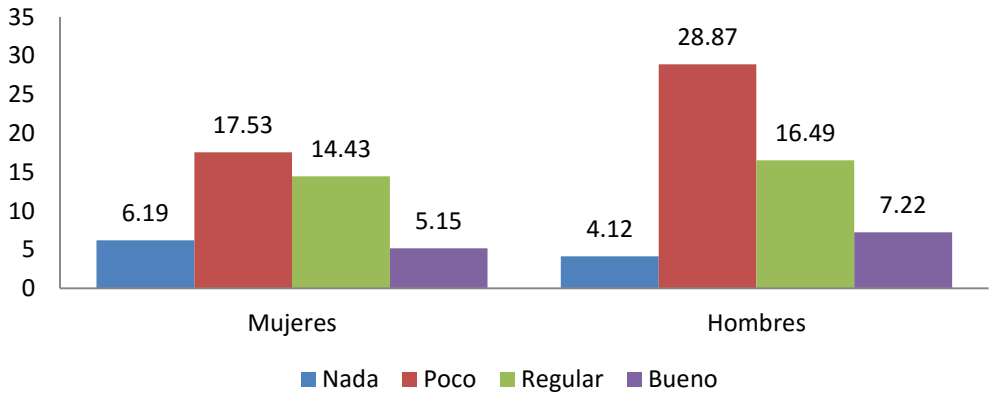
Source: developed by the author.

Graphic 6. Effective use of CBT services



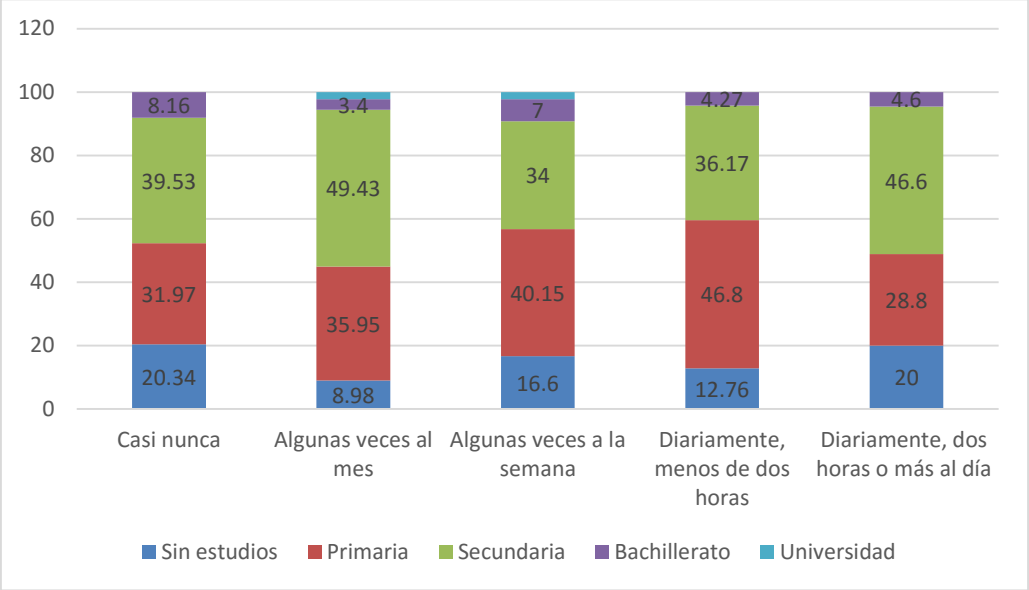
Source: developed by the author.

Graphic 7. Perception of improvement in the standard of living generated by the CBT



Source: developed by the author.

Graphic 8. Use of CBT by educational level



Source: developed by the author.

Discussion and conclusions

CBT is a viable alternative for communication and interaction in rural communities with economic poverty and social marginalization, problems that contribute to the digital divide. This is based on two reasons; first, CBT implies a low cost for users, and second, it serves to improve social integration, digital inclusion, collaboration and the development of basic ICT skills.

After the project has been carried out, it was concluded that CBT is not an option to promote the transition to IS, due to the fact that users do not have access to the network. Despite this, it is necessary to highlight that this telephony model partially covers one of the fundamental communication needs, so it is possible to perceive it as a mechanism for the empowerment of communities, which has the potential to improve the quality of life of its users through communication.

With respect to education levels, it is evident that there is a correlation between these and the development of IS. As observed, a significant part of the population in the case study has basic education (elementary 41.18% and secondary 36.78%) and the population with higher education is smaller (high school 16.6% and university 2.2%). This can be translated into limited educational conditions, which hinders, as a group, the achievement of the IS and, therefore, hinders access to the benefits brought by social and economic development. To solve this, it is necessary to increase the educational conditions of the population.

Conversely, the research uncovered that part of the CBT users in San Pedro el Alto lack skills to use ICTs or surf the net, denoting the existence of a cognitive gap and a lag in digital literacy. This is especially interesting when considering that the majority of users (58%) are young people between the ages of 16 and 35, whose relationship with CBT has the potential to improve their technological skills.

As mentioned above, the CBT model turned out to be the only alternative for the digital inclusion of the community in San Pedro el Alto, Zimatlán, since there was (and still is) no competition in the cellular telephony industry capable of providing coverage to the entire territory. For this reason, it is considered that environmental factors did not play a determining role in the implementation of this alternative. On the contrary, the results show that the participation factor had a considerable influence on the introduction of CBT, since consultation and decision making took place directly in community assemblies, in which all those interested in the service could participate.

The main axes of the public action undertaken through CBT were the actors and social participation, which complies with the premises of public action indicated in the theoretical references. The actors that participated in the CBT project are part of the public sector (authorities of the Municipal Agency, who contributed through political authority and management capacity and decision-making coordination in the community meeting), social sector (citizens in general, who intervened in decision-making and provided the necessary resources for the acquisition of equipment) and private sector (Rhizomática A. C., an organization that provided the experience and technical expertise and provided technical advice and training).

Currently, the operation of the CBT service, to a large extent, also depends on the users' committee involved in the operational management of the service and the representations, which is responsible for promoting a culture of appropriation of the CBT model through control, management and technical operation. Therefore, the representations are the essence of both social integration and digital inclusion, as well as of social appropriation of the service.

Although the criterion of institutions was not implemented as such, it has not been a determining factor in the implementation and operation of the CBT model, since the Municipal Agency of San Pedro el Alto is traditionally governed by uses and customs, that is, through informal internal rules and norms, called indigenous normative systems.

One of the negative (or at least neutral) aspects of CBT is that it does not have an influence on agricultural tasks, the main economic activity of the community; this is due to the fact that farm workers hardly use telephony services, show little interest in the subject and perceive that it does not improve their quality of life. Another negative factor is that the CCT is marked by the difference: 57% of households do not have access to a cell phone. This means that more than half of the population cannot communicate or interact through CBT, which leads to a technological divide between those who have access to this service and those who do not, a situation that constitutes social inequality.

Finally, emphasis is made on the fact that the digital or technological divide is a phenomenon that will continue to be present in marginalized rural communities as long as internet and cell phone services are in the hands of the market. For this reason, the CBT model that is operating in the Agency of San Pedro el Alto, in the municipality of Zimatlán, Oaxaca, is a viable alternative for digital inclusion and to reduce social inequality, as long as coverage is extended to all homes in the community.

It is recommended that the CBT model be promoted in other rural communities in Oaxaca with digital divide problems, since it is a digital inclusion alternative that, in addition to the low cost represented thereby, serves to promote social participation and community integration, as well as collaboration between the public and private sectors.

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