
Reducing the Digital Divide in Vulnerable Communities in Southeastern Mexico

Reducción de la brecha digital en Comunidades Vulnerables del Sureste de México

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Abstract

In the XXI century, it is crucial for people belonging to vulnerable and highly marginalized communities have access to telecommunications and have the minimum skills required to use technology, as they are rapidly becoming a tool for transmitting and obtaining information. In today information society, remains a digital divide between those who have access to technological computing resources and Internet, and those who do not, presenting a constant challenge for the development of our people.

This paper analyzes the impact of a mixed training program, called: REBREDIG-PJA for the reduction of the digital divide in young and adult people from a vulnerable community in southeastern Mexico, which presents high levels of social marginalization.

The results of this study are discussed under the guidelines of the National Development Plan (2013-2018) and the National Digital Strategy (2013) for Mexico and are compared with the guidelines stated in the State Development Plan (2012-2018) for Yucatan.

Keywords: digital divide; information society; vulnerable community; social marginalization

Resumen

En el siglo XXI, es crucial para las personas pertenecientes a comunidades vulnerables y con alto grado de marginación tener acceso a las telecomunicaciones y poseer las competencias mínimas requeridas para utilizar la tecnología, ya que ésta se está convirtiendo rápidamente en una herramienta para difundir y obtener información. En la sociedad actual de la información, persiste una brecha digital entre quienes tienen acceso a los recursos tecnológicos de cómputo e internet y los que no, presentando un desafío constante para el desarrollo de nuestros pueblos.

En este trabajo se analizó el impacto de un programa formativo mixto, denominado: REBREDIG-PJA para la reducción de la brecha digital en personas jóvenes y adultas de una comunidad vulnerable del sureste de México, que presenta altos grados de marginación social.

Los resultados de este estudio se discuten bajo los lineamientos del Plan Nacional de Desarrollo (2013-2018) y la Estrategia Digital Nacional, (2013) para México y se comparan con los lineamientos declarados en el Plan Estatal de Desarrollo (2012-2018) para Yucatán.

Palabras clave: brecha digital; sociedad de la información; comunidad vulnerable; marginalización social

Introduction

The phenomenon known as the digital information society started in the United States of America at the dawn of the 90s, when Larry Irving Jr. from the Department of Commerce and Communication administered surveys to the American population about the use of technology. He found that there was a gap in access to information services among those who could afford the hardware and software needed to be part of the global information network and those low-income families and communities that could not afford it (Boje & Dragulanescu, 2003; Irving, Klegar-Levy, Everette, Reynolds & Lader, 1999).

Different studies at a global level (Banihashemi & Rejaci, 2015; Haight, Quan-Haase & Corbett, 2014; Ataso, 2013; Chen, 2013; Warschauer & Matuchniak, 2010) coincide that

the concept of digital divide can be defined as an inequality that exists between individuals, households, companies and geographical areas at different socioeconomic levels with respect to their opportunities of access to information and communication technologies and the use of the internet for a wide variety of activities. The main emphasis of this phenomenon is on the importance of information for improving people's quality of life, increasing employment and business opportunities, generating new scenarios for thinking, learning and communication, enriching citizens experiences and for a society to function properly and equitably.

The deepening of these differences product of this phenomena, have provoked that people who live in urban areas with a larger grade of development, have better access to telecommunications being able to enjoy higher speed in their telephonic services, have competitive providers and attain a greater amount of content and information that is relevant to their lives. On the other hand, those people that live in rural communities of high vulnerability have limited to no access to these technologies which limits their opportunities of accessing a higher quality of life, preventing levels of education and retarding the successful incorporation into the technological society.

The impacts of this phenomena have triggered studies around the world. As an example: Negreiro (2015) wrote for the European Parliamentary Research Service (EPRS) a document titled: Bridging the digital divide in the EU, in which the importance of having digital technologies in the everyday life of the majority of Europeans was emphasized, where it's made evident how internet allows people, companies and governments to transform the way they communicate and relate to each other. The document states that the divide has substantially decreased in Europe during the last decade, but continues to be far from closing, since there are still some sectors of the population that are excluded from the use of these new technologies. For EPRS the infrastructure is as important as the optimization of digital abilities of citizens, proof of that, is that every home in the European Union (EU) has basic wide band access and 75% of all Europeans are regular internet users in accordance to data from the European Commission's Digital Agenda (2014). However, the document mentions that the challenges set by internet use continues to be important, this because at least half of the less educated and elders of the population do not use it regularly, and around 58 million people in the EU (between 16 and 74) have never used it. Findings were consistent with the work of Peacock (2019), Gonzales (2016), Cohron (2015), and Wei and Blanks (2011), who found that the acceleration of technological development and globalization has turned the use of technology into a domain indispensable only for the privileged social classes and for the most developed countries. The challenge is how to increase access for those in need, in order to close the gap.

Likewise the United Nations Educational Scientific and Cultural Organization (UNESCO, 2017) in the document titled "Leaving no one behind: from digital divide to *digital empowerment*, concrete examples are shared on how the resulting digital empowerment from successful measures were adopted at an international and national level bettered the quality of life in people with a disability, gave access to information and knowledge, helped learning and teaching, cultural expression and employment. The document emphasizes that scientific and technological progress should not deepen even further the existing division between young and elderly people, children, women and men; speakers of tongues barely in use, those that live in remote and urban areas; as to those that have different capacities, on the contrary, it is necessary to create tools and opportunities to access multi-languages information and knowledge, utilizing the inclusive ICT and allowing the full expression of culture and arts, to ascertain full par-

participation from society. Prior results were consistent with other studies carried out in diverse contexts where there is a clear impact on the gap in the use of technology, indicators of inequality and the number of years of schooling (Mecinas, 2016; Van Deusen & Van Dijk, 2014).

Now, the World Bank (2016) in a study entitled: *Digital dividends – General View*, states that life for the majority of the world's population will basically remain unaltered by the digital revolution. Only around 15% can afford Wide Band Internet access. Mobile telephony, to which almost four fifths of the world population has access, constitutes the main source of internet access in developing countries. But, even so, almost 2,000 million people do not own a mobile telephone, and around 60% of the world's population does not have internet access. Those people are mainly in India and China, however in North America there are still more than 120 million people without an Internet connection (See figure 1).

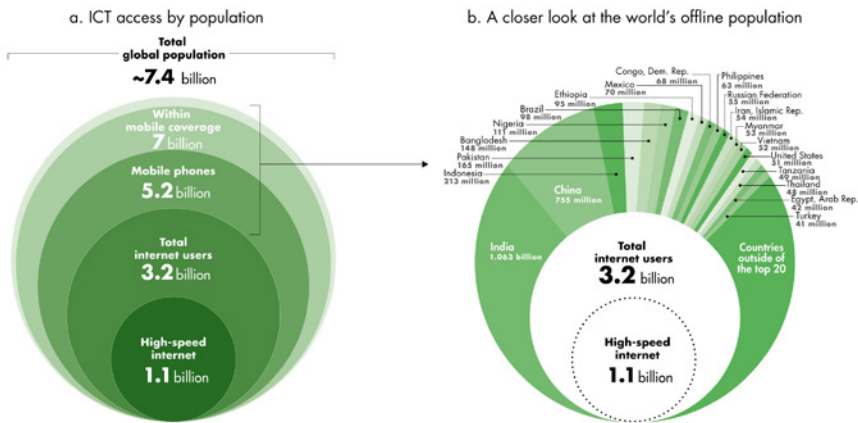


Figure 1. World Population – 7,400 millions

The results, specifically in the case of Mexico, show that according to the World Bank (2016) there are 70 million users that have no access to internet nor can they afford it, which after comparing it with the last inter-census poll from the National Institute of Statistics and Geography resulted that in Mexico there are 119,938,473 inhabitants, from which 58% of the total population does not have internet nor can they afford it, which represents a priority task for the country, mainly in vulnerable communities with high risk of marginalization.

Additionally, the Organization for Economic Cooperation and Development (OECD, 2015) in its publication titled: *Digital Economy Outlook*, it mentions that ICT and internet are essential for the economy and the general population. Its impact traditionally tends to center in the TIC sector, recently those policies have acquired a more horizontal nature, and cover matters from creating a company, employment, education, sanitation, aging, environment and development. Having as a main purpose to favor the economic and social conditions that will promote development and growth.

Also, they emphasize that the majority of countries of the OECD and associated economies have established or will soon adopt cross-sectorial national strategies that deal with political priorities related with the digital economy that will strengthen competitiveness, economic growth and social welfare of the country.

The main relevancy of this document in this study is centered in the declaration of the fundamental pillars of national strategies of global economy that says in point 6: Promote digital inclusion, especially among the elderly and marginalized social groups. In point 7 it says that it is essential to promote competence and abilities related with ICT, whether they are basic or specialized.

Last, the Inter-American Development Bank (2010) in its study titled: *Science, Technology, and Innovation in Latin America and the Caribbean*, explains the existing differences of the digital divide between member countries of OECD and Latin American and Caribbean countries (LAC, by its Spanish acronym). In this paper a statistical and indicators recompilation is represented that, as a whole, shows the existing situation in ICT in Latin America and the Caribbean. In the case of ICT, the document includes a brief record of how penetration has progressed during the last decade approximately. The relative position in the region in regards to the use of technologies is evaluated in three different levels of analysis: (i) global division – mainly between countries of the OECD and Latin America (ii) cross-regional division between the different countries in the region and (iii) internal divide within Latin American countries.

In general, the literature review shows that whilst penetration of ICT grows in the region, it is also increasing in other regions as well. Therefore, adoption and diffusion in Latin America and the Caribbean of ICT has not necessarily advanced against other regions, as countries in OECD. Likewise, Latin American countries are diverse in regards to factors that influence diffusion of ICT like entry, infrastructure, education and quality of regulations. For what the penetration of ICT in some countries is much greater and it increases faster than other countries in the region. In conclusion, the data tends to confirm that poor family homes within the less developed countries in the region have less access to technologies which means the development challenge lies in giving people the necessary ability to use ICT and increase connectivity and access to technologies in homes, schools, public areas, companies and government with the purpose of eliminating social divide in the technological advancement. In the Mexican context, some studies (Dominguez, Cisneros & Cab, 2017; Touder, 2013, 2015, 2016; Tello, 2014; Santos et al., 2012) analyze the influence of TIC under the premise that considers the use of information and communication technologies as a viable alternative to better people's lives and as an essential element for development and progress, from an accessibility and services perspective. At the same time, some of the factors that are contributing to the increase of this divide seem related to the differences in access, the availability of technological resources and the absence and/or difficulty to develop competence to interact with technological equipment mainly in areas of exclusion.

Methodology

This study analyzed the impact of a mixed training program for the reduction of the digital divide in young and adult people from a vulnerable and marginalized community in southeast Mexico.

This was an action research study using both quantitative and qualitative methodologies. Action research systematically investigates a given social situation and promotes democratic change and collaborative participation through studies that achieve positive changes and improvements in the social situation of the participants (Elliot, 2005; Boggino & Rosekrans, 2007; Greenwood & Levin, 2007).

This study, was part of a greater research that had as its purpose: reduce the digital divide in young and adult people of vulnerable communities in the south of Yucatan through the strengthening of digital competence for the use of Information and Communication Technologies.

During the development of this study, as part of the utilized methodology, the action phase was proven through the implementation of a formative program named: REBREDIG-PJA. This program had a duration of 5 month and was integrated by 13 competence units (see Table I).

Table 1
Competence units of the REBREDIG-PJA program

Code	Competence Units	Dominium elements	Duration/weeks
D1	Computer knowledge	7	1
D2	Document production	7	1
D3	Copyright awareness	4	1
D4	Applications and programs	3	2
D5	Information localization	4	1
D6	Storing and recuperation	3	1
D7	Communication	4	1
D8	Internet interaction	4	2
D9	Personal Information Protection	5	2
D10	Security	6	2
D11	Internet use dangers	4	2
D12	Web interaction	5	2
D13	Health consequences of TIC	5	2

The competence units were constructed and presented in a gradual order of difficulty from basic knowledge of computers (connect, turn on/turn off, keyboard knowledge), to the health risks that ICT may produce (posture, addictions). In the construction, three community advisors from the Adult Education Institute in the State of Yucatan, three experts in the area of information technologies from the Autonomous University of Yucatan and students from the Information Technologies Administration Degree of UADY participated.

Community characteristics

According to the last population census of the National Institute of Statistics and Geography (INEGI, 2010) the social-demographic scene in Yucatan shows that the Mayapan Municipality has a population of 3,269 habitants. Its population represents 0.2% of the federal entity population. According to INEGI for each 105 men there are 100

women and the average age of the population is 19 years or less. For each 100 people of productive age (15 to 64 years) there are 80 in age of dependency (younger than 15 years or older than 64 years).

One of the most relevant and significant indicators for this study is the one related with Information and Communication Technologies in the community. The results from INEGI (2010) shows that for every 100 homes only 1 has internet connection, which has grave social implications that strengthen the growth of the digital divide. Likewise, 1.9% of the population has a computer, this means that from every 100 homes only two have a computer. 7.4% has telephonic service and 29% has mobile telephony.

As far as the educational level, from the whole population, 588 people have no type of instruction (schooling), 78.8% has basic education, 2.4% has high school education and only 0.6% (19 people) has higher education, that in accordance with the specialized literature (Domínguez J., 2015; Atkinson, Black, & Curtis, 2008; Gardner & Oswald, 2001) about the determining factors that contribute to intensify the phenomena known as the digital divide, this is one of the main ones.

Participants

The participants were members of three groups from the community organizations: People from the community square (nats aba xook), the Primary school (PS), and the junior high school (JHS), all are part of the State Ministry of Education. The population of coputer users from these three institutions was 267 people divided as follows: Community square: 26 participants; Primary school: 106 participants; and Junior high school: 135 participants.

All participants were invited to be part of the stuy, but only 68 agreed of the three groups voluntarily decided to be part of the study. The characteristics of the participants are described below:

Tabla 2
Characteristic variables of the population

Characteristic variables of the population							
Maximum grade of study	f %	Civil Status	f %	Mother's schooling	f %	Father's schooling	f %
Primary	44 65	Single	55 81	No studies	26 39	No studies	19 28
Secondary	23 34	Married	7 10	Primary	28 41	Primary	30 44
High School (Baccalaureate)	1 1	Common Law	6 9	Secondary	14 20	Secondary	19 28
Total	68 100		68 100		68 100		68 100

Sixty-eight people from the Mayapan community participated in this investigation. 36 were women (52.9%) and 32 were men (47.1%). The ages of the participants were be-

tween 12 to 44 years and the average age was 18 years. From the total of participants, 98.5 speak Maya. Table 2, shows the results of the principal variables that better characterize the participating population, these variables are: maximum level of studies, civil status, mother and father's schooling.

As it can be observed in the above table, 65% of the participants (44) have as their maximum level of education: primary school, following by 34% (23) at the secondary level and only 1% at the High School level. In regards to the civil status, it can be seen that the majority is single (81%), followed by 10% that are married and 9% live in a common law marriage. As far the parent's school level, mothers have a lower level of instruction compared to that received by the participating fathers.

Instrument (document)

In constructing the instrument developed by Domínguez, Vázquez, Suaste, and Cab (2016), the study of demographic and personal information was taken into account and a Likert measuring scale with six levels was adopted. In this scale the respondents were instructed to think about the level they possess for the performance of the competence (CCC), considering an ascending scale from 1-5. At the same time, the participants were asked to assess if the competence would be important for finding a job (CICT) and if they would be interested in learning about this competence (EIA). (See figure 2).

Competence	CCC					CICT		EIA		
	0	1	2	3	4	5	Yes	No	Yes	No
DOM 5. INFORMATION LOCALIZATION										
Various browsers were used (Google, Firefox, Explorer) to navigate the Internet.	0	1	2	3	4	5	Yes	No	Yes	No

Figure 2. Example of the enunciation and response format of each dominium

The construction of this instrument took as a reference the conceptual base of some prior studies (Domínguez, Canto, Ortega, & McCalman, 2016; Suárez, Almerich, Gargallo, & Aliaga, 2010; Cano, 2005). As it can be seen the instrument is composed of three sections: competence, its importance for a job, and interest of the participants for learning that competence. The first section was used a Likert type assessment scale to collect primary information from one step and six levels that the degree the author perceives he or she has acquired the competence. Next, with the utilization of a dichotomic scale, the participant was moved to answer, how important the competence was for finding a job; and last, if he/she was interested in learning about it. Next on Table 3, technical indicators of the three sections of the instrument were reported.

Likewise, as part of the design, the researchers used three focus groups *in situ*, by means of this technique the researchers formulated a series of categories (based on participants' opinions) that included questions about the studied reality. Some of the more relevant categories focused on how to better educational practice, use technology in the class room, availability of infrastructure, context influence and the reasons

that impede the reduction of the digital divide in the community. Additionally, the different participants identified issues for bettering their educational practice.

Table 3

Instrument's sections and its technical indicators

Scale sections	Cronbach's Alpha
Competence dominium	.979
Importance for a job	.985
Interested in learning	.959
Total	.960

Analysis and results

The results of the formative program named REBREDIG-PJA that was used as a strategy to reduce the digital divide in the south of Yucatan are presented in this section. In Figure 3 we can see the behavior of the participants from the onset (pretest) and after taking the formative program (posttest). The results show important characteristics to highlight.

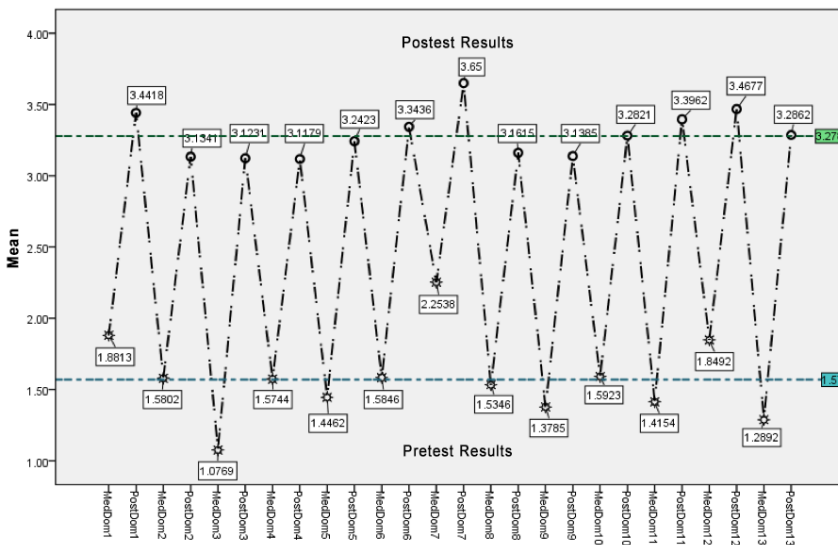


Figure 3. REBREDIG-PJA pretest and posttest results

First, it is clear the evidence of effectiveness of the formative program had in reducing the digital divide in participants of vulnerable communities in the south of Yucatan in the thirteen competences that were taught. In a global view we can see that the rendering middle in the preset was of (inferior dotted abscissa) and after taking the formative program the competences better registering a middle score in the posttest of (superior dotted abscissa).

Second, the competences that had a higher grade of difficulty for the people from vulnerable communities were: knowledge about copyright (*MedDom3*); along with health consequences associated to ICT use (*MedDom13*). However, in both competences, the participants performed significantly better at the end of the program.

Third, the competences where the best results were observed from the beginning were: communication (*MedDom7*), computer knowledge (*MedDom1*) and web interaction (*MedDom12*) that coincidentally were the competences that registered a greater performance in young and adult people in the community.

Fourth, lastly, it is relevant to mention that the competence with the best performance shown in these two phases (*pretest-posttest*) in the opinion of the participants was communication, which involved variables such as the following: sending messages via mobile telephone, information exchange via electronic mail, conversation through tools such as WhatsApp or similar and using social media.

Other point that were analyzed in this study were the behavior of both sexes in the reduction of the digital divide. The results show proof of the importance of analyzing which of the two groups was able to develop better technology use competence in the studied context. First, comparing both groups in the pretest, it can be observed that women scored the highest, including above two in the following variables: *MedDom1* (computer knowledge) *MedDom7* (communication), *MedDom 12* (web interaction) (See Figure 4). However, when analyzing the results obtained by the men at the conclusion of the formative program it can be observed a clear difference favoring the men. The prior behavior, can be indicative of a better performance in men in the majority of the competences taught, which could mean that the men in the community performed better than women in the formative program.

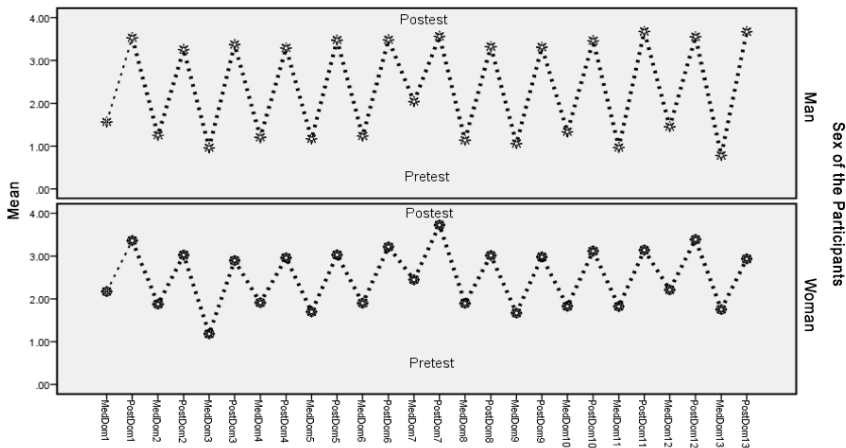


Figure 4. Before and after the formative program results

Next, the competences of the two groups that had the biggest upturn in grades, both in the pretest and the posttest, was: *MedDom7* (communication) and the one with the greatest difficulty for both groups, was: *MedDom 3* (Copyright knowledge). Another of the variables that had great relevancy in this study in the reduction of the digital divide was the academic education of the participants. They presented a range in their aca-

demographic level, from basic education with primary up to high school. The results in Figure 5 show important characteristics to analyze. First, it can be observed that consistently with figures 3 and 4 the competence that obtained best scores regardless of their academic level was: MedDom 7 (communication) which shows that regardless of the academic level, students showed good competences for the exchange of information using electronic mail, social media and communicating through mobile telephones.

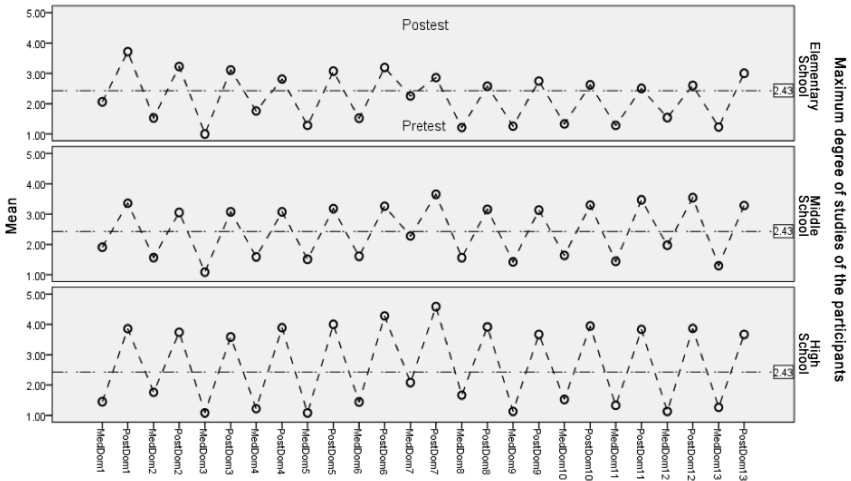


Figure 5. Pretest and posttest results by maximum grade of studies

It was clear that students with a greater academic level, obtained the best performance after concluding the formative program. The aforementioned is seen when comparing the average grade in three levels. This can indicate that the students with greater school training are used to working with technology and have developed a maturity that allows them to understand the functions of different tools and adapt them in the solution of daily life problems.

It was also found that all the competences worked in REBREDIG-PJA, tendencies towards higher performance was observed in all three levels, which indicates the competences of participants improved 100%.

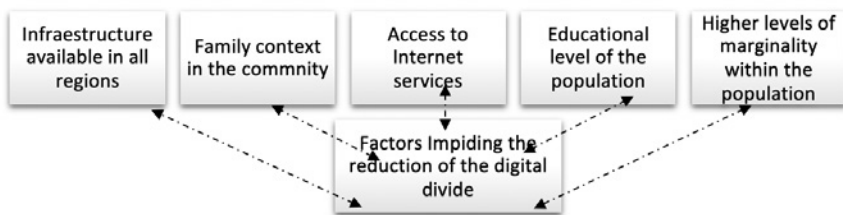


Figure 6. Main categories emerged from the focus groups

Other findings focused on understanding the possible reasons why the reduction of the digital divide is intricate in the studied context. To explore this situation, three focus groups were conducted involving twenty-five people of the community, both

men and women that participated in the program. As a result, five main categories emerged (See Figure 6) from the perception of the subjects, that were consistent in the three groups. The categories were used to understand with greater clarity the causes of the studied phenomena.

For the analysis and interpretation of qualitative information and as a result of great textual and graphic data from the onset of the creation of hermeneutical units, each one of the emergent categories were presented in an esquematical manner under the data interpretation model (see Figure 7) that in the opinion of the speakers were the most relevant and they serve to characterize the main categories. The data analysis process involved four phases: data preparation (data gathering and storage *in situ*), the initial analysis (open codification), main analysis (refinement of the indexed system) and obtained results (organization of key concepts, relations, significative associations and models).

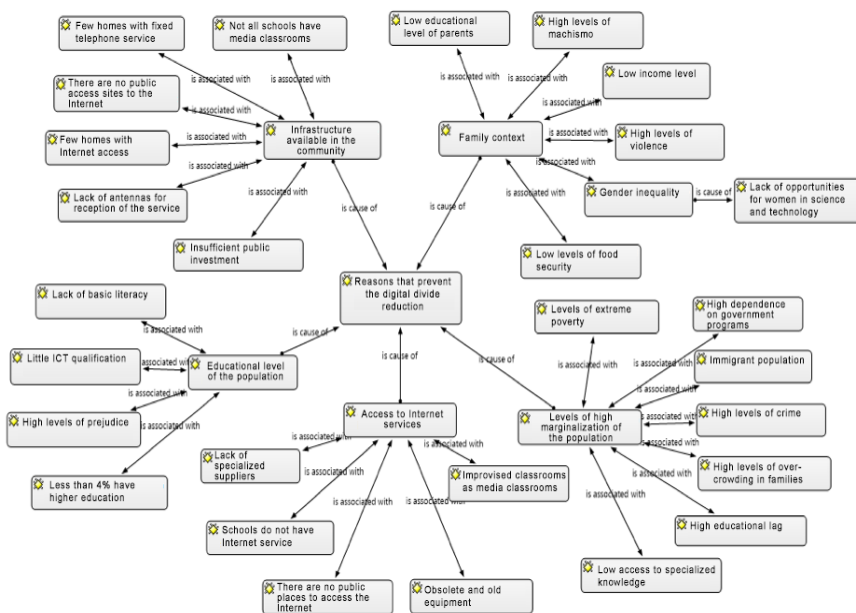


Figure 7. Conceptual web of reasons that impede the reduction of the digital divide

As it can be observed in the above figure each one of the main categories (*i.e.* population educational level; family context) with its respective sub-categories that are integrated by (*i.e.* lack of basic alphabetization; level of low income). The function of the sub-categories categorized each one of the main categories, with the intention to contextualize the problems and achieve a better understanding in the described experience of the speakers. To achieve this strategy the process of open codification was organized through conceptual webs for the interpretation of the obtained results.

Regarding the most relevant subcategories for the category of available infrastructure in the community, the subcategory that was the most consistent in the opinion of the speakers was that there are no areas with public access to internet and if there is access, this is very limited and of low infrastructure. For the population's academic level category, the most relevant subcategory in the opinion of the speakers was: the lack

of basic alphabetization, they said the people in the population have very low training in the use of technology making the integration to changes and current procedures difficult.

For the family context category, the most relevant three sub-categories were presented, these were: low income level, parents' low academic level and gender inequality (putting women in disadvantage of opportunities). In the category named population margination, the most relevant subcategories were two: high index of extreme poverty and high dependency on government programs. Finally, the category *access to internet services*, the most relevant subcategory was: the conditions of equipment found in schools are deficient, old and in bad condition which difficult children and teenagers to better their learning.

Discussion and conclusions

Even though the specialized literature (UNESCO, 2009, 2014; OECD, 2016) emphasized the importance to push and implement directives regarding policies of inclusion focussed on vulnerable groups in the use of technologies with the intention to strengthen the economic and social development, accelerating the innovation processes and in general obtain a greater liberty to decide by the citizens, results are not the desired ones and it is required that their actions be focused on bettering the quality of learning in these communities and in attention of their main necessities to increment their quality of life, and their insertion into the knowledge society.

In this paper it was analyzed the effect of the formative program named REBREDIG-PJA had upon the participants to better technological competence of young and adult people of a community in the south of Yucatan that has an index of human development lower than the national average and an equally mobility income considered as low (United Nations' Development Program, 2015) aside from presenting the education indexes considered as one of the poorest of all municipalities in Yucatan (United Nation's Development Program, 2014).

The program showed that through the course focussed on strengthening the technological competences in people that are found inside these belts of exclusion and high social margination, adapting to the main needs of the context, with clear instructions in their mother tongue and with the help of colleague students in the field of technology to be with them and do their homework, it is possible to better their competence technology use and to favor their gradual insertion into the knowledge society, at least at the residential level, for the use of digital technologies. This project also contributed to help in one of the areas detected as critical which is the population's academic level, since through their participation in this formative program students remained in school and developed competencies to better their learning, that before they had in a very low level, which made their own learning process difficult.

To develop actions to helping vulnerable communities that are found in geographically far regions and with a high margination in order to reduce the digital divide, it is necessary more than policies directed to supply technological infrastructure (in the best of cases) and computers. Programs must be designed considering the population's context with orientation towards taking care of real problems that the community considers pertinent and relevant. In addition to this, we propose the work together of experts from universities, investigation centers and state programs in charge of

preparing people if we really want to significantly help communities in reducing the digital divide.

Findings were consistent with those of official policy documents, such as the 2013-2018 National Program for Development, which emphasizes that telecommunications have become a strategic input and a prerequisite for individuals to be more competitive. This policy also stresses that citizens need to take full advantage of the potential of digital technologies. On the other hand, the National Digital Strategy for Mexico (2013), states that the inclusion and development of digital skills is a need for all social sectors in order to take advantage of ICTs on a daily basis. In addition, there is a need for increasing access to telecommunication services, for such groups as people of indigenous origin, the elderly, people with disabilities, the poor and those experiencing extreme marginalization. A strategy for accomplishing this, involves establishing a network of digital education community centers that provide training and digital education to allow access for the entire population to telecommunication services and for them to learn how to use them for the benefit of their quality of life.

Likewise, it is necessary that these state programs in charge of supervising the development of technological competencies carry out studies to find out the level of competences of vulnerable communities in the state of .. These studies should involve the main stakeholders: parents, students, teachers and people with disabilities, because the only way to truly contribute to the shrinking of the digital divide would be through an integral strategy that includes universities and the state, working together for the service and development of the people, so not one vulnerable group in our country will be left behind.

This initial research opens a dialogue to study the possible existing divide in all other municipalities of the state of Yucatan that are at a greater geographic distance and in similar or worse conditions of those studied in this paper. We also recommend paying close attention to some vulnerable groups that are within these communities such as: people with disabilities, indigenous, migrant population, elderly adults and female head of households with the intention to contribute in the shrinking of the existing divide and to elaborate integral actions that will allow them to have a dignified life with greater possibilities of wellbeing.

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