



# Breaking the Gap: Collaborative Environment as a Meeting Point to Provide and Receive Help to Overcome the Digital Gap

David E. Santos Covarrubias<sup>1</sup>(✉) , Graciela Karina Galache Meléndez<sup>1</sup> ,  
Jorge Alberto Martínez Cerón<sup>1</sup> , Sony Solano Cristóbal<sup>1</sup> ,  
and Rocío Abascal-Mena<sup>2</sup> 

<sup>1</sup> Master in Design, Information and Communication (MADIC), Universidad Autónoma Metropolitana, Unidad Cuajimalpa Avenida Vasco de Quiroga 4871, Colonia Santa Fe Cuajimalpa, Del. Cuajimalpa de Morelos, Distrito Federal, C.P. 05300 Mexico City, Mexico  
surikatofic@hotmail.com, karina.galache@gmail.com,  
neuroalbertounam@gmail.com, scs.pedagogia@gmail.com

<sup>2</sup> Department of Information Technologies, Universidad Autónoma Metropolitana, Unidad Cuajimalpa Avenida Vasco de Quiroga 4871, Colonia Santa Fe Cuajimalpa, Del. Cuajimalpa de Morelos, Distrito Federal, C.P. 05300 Mexico City, Mexico  
mabascal@cua.uam.mx

**Abstract.** As a result of the COVID-19 the teaching staff has been required to use technological tools that allow them to follow their activities under confinement. Teachers have highlighted the problem of the digital gap, updating and inequality that they suffer in Mexico as one of the historical problems to be addressed in this sector. This paper presents a platform designed to work as a meeting point between teachers with the digital gap and people willing to help them. The process was based on the User Centered Design approach in order to find a relevant solution.

**Keywords:** User centered design · Digital gap · Teacher · Education · Usability · COVID-19

## 1 Introduction

The global context is going through one of the most devastating historical events of this century. From the outbreak of the SARS-CoV-2 virus and the COVID-19 disease in Mexico, as in other countries around the world, the state of alert and confinement was declared. This has affected most of the social and productive sectors of the population. The pandemic isn't yet over and, without a doubt, there will be repercussions in practically all the areas of daily life.

Due to official regulations, the formal education sector had the urgent need to solve and formulate emerging and improvised strategies for the implementation of education from home using the available Information and Communication Technologies (ICT). In this entrustment, the collaboration of the entire school community has been decisive because, in addition to covering specific tasks to the school environment, teachers,

students and parents have had to face daily life in an environment of uncertainty and affected mental health. Now, classroom practices move to digital and private spaces, and that is strongly questioned for the needed and rapid adaptation to new technological dynamics.

In this sense, breaking the digital divide in teachers is one of the most difficult tasks to be filled. The uncertainty in the use of technological tools, the constant updating of them, together with the little time available to learn them, prevents the adequate and pertinent educational domain to allow teaching and learning experiences. According to Sanchez [1] the types of problems range from logistical, technological, pedagogical and socio-affective ones that affect circumstances related to emotional, affective and health aspects that impact teachers, such as feelings of sadness, frustration, anxiety, fatigue, among others.

The objective of this project is to present a digital environment that serves as a meeting point and accompaniment space for teachers. This space aspires to support in overcoming the digital divide, connecting people who need help to solve specific doubts with people willing to help, who are easy and familiar with the diversity of technological tools. In addition, it will store different possibilities of presenting meaningful information for the solution of doubts such as tutorials and articles generated by the same community.

The rest of the paper is divided into four parts. The first presents the general concept of the digital divide, as well as the current situation in Mexico regarding teachers who suffer from it; it also shows the state of the art of similar proposals. The second part explains the methodology followed by the teamwork to design a digital environment that serves as a meeting point for people to be able to offer and receive help; on the other hand, the functions, operation and a test of its parts are exposed. The third part shows the final prototype as a result. Finally, the last part reveals the conclusions reached in the design process and the further work.

## 2 Conceptual Theoretical Framework

The “*knowledge divide*” is a concept that historically had hinted at a separation between people and knowledge mainly due to economics and geographic factors. Nowadays, it is important to emphasize the relevance that technology has over information access and therefore to knowledge [2]. The separation of knowledge is closely linked to digital skills, as they say: “*Now, the conception of digital fracture values the necessities of digital knowledge and skills, not only access. To this effective access, it is adequate to add the capacity to manage big amounts of information to convert into knowledge. All of this, in many cases, is directly linked to a generational issue*” [2].

On the other hand, other authors such as George Sciadas [3] mention that exists a gap between ICT. This involves many variables that regularly are not considered as income, education, age and geographic area. In the last decades, it has been used the term “digital divide” to refer to the “knowledge divide” that exists in the digital information area. This reflects the inequality that existed in information access, and today has been coined by everyone and reflects a social phenomenon that emerges with the growth of the digitization of information.

We are in an era in which it has become essential to know how the technology works to move freely across the information. However, not all people possess the ability to face

this reality. In a world where digital information predominates, a new type of literacy becomes relevant to these people, as Selfe indicates: *“Today the definition of literacy has expanded from traditional notions of reading and writing to include the ability to learn comprehended, and interact with technology in a meaningful way”* [4].

## 2.1 Digital Gap in Mexico

The sectors that face the digital divide are diverse and involve multiple factors. However, one of the sectors where the problem is most evident is in education. This affects different actors such as students, teachers and parents. Evangeline Pianfetti [5] emphasize the importance that the teachers have when facing digital divide, not only to do their job but also to empower students with digital skills and knowledge *“Teachers need to be digitally literate so that they can empower students with the skills and knowledge that they can need to be successful in a workplace dominated by technology”*.

Especially in Mexico, the transition to the digital world has not been an easy task for teachers, because of the economic and social reality that currently exists. On the other hand, the gap can also occur due to generational gaps or simply disinterestedness in technologies.

In the face of the COVID-19 pandemic, many teachers in digital gap situations were forced to use technologies to teach from home. As is evident, many of them have failed to adapt to these new concepts. In the following research, we give the task of approaching a group of teachers with a certain level of digital gap to understand their behaviors and motivations when facing technologies to teach from a distance. And then, we present a Human-Centered Design approach, composed of several steps, that we have followed in order to propose a solution that seeks to reduce, even partially, the gap.

## 2.2 State of the Art

In the state of the art, we can find different ways of approaching the problem of the digital gap. There are programs that seek to train and instruct people with a digital gap in the use of computers and devices, suPEOch as the Vasconcelos digital literacy program<sup>1</sup> in Veracruz, to bring technologies closer to vulnerable communities. Despite considering not only the material resource but also technological training, these attempts have a local scope.

Also, there are projects that seek to take advantage of ICTs to reduce the gap with a broader scope, such as the app “Mint”. These have the problem that not all people can access this form of digitization, so they focus on attacking the gap for lack of knowledge. Focusing in this last example, as the BUAP site posted in its page, this app is an application created by the students of the BUAP Faculty of Computer Science, in collaboration with students from Mexico City, to support primary education teachers, to help reduce the digital gap in schools [6]. With this application, teachers will share with their students the interactive classes they have created.

Unlike the existing projects, the one exposed in this document proposes to generate a community of accompaniment and collaborative support, accessible to teachers with

<sup>1</sup> Vasconcelos digital literacy program: <https://www.sev.gob.mx/programa-vasconcelos/>.

digital gap. The objective is to build a multidirectional platform that democratizes the knowledge of technology for educational purposes and in accordance with an open repository with *on purpose* information. The above, within a space that values and respects the knowledge of the community itself and serves as a meeting point to connect with people willing to provide help in real time and optimize search times and problem solving, from a focus of flexible and lifelong learning.

### 3 Development Process

The project was started from the focus of inclusion in the Human-Computer Interaction, an interdisciplinary area that carries out a recursive process of design, analysis, implementation and evaluation aimed at generating usable and easy to manipulate products, which allows the end-user to focus and perform a task in the best way. To do this, User-Centered Design (UCD) was a key perspective for the design of the interactive system prototype, where experience and satisfaction are the foundation in the process.

The stages to follow were: the definition of the problem through remote interviews, construction of people or archetypes of the main users, the establishment of points of view and inspiration board, construction and testing the prototype, evaluation and final prototype.

#### 3.1 Definition of the Problem

Observations, interviews and evidence collection were carried out remotely to three groups of possible users who are part of the school community affected by forced confinement and the digital gap: students, parents and teachers. Each group was made up of members of different ages, economic situations, and locations within Mexico City and the Metropolitan Area. After these observations, the work team decided to focus on teachers as potential users, because they integrated several of the problems found in the three groups and are main actors in teaching and learning, being the point of support between parents and students.

The group of teachers shared that, as parents, they are forced to divide their time and space to solve family, work and school stuff for their own children. However, the worrying thing for them were the excessive time and effort they invested in learning to use technologies to communicate with their superiors, peers, parents and students. In addition, the educational institutions which they belong, didn't send them clear instructions about how they should carry out the transition of the different activities to the virtual environment, so the process has been arduous, demanding and based on trial and error. Teachers may be updated in their respective areas of knowledge, but many times they are disconnected from the digital world that they could use to share their teachings. Not being able to carry out their work makes them feel frustrated, guilty and inefficient, therefore they would like to have support and accompaniment to efficiently manage conflicts, uncertainty and resolve doubts for the appropriation of digital media. The digital gap in this group, and the conditions to carry out its work, become an urgent problem to solve, with specific characteristics that led to the next stages of the project.

### 3.2 Personas

As Alan Cooper [7] indicates, a *persona* is a prototypical representation of asset of users with similar motivations and behaviors. It represents an archetype modeled from the investigation of real users and synthesized in a user prototype.

In order to attend the different motivations and needs of potential users that were discovered throughout the research, the *persona* methodology was used. From an in-depth investigation and analysis of the different profiles, three *personas* were created that characterize the main profiles of teachers with a digital gap.

- The first one, named *Juan*, represents teachers with a digital gap because of a relative lack of interest in technology. This type of teacher prefers *face-to-face* contact to teach; however, the pandemic forced him to get closer to the technological tools. It's frustrating to him that technology is becoming increasingly important to everyday and professional life.
- The second one, named *Marisol*, is the representation of the teacher who presents a digital gap due to a limited economic situation and poor access to digital resources. Despite wanting to update herself, she doesn't have the time or the resources to do it, so she has lagged behind in the use of technology to teach in the best way.
- The third one, named *Federico*, is the prototype of a teacher who suffers from the digital gap due to advanced age. Despite being an experienced teacher, he is not a frequent user of digital technology, so he has faced various complications to teach his subjects in a *non-face-to-face* mode. Despite trying, he cannot adapt to digital systems, so he constantly requires counseling.

Once the personas were defined, each member of the work team made a storyboard with the main need observed. This visualization was carried out individually and in isolation to identify the patterns of understanding the motivations and needs when compared.

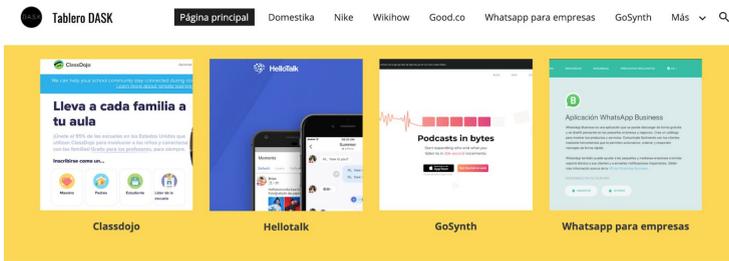
### 3.3 Viewpoint and Inspiration Board

The *storyboards* were shared and compared within the work team and each of the represented needs was analyzed. The main observations were:

1. The teacher seeks help with close people, but many times he doesn't find someone available and he doesn't know how to solve the problems by himself, so he feels alone and unmotivated;
2. Teachers are curious and willing to learn technologies but they don't know where to look and find timely support to answer their questions.

Once the analysis of the perspectives observed by each member was carried out, it was agreed that the general point of view for this project would be "Overcoming the digital gap is based on an environment of comprehensive support". In addition to *storyboards*, important support in the process of this research was the creation of an inspiration board, that helped to concentrate on existing ideas of possible solutions and

to know the state of the art (see Fig. 1). The search for resources was made through the web that concentrates applications, services, artifacts and products on the market.



**Fig. 1.** Inspiration board with related work.

### 3.4 Pretotype

Alberto Savoia proposes this stage for “make sure you are building the right it before you build *it* right” [8]. The work team decided to use the “false door” technique, which is to offer a product or service that doesn’t yet exist to users, in order to easily identify the level of interest before prototyping. The implementation consisted in publishing on Facebook pages and groups dedicated to teachers, these included a poster with the invitation to become part of a community that helps other teachers to overcome the digital gap in the days of COVID-19 and a *call to action* to enter in a landing page with project descriptions. This sought to measure two different levels of interaction: the first with impressions on Facebook and the second with income and interaction with the site.

The scope of the technique was high; however, more interaction was expected from people, which led to the conclusion that the announcement was presented in a reserved manner because it didn’t present more false information that caught the attention of potential users. However, at this stage, a new user appeared who wasn’t initially contemplated: the ordinary citizen with technological skills who wants to collaborate supporting teachers for altruism. This showed that there is a genuine interest in people to want to help.

From these findings, the work team began to outline the elements of the prototype design, respecting the original idea of addressing teachers with a digital gap, but also considering users willing to help. What was initially interpreted as a low response, became an area of opportunity to strengthen the idea of simplicity in access, interface and use of an effective tool.

### 3.5 Wireframe

To develop the wireframe, the work team focused on the need to have a support and accompaniment environment that serves as a meeting point between people who want to give or receive help to overcome the digital gap. Therefore, to start, two main categories of users were carried out: one for those who receive help and the other for those who

have the possibility of giving it. The Fig. 2. shows the main screen for the two types of users “I need help” and “I want to help”.

In the research, it was discovered that one of the tools that people with a little approach to digital technology use minimally was WhatsApp, so the prototype was thought of with references to its structures and dynamics. Above all, ease of use was considered, based on simple dynamics, intuitive forms and familiar metaphors. In addition to the possibility of connecting teachers with other people to receive help in real-time, an alternative way of solving doubts was planned, based on content that does not involve direct connection with another user. This is because, according to the results of the interviews, some teachers feel more comfortable solving their questions directly with content but aren't sure where to look. In this situation, the possibility of storing and having a repository of specialized articles and videos was integrated into the prototype so that the teacher requesting help has the possibility of choosing what suits him or her best, according to his needs and disposition. Because the prototype focused primarily on teachers with a digital gap, the “resolve a question” section was fully developed, while the “I want to help” section was partially constructed. At the end of the wireframe construction, the first version was evaluated and faults and possible improvements in the interaction were identified.

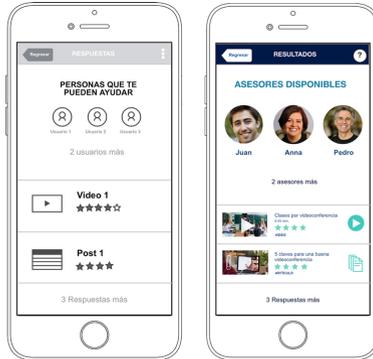


**Fig. 2.** Firsts screens for the wireframe.

### 3.6 Evaluation

At this stage, the instructions were designed for testing six voluntary users, in a remotely way, all of them teachers of universities, to carry out three tasks and, based on the observation of their interaction with the first version of the prototype, the necessary adjustments were made. For the above, the ten heuristic proposals of Jakob Nielsen [9] were reviewed as minimum aspects that a digital prototype should have. The main screens used in the evaluation are shown in Fig. 3.

In order or importance, the main problems that the six users showed were: confusion in completing a task, returning to a specific section, having to evaluate an advisor, exploring all the possibilities of the interface, distinguishing between the different information resources, having the opportunity to rectify their decisions during registration and that some iconographic elements weren't entirely clear.



**Fig. 3.** Main screens used in the evaluation.

On the screen to contact advisors and receive help, teachers did not know if the users were people looking for information or others with questions. Furthermore, there was a confusion between the videos and the posts due to the absence of graphic identifiers. Another one of the doubts, on the part of the users, was the location of the help button, which was located in the three points on the upper right side. This was resolved by changing the points to the question mark.

The above showed the need to reinforce heuristics such as: showing the status of the system at all times, using familiar metaphors and language, preventing errors, providing control and freedom, making it possible to recognize, diagnose and recover from errors, have an esthetic and minimalist design, having help at all times, consistency, control and freedom in the system. All these needs are materialized in the final prototype stage.

## 4 Final Prototype

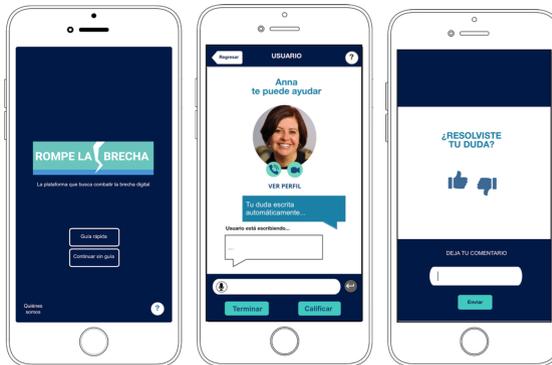
After detecting the interaction problems in the wireframe, the final prototype was developed, taking as reference the ten heuristic proposals of Jakob Nielsen, correcting the errors and refining the graphic identity. Assessments were also made during refinement to ensure interaction was adequate. It should be noted in the final observations, the users who interacted with the latest version had a better experience of use and understanding thanks to the modification in the language and reinforcement of the graphic composition.

The Fig. 4 shows the latest version of the prototype which was remotely evaluated with six new volunteer teachers. In this test, it was found that new users were using the prototype more fluently, due to errors being corrected.

On the other hand, aspects that were initially considered key to the prototype were recovered, such as reinforcing the idea of having different communication channels, the possibility of gamification dynamics, offering security and support in the formation of the collaborative network built from the healthy interaction of the different user profiles.

## 5 Conclusions

In this work, we presented a significant approach to the attention of the digital gap in Mexico from the DCU methodological approach. At different moments of the research,



**Fig. 4.** Final prototype, usability errors were corrected and a graphic image is consistent with what users needed.

new problems and users emerged to be considered within the framework of the IHC, which reveals a broad interdisciplinary field of action from an inclusive and participatory social approach.

Designing systems and prototypes for people in contexts of uncertainty opens the possibility for innovation and to rethink the ways of integrating digital collaboration networks that provide support and accompaniment in overcoming problems such as the digital gap in teachers. On the other hand, implementing the methodology in confined conditions demonstrates that it's possible to carry out interdisciplinary research using ICT, so the construction of proposals of this type allows the fundamental principles of DCU and IHC to be recovered at the service of educational, training and upgrade.

The project aroused genuine interest in the teachers and other people involved, showing that the proposed solution addresses the correct motivations and needs. This openness on the users leads us to believe that the project has sufficient relevance and significance to continue developing in the future. It's necessary to resolve some issues in direct evaluations with the user, impossible in this study because of the confinement, such as the platform usability by people with a high level of digital gap or its relevance in marginalized sectors. It's also necessary to prototype the section of the site dedicated to users who can provide help.

The research findings give indications of some issues to develop regarding the creation of a community for the possible use of the tool. It is extremely important to delve into engagement strategies and attract new users, as well as social interaction dynamics and gamification techniques that motivate them to constantly use the platform. Finally, it is important to consider aspects of technological operation, programming and database that were not possible to implement at the time of this investigation, for example: automatic search, content classification, message processing, types of system users, privacy and data protection.

## References

1. Sánchez, M., et al.: Retos educativos durante la pandemia de COVID-19: una encuesta a profesores de la UNAM. *Rev. Digit. Univ.* **21**(3), 9 (2020). <https://doi.org/10.22201/codeic.16076079e.2020.v21n3.a12>
2. Empresa Actual: Alfabetización digital, la solución a la brecha digital (2020). <https://www.empresaactual.com/alfabetizacion-digital-solucion-fractura-digital/>
3. Sciadas, G.: The digital divide in canada. science, innovation and electronic information division. Statistics Canada, Ottawa (2002). [https://www150.statcan.gc.ca/n1/en/pub/56f0009x/56f0009x2002001-eng.pdf?st=STYLPg\\_q](https://www150.statcan.gc.ca/n1/en/pub/56f0009x/56f0009x2002001-eng.pdf?st=STYLPg_q)
4. Selfe, C.L.: *Technology and Literacy in the Twenty-First Century*. Illinois University Press, Carbondale Southern (2000)
5. Pianfetti, S.E.: Focus on research: teachers and technology: digital literacy through professional development. *Lang. Arts* **78**(3) (2001). <https://www.jstor.org/stable/41483145>. <https://doi.org/10.2307/41483145>
6. Benemérita Universidad Autónoma de Puebla (BUAP). Estudiantes de la FCC diseñan app para reducir la brecha digital en las escuelas (2016). <https://www.buap.mx/content/estudiantes-de-la-fcc-dise%C3%B1an-app-para-reducir-la-brecha-digital-en-las-escuelas>
7. Cooper, A.: *About Face 3 The Essentials of the Interaction Design*. Wiley, Indianapolis (2007)
8. Savoia, A.: *Pretotype it: make sure you are building the right it before you build it right*, 69p. (2012). [https://www.pretotyping.org/uploads/1/4/0/9/14099067/pretotype\\_it\\_2nd\\_pretotype\\_edition-2.pdf](https://www.pretotyping.org/uploads/1/4/0/9/14099067/pretotype_it_2nd_pretotype_edition-2.pdf)
9. Nielsen, J.: 10 usability heuristics for user interface design. Nielsen Norman Group (1994). <https://www.nngroup.com/articles/ten-usability-heuristics/>