The Effects of Covid-19 on the Digital Literacy of the Elderly: Norms for Digital Inclusion

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The current sanitary crisis due to COVID-19 has further evidenced the enormous digital exclusion of older adults. Furthermore, the crisis has urged older adults to adopt new technologies to facilitate their tasks, as well as to provide them with an effective means against loneliness and social isolation caused by the confinement. In light of this, Digital Literacy is necessary for all those excluded from the digital era, who are characterized mainly by little or no ability to effectively use technologies. Nevertheless, detailed studies showing the leap from mixed (Blended Learning, BL) to digital literacy in the elderly have not been published. The objective of the present research was to analyze the level of Digital Literacy with the Digital Literacy Evaluation (DILE) of two groups of elderly adults with different levels of literacy (Group 1: G1, and Group 2: G2) during three stages: BL (Aug–Dec 2019); Transition (Feb–Jun 2020); and Digital (Aug–Dec 2020). Comparisons were made before each educational level (pre-pre-pre) and after each educational level (post-post-post) and during consecutive periods before and after each semester (pre vs post) and throughout different educational levels (G1: Basic 1, B1; Basic 2, B2; and intermediate 1, I1; and G2: Intermediate 1 to 3, I1, I2, and I3). Subsequently, considering all the elderly who had passed at least one of the literacy levels, we worked with a total sample of 176 older adults. The comparisons showed that, before the pandemic, G1's pre digital literacy levels increased between B1 and B2 and that the differences continued with that increasing trend between the B1 level and the I1 completely digital treatment, and the same was observed for post measurements. On the other hand, for the G2, the differences in the DILE were statistically significant between the pre-condition of I2 (before the pandemic) and the I3 (completely digital treatment); and between the pre-conditions of I1 and I3; the same results were obtained for post treatments. Also, pre vs post scores on the DILE were statistically significant and older adults increased progressively their digital literacy despite the COVID-19 pandemic and jumped to the digital age.

Keywords: digital literacy, elderly, digital inclusion, online education, blended learning, Covid-19

INTRODUCTION

It is a fact that Information and Communication Technologies (ICT) have allowed the construction of new communication and interaction realities, which are now embedded in a natural and almost invisible way in our daily lives and in several sectors of society. The evolution and rapid expansion of ICT have caused people to continuously train themselves and acquire digital skills, as they have become essential tools in their everyday lives (Yu et al., 2017). The digital divide was initially attributed to underdevelopment and was perceived as something temporary that would disappear with the popularisation of technology. Nevertheless, the divide persists nowadays despite the mass marketing of electronic devices with Internet access (Lai et al., 2021). Jointly, several authors argue that the digital divide persists even in conditions in which the presence of ICT, is high, that is, even though most communities have access to technological equipment, the digital gap is still present (Bach et al., 2018; Vartanova et al., 2019; Lai et al., 2021).

The current situation has also revealed that emerging technologies and digitalization are great allies against the pandemic, offering a wide array of opportunities, such as better services, greater productivity and ease of communication (Faraj et al., 2021). It is necessary to recognize, though, that they also hide challenges which, if not addressed in the correct way and urgently as a priority, can generate further imbalances.

Digital inclusion has been considered a very useful approach that seeks to understand the importance of ensuring that less privileged groups gain access not only to ICT, but also to the means of learning how to use them (Ragnedda et al., 2018). The sole act of using ICT promotes various changes in the behavior of people or social groups so that they are considered members of the information society. However, to acquire these advantages it is necessary to develop important skills in the digital world, such as learning and handling digital tools and building a digital identity that allows access to various platforms and devices (Blažič et al., 2020). One of the various existing projects to promote the use of new technologies is the Digital Literacy Workshop for the Elderly (Taller de Alfabetización Digital para adultos mayores, TAD, in Spanish), created by Martínez-Alcalá (2015) and delivered in the Autonomous University of the State of Hidalgo (Universidad Autonoma del Estado de Hidalgo, UAEH, in Spanish). This workshop has provided older adults with the opportunity to acquire digital skills through face-to-face classes, personalized counselling, and support from a group of gerontologists (Martínez-Alcalá et al., 2018). However, due to the social isolation caused by the COVID-19 pandemic, older people had to adopt a new modality: online.

Together with the arrival of the Coronavirus (COVID-19) pandemic, other threats came along, mainly affecting particularly the elderly, living inequality in terms of access, use and appropriation of telecommunication services and ICT, in other words, they are protagonists of a more visible digital divide (Moore et al., 2020). In this sense, Digital literacy is considered a key element to the development of today's society. Thus, continuous education in ICT is needed, and thereby it is important that the elderly acquire digital skills before being able to fully adopt and take advantage of the ICT (Chetty et al., 2018).

This leads us to question the purpose of promoting the acquisition of digital literacy skills in the elderly population. Similarly, we ask ourselves: How is the ICT learning process for older adults? Which digital skills must older people acquire to be considered digital literates? What difficulties did the elderly present during the transition from face-to-face to online classes? Was elderly literacy level affected by migration to fully online classes?

Theoretical Bases of the Digital Literacy Process

One of the main objectives of digital literacy for the elderly is that they assume a more participative role in society and thus promote active aging. The Digital Literacy Workshop for the Elderly began as an educational strategy based on gerontological foundations and andragogy (that is, taking into account biological, psychological and social characteristics of the elderly population), and its objective was to provide support in ICT learning and management, thus providing new opportunities for digital inclusion among the participants. As ICT users, the elderly have needs and demands similar to those of people from other age groups, that is, they require useful, functional, user-friendly and meaningful technology; likewise, their access to ICT depends on their purchasing power or management capacity, among other factors. Therefore, the digital literacy workshop allows older adults to learn through practice by respecting their own learning rhythm and, if necessary, by repeating practical procedures for a better understanding; jointly the development of their tasks and activities are related to their interests or social roles (Martínez-Alcalá et al., 2018).

There are various reasons that motivate elderly people to learn how to use of the computer. For instance, one of these reasons is to avoid depending on other people for using technologies. Other reasons correspond to more specific situations such as: helping their grandchildren with their studies, getting a new job or keeping up to date. More specifically, the elderly who participate in the workshop are mostly independent, have lower-secondary educational level, and the number of women is greater than that of men. The workshop began with pilot classes, where the elderly participated in face-to-face classes and learned from the basics (turning a computer on and off) to surfing the Internet. This first workshop had 17 participants who reached the basic level. Likewise, the elderly, who had voluntarily enrolled in the workshop, had access to computer rooms equipped with desktop computers or "All in One" connected to the Internet and with a Windows operating system.

Subsequently, more Basic level workshops were opened with the support of students from the Faculty of Gerontology to personally assist the students. Derived from the demand of adults, more levels of digital literacy were designed, with the purpose of introducing participants to the use of more digital tools. In 2017, Basic 2 level was opened, where adults who had acquired basic digital skills continued their training in ICT. Later,

TABLE 1 | Description of the levels, names of the modules and topics of the digital literacy workshops.

| Level	Basic 1	Basic 2	Intermediate	Upper intermediate	Advanced
Module 1	Introduction to computing	Introduction to computing 2	Computing	Gmail and cloud services	Cloud services
Topics	Hardware and software	General PC settings	Internal components of the PC	Email; drive, dropbox, OneDrive	Applications for virtual meetings
	Operating systems	Storage devices	Peripheral Configuration	Google docs	Online applications
	Mouse and keyboard	Antivirus and computer viruses	Installation of programs	Google slides	—
	—	—	Computer programs	Google maps	—
	—	—	Creation of videos	—	—
Module 2	Computer programs	Computer programs 2	Internet and applications	Applications for virtual meetings and streaming	Social networks and virtual communication
Topics	Basic windows programs	Basic windows programs	Browser settings	Zoom	Facebook messenger
	Introduction to MS word	MS word (more advanced use)	Google drive	Google meet	Chatbots
	Introduction to MS PowerPoint	MS PowerPoint (more advanced use)	Google docs	WhatsApp rooms	Telegram
	—	—	Google slides	Jitsi meet	Skype
	—	—	Google sheets	Facebook live	—
	—	—	—	YouTube live	—
Module 3	Introduction to internet	Internet and social networks	Mobile devices	Apps and mobiles	Blogs and online stores
Topics	Internet browsers and search engines	Internet browsers and search engines	Mobile operating systems	Applications for virtual meetings and streaming	Introduction to blogs
	Social media	Email (more advanced use)	Online messaging: WhatsApp web	Email	Online stores
	Email	Facebook	Basic use of the cell phone	Cloud services	—
	—	Facebook advertising page	Installing apps	—	—
	—	—	File transfer	—	—

in 2018 the Intermediate level was incorporated and an Online Course (alfabetizaciondigitalam.neolms.com) was designed to facilitate the learning of the participants through the development of a set of activities, such as obtaining digital educational material, performing tests, uploading practices, among others.

Currently, the workshop consists of five levels of digital literacy (Basic 1, Basic 2, Intermediate, Upper Intermediate, and Advanced), which have been designed according to the needs and characteristics of the elderly, so that they can increasingly acquire more sophisticated digital skills. Each level is divided into three modules. For this study the first four levels are taken into account, because the advanced level was implemented in 2021 (see **Table 1**).

The methodological part of the workshops was based firstly on considering the motivation of the elderly. Various studies have shown that elderly adults are capable of obtaining levels of knowledge equal to or higher than those of younger people if they are highly motivated to do so (Lordache et al., 2017; Ragnedda eta al., 2018; Falloon, 2020). According to this, each class begins with an integration activity where adults can interact and express themselves with all the members of the group. In this sense, it has been observed that a definitive factor for older people to continue with their training is the social aspect, that is, coexistence and establishing a climate of trust and understanding with more people, allowing to develop a sense of belonging within a group.

Likewise, it was sought that the practices and exercises were useful and applicable to their daily life, since if the adults have the feeling that what they learn does not serve a useful purpose for them, they will become unmotivated, divert their interest and stop learning. Finally, different learning strategies were chosen to reinforce what was learned, such as constant reviews of each topic, where a practical review is carried out in class and students are also asked to answer a digital review activity within the online course.

It is important to mention that in digital literacy, several levels can be involved, ranging from the most basic (elementary skills), to the intermediate (in which technology is used to improve one's life or be more efficient), and to the advanced level (based on the creation of their own digital content and the consolidation of a digital identity and consciousness). According to Herrera et al. (2015), when referring to digital literacy, it is understood that it involves information literacy, which is defined as the knowledge and digital skills of a person to locate information in various formats. Consequently, to be digitally literate, people must be able to identify information to critically analyze it and reconstruct it, developing specific digital skills (data management, navigation, communication, content creation) (Lordache et al., 2017). This set of skills leads to a digital intelligence, which refers to the set of social, emotional, and cognitive skills that allow individuals to face the challenges and adapt to the demands of digital life (Rahman et al., 2021). Therefore, the four skills considered within the Digital

FIGURE 1 | Digital literacy process of the elderly. Source: Authors, based on present results.
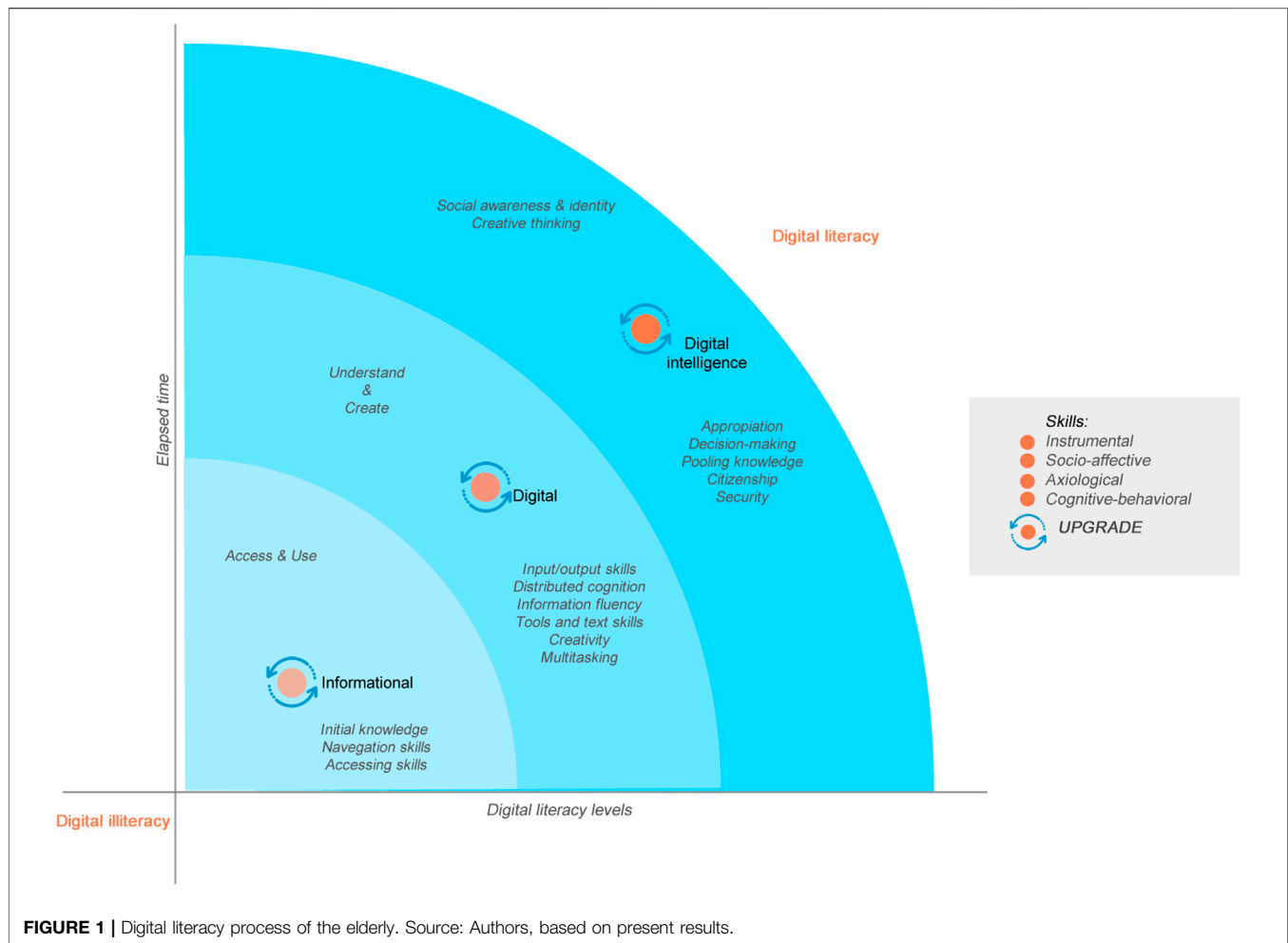
Literacy Workshop: 1) Instrumental: it refers to practical knowledge and digital skills for hardware and software use. -Learning and understanding of use-; 2) Socio-affective: it refers to the ability to build affective and emotional ties with others through the use of ICT, establishing effective communication. -Ability to communicate and socialize through ICT-; 3) Axiological: it allows the acquisition of ethical values with regard to the use of ICT. -Awareness regarding the use of information on the Internet- and 4) Cognitive-behavioural: it refers to the acquisition of knowledge and cognitive skills to be able to search, select, analyze, interpret and recreate information in order to give it meaning. In **Figure 1**, this proposal is presented.

It should be noted that these skills are progressively addressed in the five literacy levels of the workshop. Likewise, these four skills are integrated into the three literacy phases: informational, digital, and digital intelligence.

COVID-19 and Digital Literacy in Mexico

The Coronavirus (COVID-19) pandemic has revealed the lack of such digital literacy, in the older adult population, who has more limited access to ICT, in comparison with other age groups. Given the unexpected state of alarm that is being experienced worldwide due to the COVID-19 pandemic, nations have been urged to modify the ways in which their most essential activities are

carried out; such is the case of education (Bozkurt, 2020; Moore et al., 2020). Mexico has not been the exception and, as in other countries, prevention measures were established, such as cancelling face-to-face classes and consequently adopting remote/online education, in order for students to continue their academic activities online. It is noteworthy that the first case of COVID-19 in Mexico was detected on the February 27, 2020, in Mexico City (Tariq et al., 2021). Phase 1 of the COVID-19 pandemic in Mexico started on February 28th, and on March 24th the federal government declared Phase 2 upon detection of the first local infections (Caldera-Villalobos, 2020). Nearly a month later, non-essential activities in the public sector were suspended, massive gatherings were restricted, and the general population was advised to remain in their homes, especially people over 60 years of age. At the time of writing this article (May 14th, 2021), Mexico has been in confinement for 417 days and has reached fourth place among nations with more deaths from COVID-19, according to Johns Hopkins University statistics (Dong et al., 2020).

Therefore, training elderly adults in the use of ICTs, in a completely online modality, is a challenge for the institutions and programs dedicated to the digital literacy of this population. At the same time, older adults are less likely than younger people to

FIGURE 2 | Distribution of Internet users by age group (INEGI, 2019).
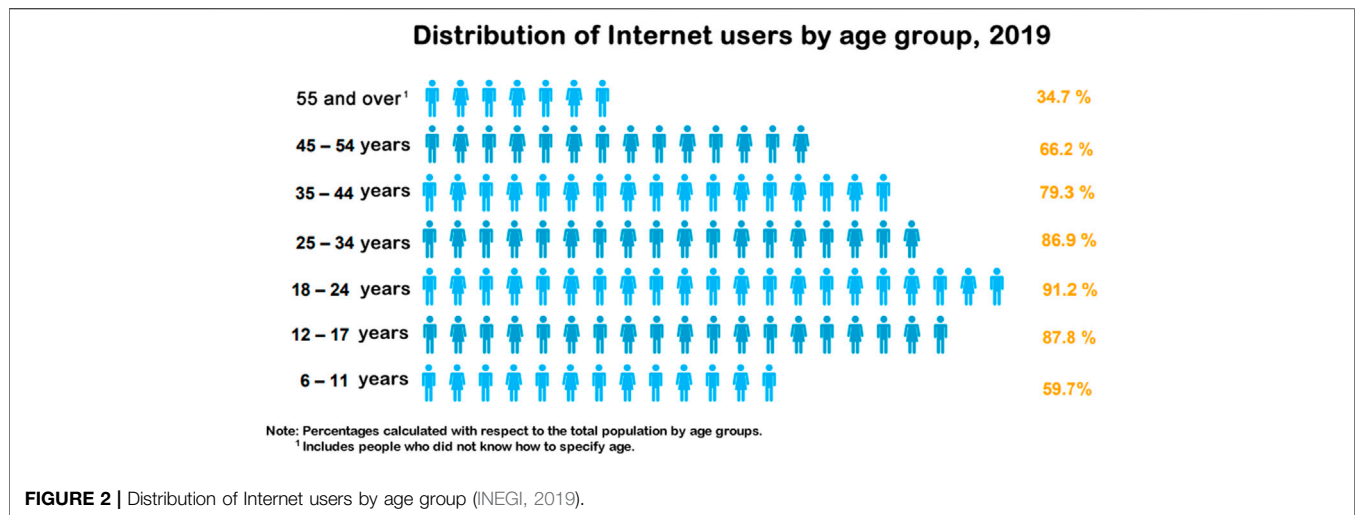
be able to take advantage of the opportunities enabled by modern ICTs, because they cannot afford internet access or ICT devices, do not use the internet, or lack the skills to use ICTs even if they do have access.

According to data from the 2019 National Survey on the Availability and Use of Information Technologies in Households (Encuesta Nacional sobre Disponibilidad y Uso de Tecnologías de la Información en los Hogares de 2019, ENDUTIH, in Spanish), in Mexico 20.1 million households (56.4% of the national total) had Internet connection. Likewise, the age group that concentrates the highest proportion of Internet users was the group between 18 and 24 years old, with a participation of 91.2% (INEGI, 2019). The second age group in which Internet was most widely used was that of 12–17 years old, with a participation of 87.8%. In third place, we found users aged 25 to 34, who registered 86.9%. For its part, the age group that least uses the Internet was 55 and over, since they registered 34.7%. In **Figure 2**, these percentages are presented.

With regard to the purposes of Internet use, the main activities are: entertainment (91.5%), obtaining information (90.7%), and communicating (90.6%). Especially, the need to communicate has been an activity that has escalated significantly in the last year, due to the exceptional situation that is being experienced worldwide caused by COVID-19. Now more than ever, our collective behavior has changed radically, as a large part of our activities has focused on using the Internet and how it is used in everyday life. As massive events were suspended and workplaces and schools went online, the world changed Internet habits, both temporarily and prospectively, triggering an increase in the use of the Internet for specific purposes (Lee et al., 2021). Based on the above, it is a fact that the younger generations were born immersed in a world where the use of ICT is essential for many processes and exchanges of daily life, but it is risky to assume that the entire population, specifically the elderly, have the same level of access to devices, to the Internet and whether they have the necessary skills to take full advantage of technological tools.

Simultaneously, the increase of Internet users in Mexico went from 62.4 million to 80.6 million from 2015 to 2019; however, it also prevails that in Mexico there are around 4.7 million people who, in addition to being illiterate, do not have the necessary digital knowledge and skills to use ICTs as a tool for their economic and social development. This digital illiteracy has been evident in the Mexican population even before COVID-19. According to Yu et al. (2017) digital illiteracy involves a number of factors, such as lack of technical knowledge of ICT tools, lack of literacy skills and competencies, lack of access to computers and the Internet, the digital divide and digital exclusion. In this sense, the digital divide is combined with digital illiteracy and adds to the compendium of variables that hinder the digital inclusion of older adults (Datta et al., 2018). Under the state of emergency caused by COVID-19, the appropriation of ICTs and the possibility of using them as an effective means against loneliness and social exclusion has been problematic for the elderly population.

Despite the positive digital participation outcomes for people worldwide during the COVID-19 pandemic, older adults feel the risk of being doubly excluded, first from physical contact and second because of digital exclusion from a digitally dominated society (Seifert et al., 2021). For those reasons, digital exclusion means exclusion from a society dominated by the internet and other digital technologies in many areas of everyday life. Exclusion from participation in these digital areas can sometimes lead to subjective feelings of social exclusion by the most vulnerable population -older people- (Seifert et al., 2018).

Therefore, the present study has four objetives: 1) To describe three treatments that were developed in the TAD despite the pandemic; 2) To present a longitudinal and pooled study and we analyzed the effects of the Coronavirus (COVID-19) pandemic on the digital literacy of older adults and 3) To describe special cases and dropouts and 4) To present how is the ICT learning process for older adults to become digital literates before, during and after COVID-19 pandemic. Given the above considerations, the analysis of the level of Digital Literacy of two groups of elderly

adults with different levels of literacy during three stages: Blended Learning; Transition and Digital was undertaken.

Now, for the second and third objectives, four hypotheses were tested: H1: the number of people interested in becoming digitally literate will be low; H2: basic level groups would be the most affected during the pandemic; H3: the dropout rate during the pandemic would be higher compared to the blended treatment (face-to-face classes) and H4: the post-DILE score would be lower compared to the blended treatment and the online treatment itself.

MATERIALS AND METHODS

Subjects

This study involved 176 adults, 140 Females and 36 Males, aged around 60, and with a range of 12–14 years of education. Twenty older adults were considered for longitudinal analyses and 251 for pooled analyses.

The participants were Mexicans living mainly in the state of Hidalgo and its surroundings. All subjects gave their informed consent in written and digital form, in accordance with the Code of Ethics for Psychologists (Sociedad Mexicana de Psicologia, Mexican Psychological Society, 2010) and the General Health Law (Diario Oficial de la Federación, 2020). Furthermore, all subjects were independent and there was no need for someone else to sign for them.

Instruments

The "Digital Literacy Evaluation (DILE)" is an instrument that was designed to measure the digital literacy level and it is based on previous questionnaires (e.g. National Survey on the Availability and Use of Information Technologies in Households, ENDUTIH). On the basis of this, one of the authors (Martínez-Alcalá et al., 2018) designed an adapted version of the instrument, thanks to her education as a Multimedia Engineering PhD.

The instrument was applied digitally in a systematic way in all workshops (pre and post). The scale contains 110 items divided into three sections: Use and knowledge of the computer, Use and knowledge of the Internet, and Knowledge of home and daily life devices (Martínez-Alcalá et al., 2018). The scores an elderly can obtain in the Evaluation in Spanish letters are: A+ (Total competence); A (Moderate competence); +M (Medium competence); M (Medium-Low competence); +B (Low-Medium competence) or B (Low competence). These scores are only indicative, and it is not possible to assert that the scale provides absolute digital literacy values, but it presents specific and significant indicators of the technological competencies of the elderly (Cepeda-Rebollar, 2016; Martínez-Alcalá et al., 2018).

The validity of the DILE instrument previously named SDLE is described in the article "Digital Inclusion in Older Adults: A Comparison Between Face-to-Face and Blended Digital Literacy Workshops" where the authors reported the content validity, in order to determine whether the items or questions proposed in the instrument reflect the knowledge, abilities and skills required to determine the Technological Literacy Level in the elderly. This evaluation was carried out in the second semester of 2014, by a group of seven experts in the area (5 females and 2 males) who have a PhD degree. These experts undertook the task of evaluating the content validity and the relevance of the instrument. The content value analysis of the items incorporated in the instrument revealed which items are considered relevant for the evaluation of technological literacy level in older adults. In general, the results of the index show that the DILE instrument can be considered valid in its content.

Treatments
Generalities of the Treatments

In this section, we will describe some of the situations that took place in all the stages of the digital literacy workshop.

- *Learning acquired by levels:* The levels designed within the workshop are intended for the student to increase their digital skills at their own pace and progressively. The learning outcomes achieved at each level will be described here. Regarding basic levels 1 and 2, students study the same topics (Introduction to computing, computer programs and the Internet), adding some additional concepts or tools to each module. For example, in the case of MS Word in basic 1, students get to know the home and insert tabs; in the case of basic 2, these tabs are studied again, and two other tabs are added, namely design and format. Successively, each higher level takes up topics from the previous level and adds new topics. This allows students to reinforce topics previously discussed, as well as to increase their knowledge and skills in the use of ICT.
- *Repetition-based learning:* It has been demonstrated that older adults tend to forget or to have a retention skill loss, especially if a long time has passed since the time of learning. In the case of digital literacy sessions, if the tutor explains how to access an Internet browser, he has to consider that in subsequent sessions the procedure will have to be reviewed again. The initial explanation of an activity is important, but it is unable to give the student knowledge if he has not done the practice, that is why the student learns better by doing and repeating the procedure, to better retain the knowledge. Even in the digital stage, where there are videos of each class, the students reproduce the video several times to remember and carry out the step by step of each activity. The workshop has worked well when a practice is carried out repeatedly, as the learning is more long-lasting and consistent for the students.
- *Digital learning:* The online digital literacy course was incorporated into the workshop to facilitate the learning of the participants, through the development of a set of activities. This course allows that, once the lesson has been taught and the task has been sent, students can send their practice and receive feedback from their tutor, being of great help for the subsequent interaction after class, since it allows to clarify many interesting doubts regarding the task.
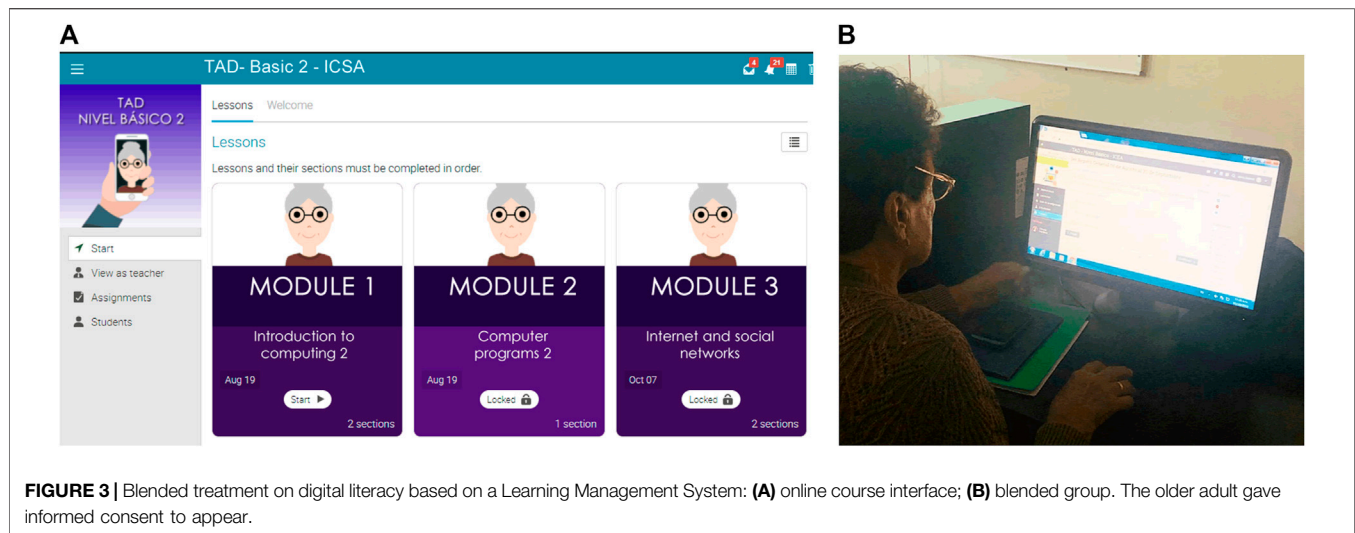
FIGURE 3 | Blended treatment on digital literacy based on a Learning Management System: **(A)** online course interface; **(B)** blended group. The older adult gave informed consent to appear.

- *Learning the terminology:* One of the peculiarities of the elderly enrolled in the workshop is that they sometimes know how to use the tools in a practical way, but they do not remember how to name them. For instance, when students register for the online course, the tutor mentions that they will use an online course developed in the NeoLMS Learning Management System (LMS), and that within the course they will be able to consult multimedia material, perform their reviews and upload their practices. Students learn how to enter the course on their own and they carry out all the corresponding activities; however, when asked within the Digital Literacy Scale if they use Internet resources such as online courses, their answer was "no", meaning that they do not identify the resources with their names. This situation occurs continuously at the most basic levels, and begins to dissipate in the more advanced levels, when they have been practicing with the online course or with a specific tool for much longer.

- *Memory loss perception:* The elderly enrolled in the workshop frequently worry about their memory and other cognitive skills, indicating that it takes them longer to learn new things and that they tend to forget topics or procedures they recently studied or even service authentication data for the Internet such as email and social networks. This perception of memory loss and lack of attention causes some adults to be discouraged from continuing in their digital literacy process; hence, it is important to keep learning by repetition and progressively, encouraging them so that this "forgetfulness" does not prevent them from learning and acquiring digital skills. Jointly in the case of data such as username and password of digital accounts, they are advised to use characters that are easy for them to remember.

- *Seeking Independence:* One of the reasons why the elderly have a need to become digitally literate is to become independent; in other words, they wish not to require the support of their family members to carry out personal activities or search for information of interest to them.

The main reason for this need for independence is that adults mention that when requesting assistance from a relative, they do not receive the assistance they expect, since their relatives prefer to carry out the given action without stopping to explain how to carry it out, leaving the adult with the same doubts and neglecting their need to learn. Similarly, many of the elderly indicate that when there is the possibility of learning a digital skill with a family member, the latter lacks patience and empathy, which leads them to be discouraged from learning new technologies. The digital literacy workshop has allowed the elderly to be more autonomous and independent in relation to the use of ICT, even in times of the COVID-19 pandemic. This last point was an unexpected fact since the digital treatment (which is reported in this study) had a good response from the adults even though the assistance was entirely online, demonstrating that this population requires digital independence.

The Digital Literacy Workshop for the Elderly went through a transition due to the COVID-19 pandemic, and this situation posed a great demand and an unprecedented challenge for all the groups involved. Next, the three different treatments of the workshop that occurred in three different time periods will be described. During these periods older adults had to experience various changes in their learning and the way they took the sessions.

Blended Learning Treatment

The blended workshops were carried out within the period of August to December 2019, with a total of 101 older adults enrolled in different groups who attended, learned and interacted face-to-face and also accessed the online digital literacy course, which was used as a tool to support their learning (see **Figure 3**).

Within this treatment, the following groups were formed: five groups of Basic 1 level, one of Basic 2 and one of Intermediate. Each group had a tutor, who indicated the topics to be developed

in each class. In addition, professional staff (gerontologists) provided support and personalized attention to each older adult. The students attended the computer classrooms twice a week for 2 h and a printed manual was provided. For the digital skills teaching process, the tutor used digital presentations and a projector as support material. The class structure that the tutor followed was: Integration activities, review of previous class contents and elaboration of the topic. The elaboration of the topic consisted in the tutor giving a brief introduction to concepts, followed by the execution of the corresponding practice; at the same time, the student followed the instructions step by step, always with the aid of the support staff.

Communication with adults was totally face-to-face and only in extraordinary cases was the instant messaging application WhatsApp used, through which they were notified of important announcements, class cancellations or to schedule a counseling session. Counseling sessions consisted in personal assistance to the elderly, regarding doubts about activities carried out in class. Counselling sessions were held individually before or after classes and lasted from 20 to 30 min.

It is worth mentioning that the online course registration was carried out in person, in order to support the adult in the generation of their username and password, and that these data were noted in their manuals to avoid losing them. Taking into account that not all adults had a computer equipment at home, the online reviews were also carried out in the classroom setting. Students could make up to five attempts at their reviews, in case they wanted to improve their score. In the particular case of students who did not have a computer at home, they carried out additional attempts from a mobile device or entered their classroom earlier.

Transition Treatment

This treatment called "transition" took place within the period February to June 2020, with a total of 115 older adults enrolled in different level groups. Nine groups were formed: four groups of Basic 1, four of Basic 2 and one of Intermediate level. During the month of February and mid-March 2020, all students took their classes in the blended modality, attending the computer classrooms two times a week and using the online course as a support tool for their learning. However, with the social distancing measures implemented due to COVID-19, educational institutions decided to carry out a total closure of their facilities.

Therefore, it became necessary–even essential–to introduce the elderly to the new remote learning modalities, and to give them the opportunity to learn about new ways of accessing knowledge and introducing them to the technological reality in which we live. That said, the participants had a break from classes from March 23 to April 3, 2020; meanwhile the team of instructors and coordinators made adjustments in the planning of the classes and the decision was made to change the teaching-learning methodology (not forgetting the gerontological foundations and andragogy) in a very short period of time.

Resources were sought to optimize not only students' ICT learning, but also the communication and administration of activitie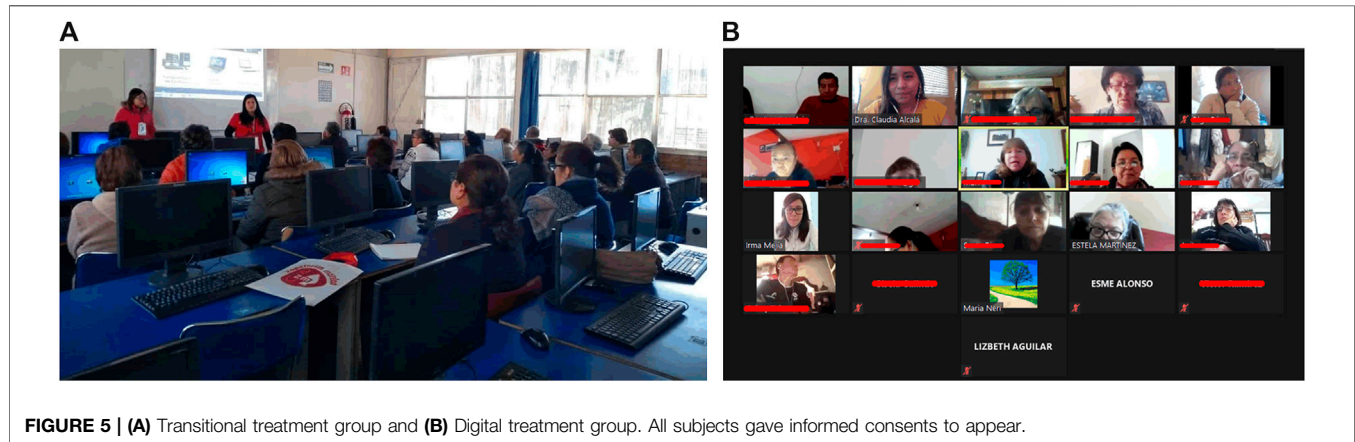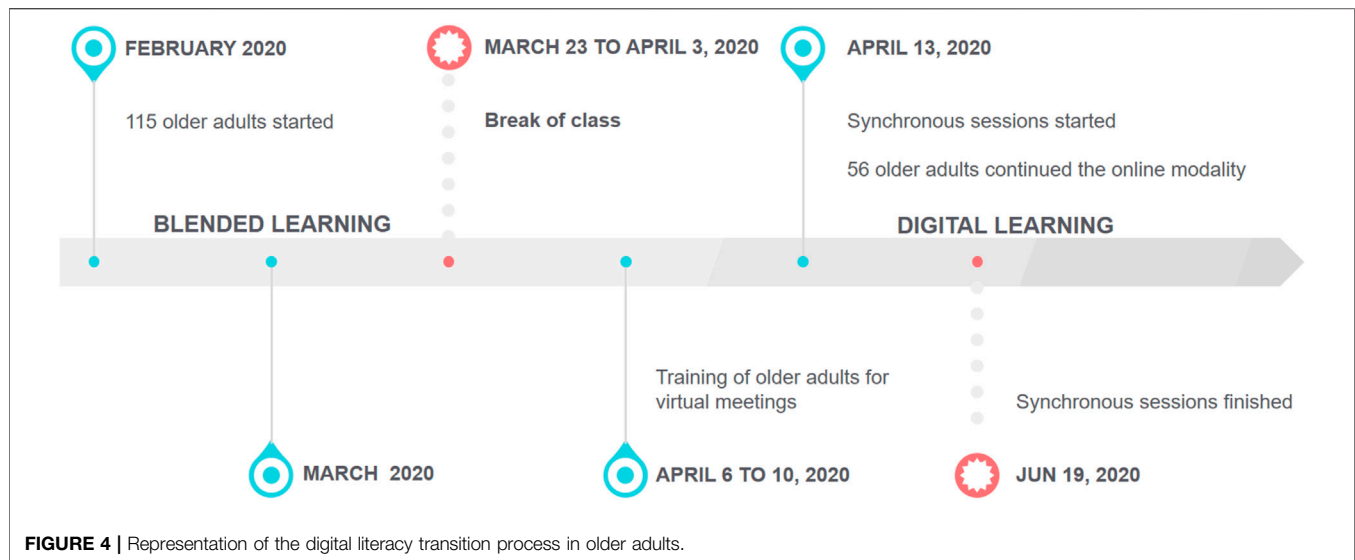s. Additionally, tutorials were generated so that students would begin to learn about different platforms such as Google Meet, Zoom, Jitsi or Microsoft Teams. In our workshop, we decided to adopt Zoom for the delivery of synchronous classes, so from April 6 to 10, we proceeded to teach the adults how to enter an online meeting and use the basics of this application, through video tutorials and telephone assistance. The main reason for choosing this application was because it offered the possibility of recording the online classes–even in its free version–which allows the generation of teaching material that can be shared with students subsequently. The advantage of these recordings is that they were made available so that the adults could consult the classes (practice, concepts and procedures) as many times as necessary.

Synchronous sessions started on April 13. However, of the 115 adults who had started this treatment, only 56 continued their ICT learning process, adopting the online modality. The complications that prevented the elderly to continue with their training in digital literacy were due to the following factors: 1) not having the necessary resources at home (computer, Internet or both); 2) the lack of basic skills and knowledge of digital technology, specifically the Basic 1 level students who were just starting the workshop; and 3) the decision to wait for the next workshop. For these reasons, the adults who continued were mostly at Basic 2 and Intermediate levels.

Likewise, synchronous sessions were 4 h a week (divided in two 2-h sessions in response to the participants' requests) and the class consisted of three stages: integration activity, recording of topic, Q&A. However, the recording of the topic consisted in explaining practical procedures, so that the students could observe each practice step by step. Likewise, reviews of previous topics and online course registration were recorded to optimize session times. In the case of the Q&A stage, the students had a space to express their doubts about the subject seen in class and about the previous session.

Particularly, participants' registration in the online course was carried out with the aid of a video recording and they generated their username and password. However, there were some complications, for example, they reported not being able to register because they could not find the option that was indicated in the video or they forgot their access data, so personal advice had to be provided. In addition, online reviews were requested as homework for the student to answer later, so students no longer had limited time and could better analyze their responses and pause if necessary, to respond later.

At the same time, we also continued to work through the instant messaging application WhatsApp, in order to share the data from the synchronous sessions, send links to the class videos, notify announcements, or schedule a counselling session. The didactic material of the educational platform was updated so that the students could consult more content related to the topics seen in class. During this period, it was understood that for people to be "digitally included", they must have a "digital ability", since this can offer them not only great learning advantages, but also social, cultural and health benefits, among others. In **Figure 4**, a representation of the digital literacy transition process that took place with the pandemic is shown.

FIGURE 4 | Representation of the digital literacy transition process in older adults.

FIGURE 5 | (A) Transitional treatment group and **(B)** Digital treatment group. All subjects gave informed consents to appear.

Digital Treatment

This treatment was initiated in a completely online modality and it took place within the period of August–December 2020, with a total of 94 registered adults. The workshops were disseminated through social networks and digital media (radio, e-mail and WhatsApp groups). In order to register in the workshops, the elderly were required to have access to a computer and the Internet, and the new students were asked to schedule a trial session in Zoom for personal assistance. For these trial sessions, one video-tutorial was sent on how to download Zoom and how to enter a Zoom session. Then, if required, a phone call was made to clarify doubts about entering the application. Subsequently, the meeting invitation was sent *via* WhatsApp, and once in the session, the tutor supported the adult to learn the basic Zoom tools (camera, audio, chat and reactions).

At this digital treatment, eight level groups were formed: two groups of Basic 1, two of Basic 2, three of Intermediate, one Upper Intermediate level. Moreover, the structure of synchronous sessions was similar to the previous period, personal

counselling and communication *via* WhatsApp were maintained. The online course continued to be used as well. As additional material, short videos (minimum 3 min) were shared at all levels in order to support students in understanding practical procedures.

However, for the Basic 1 groups, the tutors provided an explanation of basic concepts, followed by the practical procedure, repeating it several times and exposing different views of Windows for better understanding. During the first 3 weeks, most of the students at this level were provided with personalized advice and telephone assistance, so that they could achieve the following activities by themselves: turning their computer on and off, entering the Zoom session and using the basic Zoom tools, using their mouse and keyboard more fluently, recognizing their taskbar and file explorer, and creating folders.

From Basic 2 and upper levels, sessions were carried out with a different pace, since the participants were already familiarized with the structure of the sessions. For instance, in the Q&A section, if a student reported to have difficulties carrying out a practice, the
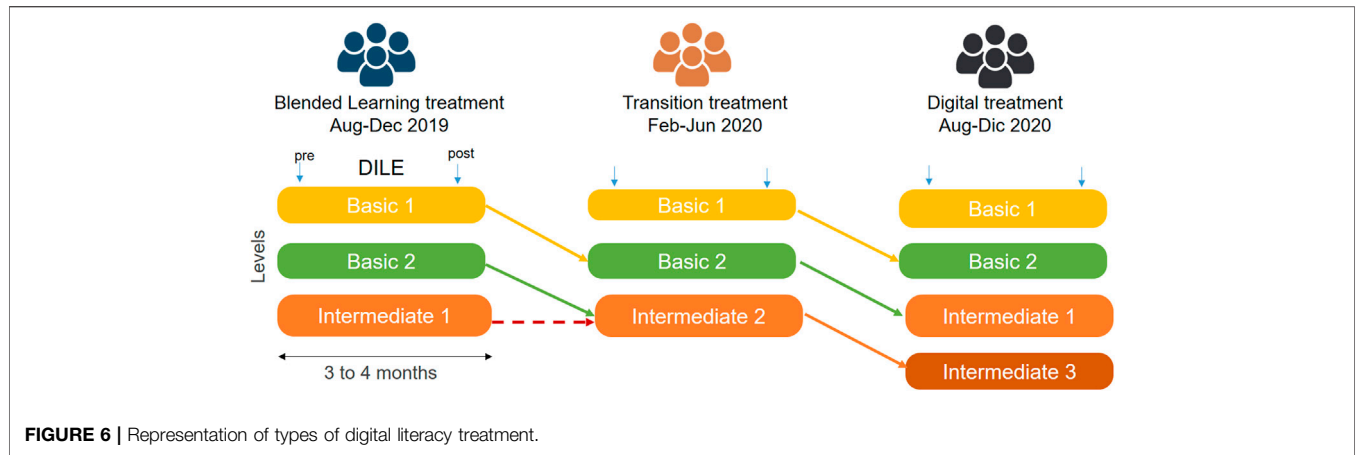
FIGURE 6 | Representation of types of digital literacy treatment.

TABLE 2 | SOCIO-DEMOGRAPHIC characteristics of the two groups (longitudinal analyses). Blended Learning (BL) treatment; Transition to pandemic (TP) treatment; Digital (DI) treatment. Digital levels of Group 1 (G1); Group 2 (G2); Basic 1 (B1); Basic 2 (B2); Intermediate 1, 2 and 3 (I1 I2 I3, respectively).

Treatments	Blended learning (BL)	Transition to pandemic (TP)	Digital (DI)
Digital levels of G1	B1	B2	I1
- n	11	11	11
Treatments	**BL**	**TP**	**DI**
Digital levels of G2	**I1**	**I2**	**I3**
- n	9	9	9
Socio-demographic characteristics			
Socio-demographic characteristics of G1		*Socio-demographic characteristics of G2*	
Male—n, % 2, 18.18%		Male—n, % 3, 33.33%	
Female—n, % 9, 79.31%		Female—n, % 6, 66.66%	
Age - mean (SD) 61.27 (3)		Age—mean (SD) 65.44 (8)	
Education in years—mean (SD) 12.64 (2)		Education in years—mean (SD) 14.33 (2)	
Ocupation—n, %		Ocupation—n, %	
Housekeeper 6, 54.5%		1, 11.11%	
Pensionate/retired 3, 27.2%		6, 66.66%	
Employee 1, 9.0%		0, 0%	
Professional 1, 9.0%		1, 11.11%	
Trader 0, 0%		0, 0%	
Autonomous job 0, 0%		1, 11.11%	

tutor asked the student to share their screen in order to guide them. This activity allowed the other students to observe and if their doubt was similar, it was resolved at the same time.

It is important to point out that the Upper Intermediate level was opened for the first time in this Digital period. The level consisted in introducing students to the use of online videoconferencing and streaming applications. Google Meet, Jitsi Meet and Zoom were some of the applications for online meetings that students were introduced to in this level, mainly learning their basic features and functions like creating and managing a meeting. Students at this level had more advanced digital skills since most of them had been in the workshop for more than two years.

Of special importance is the fact that the Digital treatment gave other elderly adults the opportunity to access the Digital Literacy Workshop, especially to those who had not been able to join previously due to geographical limitations. In **Figure 5**, a representation of the blended to the digital treatments is observed. The period between these treatments was named "transition treatment".

Statistical Analysis

In order to evaluate the effects of the pandemic, a longitudinal perspective considered only those older adults whose active presence was completed over three consecutive semesters: before the pandemic (August–December 2019), at the precise semester the pandemic began or Transition to pandemic (February–June 2020) and the following semester (August–December 2020). Then, within each semester, a comparison between pre and post score of the DILE was undertaken. Furthermore, to obtain norms with global parameters (mean, median, standard deviation, range, etc.) of the DILE for each type of digital literacy treatment, groups were pooled with those older adults who at least could complete the entire semester of digital literacy. For each group, socio-demographic and DILE scores are presented. Finally, comparisons with independent Student t-tests between pre-pre and between post-post DILE scores within different treatments of the same digital level were performed

TABLE 3 | Socio-Demographic characteristics (pooled groups).

Levels	B1	B2	I1	I2	I3
- n	115	69	39	13	15
Male—n, %	26, 22.6%	14,20.3%	6, 15.4%	4,30.8%	3,20.0%
Female—n, %	89, 77.4%	55, 79.7%	33,84.6%	9,69.2%	12,80.0%
Age—mean (SD	63.97 (7)	62.63 (5)	62.5 (6)	63.8 (7)	64.7 (6)
Education in years - mean (SD)	12.8 (3)	13.7 (2)	13.2 (3)	14.3 (2)	14.9 (4)
Ocupation—n, %					
Housekeeper	43, 37.4%	21, 30.4%	12,30.8%	2,15.4%	2,13.3%
Pensionate/retired	36,31.3%	21, 30.4%	18,46.2%	8,61.5%	10,66.7%
Employee	12,10.4%	7, 10.1%	4, 10.3%	1,7.7%	0.0%
Professional	14,12.2%	9, 13.0%	3, 7.7%	1,7.7%	2,13.3%
Trader	5,4.3%	4, 5.8%	0, 0%	0, 0%	0.0%
Autonomous job	5, 4.3%	7,10.1%	2, 5.1%	1,7.7%	1,6.7%

Basic 1 (B1), Basic 2 (B2); Intermediate 1, 2 and 3 (I1, I2 and I3).

(for B1 and I1). In **Figure 6**, the types of digital literacy treatments are presented.

Longitudinal Analyses

Socio-demographic characteristics of the subjects that assisted consecutively throughout the three semesters to the blended, transition to pandemic and digital courses at their respective digital literacy levels [G1: B1, B2 and I1 (n = 11); G2: I1, I2 and I3 (n = 9)] are presented in **Table 2**. Data concerning gender, age, education in years and their occupation were gathered and frequencies and percentages were calculated. These students were mainly females around the age of 60, with a range of 12–14 years of education, and they were housekeepers (G1), or retired (G2).

- For each group, a comparison among the three pretreatments and the three posttreatments of each semester were each compared with the Friedman ANOVAs (G1: n = 11; G2: n = 9). This analysis is useful to find differences among three measurements within the same group of subjects given an ordinal variable.
- Scores of the DILE considering the same subjects that regularly attended the three courses: blended, transition to pandemic and digital (G1: n = 11; G2: n = 9) were compared within the semester between each pretreatment vs. each posttreatment and Student t tests were run. Also, their differences (post minus pre scores of the DILE) were subjected to a mixed ANOVA. This last analysis served to contrast both G1 and G2 groups. In addition, post minus pre differences could indicate the degree of difficulty the elderly experienced in each course given the circumstances. Should the post minus pre differences be lower in another time, no great achievement could be inferred for the particular course. On the contrary, a high difference on the DILE could represent a high profit of the course and this seems to be valuable for the comparison within other courses, especially for the case of the semester when the pandemic outbreak occurred.

Pooled Analyses

Socio-demographic characteristics of the subjects that attended at least one course are presented in **Table 3**. Frequencies and percentages of gender, age, education in years and their occupation were asked to elderly subjects. For these analyses, females were also the predominant gender, their age was around 60 years, and the years of education were between 12 and 14. As in the longitudinal analyses, housekeepers and retired people constituted altogether the members of the group.

- The number of older adults that completed at least one course reached 251 (accomplished the pre and post DILE evaluations), therefore, subjects were pooled in order to obtain norms throughout the particular treatment levels. It is important to notice that these participants could be included or not in another type of treatment.

RESULTS

Longitudinal Analyses

As can be seen in **Table 4**, in the comparison among the scores of the three pretreatments and the three posttreatments of each semester for each group, the three scores of the pretreatments (**Figure 7A**) and the three scores for the posttreatments (**Figure 7B**) each for G1 and for G2, respectively, were statistically significant. Wilcoxon non-parametric tests were used as post-hoc tests and revealed differences for the G1 on the DILE scores over the pretreatments in all cases: between the blended learning treatment and the next treatment before the pandemic was evident (z = −2.36, p = 0.01); between the DILE scores of the blended pretreatment and that of the digital modality (z = −2.89, p = 0.003); and between the DILE scores for the transition to pandemic to the digital modality (z = −2.90, p = 0.003). For the posttreatments in the above-mentioned modalities, z = −2.75, p = 0.005; z = −2.98, p = 0.003; z = −2.89, p = 0.003, respectively. For the G2, in the pretreatment condition and the above-mentioned types of treatments, post-hoc tests between the DILE scores were, respectively: z = −0.14, p = 0.88; z = −2.61, p = 0.009; z = −2.61, p = 0.009. For the posttreatments in the G2, DILE scores were, respectively for the blended to the transition to pandemic, z = −1.70, p = 0.08; z = −2.61, p = 0.009; z = −2.61, p = 0.009. Therefore, only in the G2, both the pretreatment and the posttreatments were

TABLE 4 | Mean comparisons on the Digital Literacy Evaluation (DILE) among pre treatments; and among post treatments (longitudinal analyses)/Friedman ANOVAS. Blended Learning (BL) treatment; Transition to pandemic (TP) treatment; Digital (DI) treatment. Group 1 (G1); Group 2 (G2); Basic 1 (B1); Basic 2 (B2); Intermediate 1, 2 and 3 (I1, I2, I3, respectively).

	Group/Pre treatments					Group/Post treatments				
G1 (n = 11)	**BL** **PRE** B1 Mean (SD)	**TP** **PRE** B2 Mean (SD)	**DI** **PRE** I1 Mean (SD)	Chi gl = 2	p(chi)	**BL** **POST** B1 Mean (SD)	**TP** **POST** B2 Mean (SD)	**DI** **POST** I1 Mean (SD)	Chi, gl = 2	p(chi)
	138.09 (18)	177.72 (25)	215.18 (12)	17.64	0.0001	192.72 (16)	221.63 (14)	262.91 (18)	21.53	<0.0001
G2 (n = 9)	**PRE** I1 201.88 (4)	**PRE** I2 200.44 (2)	**PRE** I3 253.55 (16)	15.75	0.0004	**POST** I1 247.77 (9)	**POST** I2 249.55 (11)	**POST** I3 287.33 (14)	12	0.002

not statistically significant between the blended and the transition to pandemic, thus, the scores of the DILE corroborated that treatment I1, was a repetition of the I2.

Mean scores of the DILE were compared with Student t tests. In all cases, pre vs post scores of the DILE were significant, as shown in **Table 5** and **Figure 8**. To further explore how the differences between groups were along treatments, differences between the post minus pre scores were calculated with a mixed ANOVA. Therefore, the two groups constituted the independent factor and the repeated measure factor was the type of treatment (blended, transition to pandemic and digital). For the G1, the post minus pre differences within the semester for the blended treatment were 54.63 ± 14; for the transition to pandemic 43.90 ± 20; and for the digital treatment, 47.72 ± 17. For the G2, the post minus pre differences were: for the blended treatment 45.88 ± 7; for the transition to pandemic 49.11 ± 9; and for the digital treatment, 33.77 ± 5. Only the independent factor was significant ($F = 4.69$, df $= 1, 58$; $p = 0.04$). The repeated measures factor was not statistically significant (F $= 1.85$, df $= 2, 58$; $p = 0.17$) and there were not interaction effects ($F = 1.97$, df $= 2, 36$; $p = 0.15$). The representation of these differences is presented in **Figure 7C**.

Pooled Analyses

During the semester August–December 2019, the number of older adults enrolled for B1, B2 and I1 were, respectively, $n = 69$; $n = 15$; and $n = 17$ (total, $n = 101$). It is important to notice that when the semester came to the end, the I1 group wanted to repeat the course, so even when the content of the course was practically the same, this group was named as "I2" and only 13 subjects continued to attend the following semester. For the February-June 2020 (or the semester when the pandemic began on March 2020), the number of older adults for B1, B2 and I2, were, respectively, $n = 5$, $n = 38$ and $n = 13$ (total, $n = 56$). During the digital course, the number of older adults were, for the B1, B2, I1 and I3, $n = 41$; $n = 16$; $n = 22$; and $n = 15$, respectively (total, $n = 94$). The descriptive statistics for each of the treatments are shown in **Table 6**. In **Figure 9**, the normal distributions of the frequencies of each level are evident.

Comparisons Within Different Treatments of the Same Digital Level

Two extra comparisons using DILE scores were performed between modalities of treatments (blended or digital) within the

same level (B1 or I1) in different groups and semesters. The first comparison comprising B1 was not significant (blended group from August to December, 2019 ($n = 69$); pre: 128.37 ± 17; post: 184.59 ± 19; digital group from August to December, 2020 ($n = 41$): pre: 132.39 ± 23; post: 194.19 ± 30; for the pre-pre comparison, $t = 0.96$, $p = 0.33$; for the post-post comparison, $t = 1.79$, $p = 0.07$). Instead, for the intermediate level, I1, the digital group was certainly more digitally literate than the blended one both for the pre and the post comparisons (digital group from August to December, 2020 ($n = 11$); pre: 215.18 ± 12; post: 262.91 ± 18; blended group from August to December, 2019 ($n = 13$): pre: 199.08 ± 13; post: 246.85 ± 14; for the pre-pre comparison, $t = 2.99$, $p = 0.006$; for the post-post comparison, $t = 2.36$, $p = 0.02$).

Special Cases

Next, we will describe three special cases of older adults who participated in the Digital Literacy Workshop.

We will start with the case of the 68-year-old student María M., with 13 years of schooling and a professional. María decided to enroll in three levels of digital literacy (Basic 1, Basic 2 and Intermediate) during the period Aug–Dec 2020 (digital treatment). For 4 months, Maria invested 12 h a week for the synchronous sessions and approximately 6 h to carry out her activities and tasks within the online course. Likewise, she was a very constant and participative student. It should be noted that in the case of basic levels 1 and 2, María studied the same topics, however in basic level 2 some additional concepts or tools were added to complement her digital skills. Likewise, at the intermediate level, topics were retrieved from the previous level and new topics were added. Hence, Maria had the opportunity to review the basic concepts and constantly practice the procedures of each activity at each level. Regarding the lack of knowledge of terms, María was able to identify several, such as the online course, Internet, Windows explorer, in addition to differentiating between the Office packages and the office automation of the Google Suite. Regarding her evaluation of the level of digital literacy, María obtained 135 points in her pre-evaluation and 249 points in her post. Proving that being enrolled in three consecutive levels of digital literacy helped her improve her digital skills, progressively increasing her score, taking into account that the average score for the intermediate level is 260 points.

Another case is that of the 64-year-old student Lupita P. a housewife with 9 years of schooling. Lupita was enrolled in basic
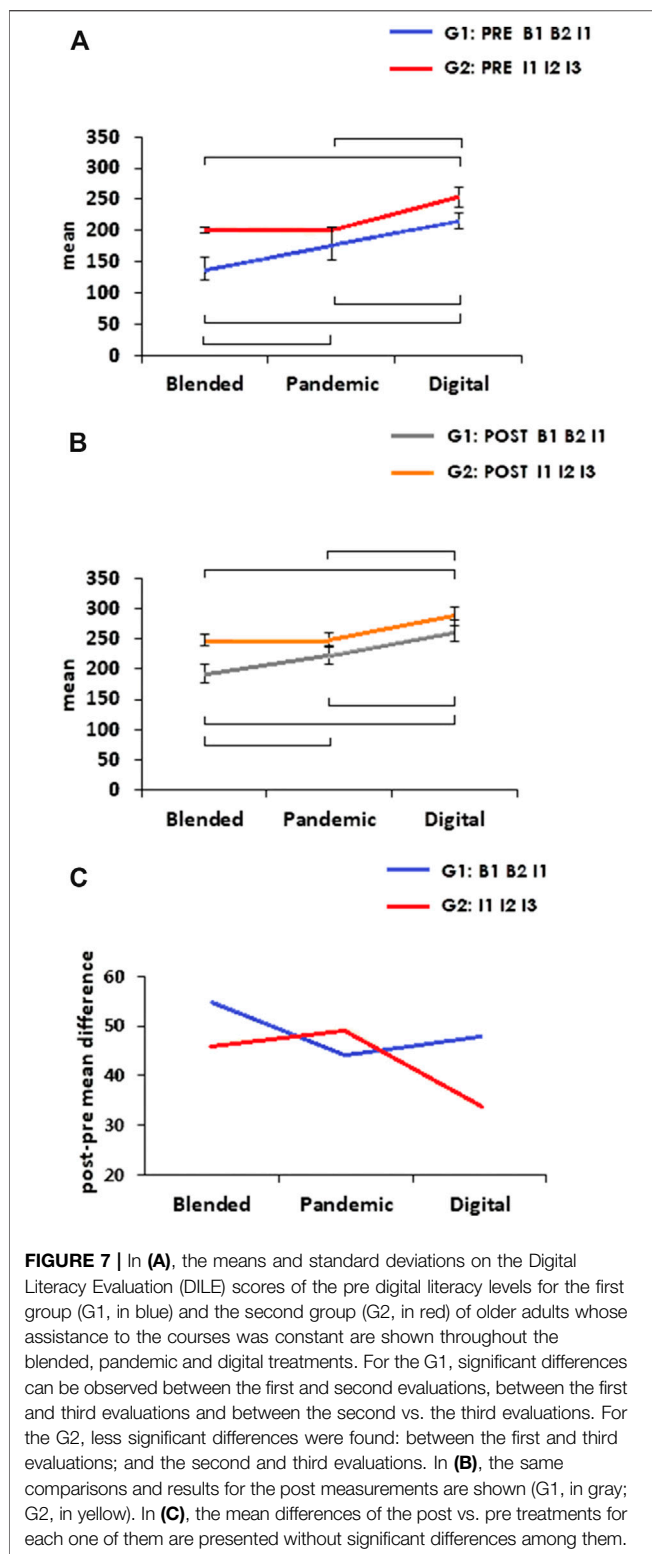
FIGURE 7 | In **(A)**, the means and standard deviations on the Digital Literacy Evaluation (DILE) scores of the pre digital literacy levels for the first group (G1, in blue) and the second group (G2, in red) of older adults whose assistance to the courses was constant are shown throughout the blended, pandemic and digital treatments. For the G1, significant differences can be observed between the first and second evaluations, between the first and third evaluations and between the second vs. the third evaluations. For the G2, less significant differences were found: between the first and third evaluations; and the second and third evaluations. In **(B)**, the same comparisons and results for the post measurements are shown (G1, in gray; G2, in yellow). In **(C)**, the mean differences of the post vs. pre treatments for each one of them are presented without significant differences among them.

level 2 during the Feb–Jun 2020 period (transitional treatment) and repeated the same level in the Aug–Dec 2020 period (digital treatment). In February 2020, Lupita began her face-to-face classes, attending a computer center twice a week and entering

the online course to complete her reviews and activities. However, she was forced to take a break from her classes for 3 weeks (transition) and was subsequently trained to enter the online sessions.

At the beginning of the synchronous sessions, Lupita had difficulty connecting and interacting with the Zoom app, therefore she was provided ongoing assistance. However, despite having completed the level, she decided to enroll again in Basic 2, because she felt that she had not been able to understand the topics previously discussed, together with the fact that the forced break and the new modality of the sessions had prevented her from carrying out the activities with clarity and independence. This fact was reflected in her evaluation of the digital literacy level. During the transition treatment, Lupita obtained 195 points in her pre-test and 224 points in her post-test. On the other hand, in the digital treatment, Lupita obtained 198 points in her pre-evaluation and 249 points in her post. As you can see, their evaluations were similar in both periods. For her part, Lupita commented that in the second attempt she was able to further strengthen her knowledge and focus more on carrying out the activities, instead of worrying about how to interact with the zoom application, since she had already understood its use.

The case of Gloria A, a 60-year-old housewife with 9 years of schooling, was one of the students who progressively advanced, participating in the three consecutive semesters: B1 (blended learning), B2 (transition) and I1 (Digital). For a year and a half, Gloria invested 192 h in face-to-face and asynchronous sessions, maintaining herself constantly. Regarding her evaluation of DILE, in the first treatment "blended learning" Gloria obtained 109 points in her pre-test and 189 points in her post-test. While in the "transition" treatment, she obtained 189 points in pre and 219 in post. Finally in the digital treatment, she obtained 220 in pre and 254 in post, showing that she had a progressive advance.

Dropouts

There was a great rate of dropouts before the pandemic occurred. For the first group, the percentage of the dropout–from the blended course (Aug Dec 2019) to the beginning of the transition to pandemic course (Feb June 2020) had been of 57.97% (G1: $n = 69$ for the first semester and $n = 29$ for the second semester). For the second group, the dropout was 23.52% (G2: $n = 17$ for the first semester and $n = 13$ for the second semester). The dropouts of the courses for the subjects that at least had assisted continuously during two semesters–from the blended to the transition to pandemic- and then, withdrew from the digital course were obtained. The dropout between these periods were, for each group, 62.0 and 30.76%, respectively (G1: $n = 29$ for the first semester, $n = 29$ for the second semester and $n = 11$ for the third semester; G2: $n = 13$ for the first semester, $n = 13$ for the second semester and $n = 9$ for the third semester). When only the semester of the pandemic is considered, a great dropout occurred especially for B1: only five older adults could complete the entire course and filled the pre and post DILEs, and 19 older adults abandoned the course (they only filled the DILE on the pretreatment), therefore, the dropout reached 79.16%.

TABLE 5 | Mean comparisons on the Digital Literacy Evaluation (DILE) between pre VS post treatments (longitudinal analyses)/Student-t tests. Blended Learning (BL) treatment; Transition to pandemic (TP) treatment; Digital (DI) treatment. Group 1 (G1); Group 2 (G2); Basic 1 (B1); Basic 2 (B2); Intermediate 1, 2 and 3 (I1, I2 and I3, respectively).

Group/Pre Vs Post treatments

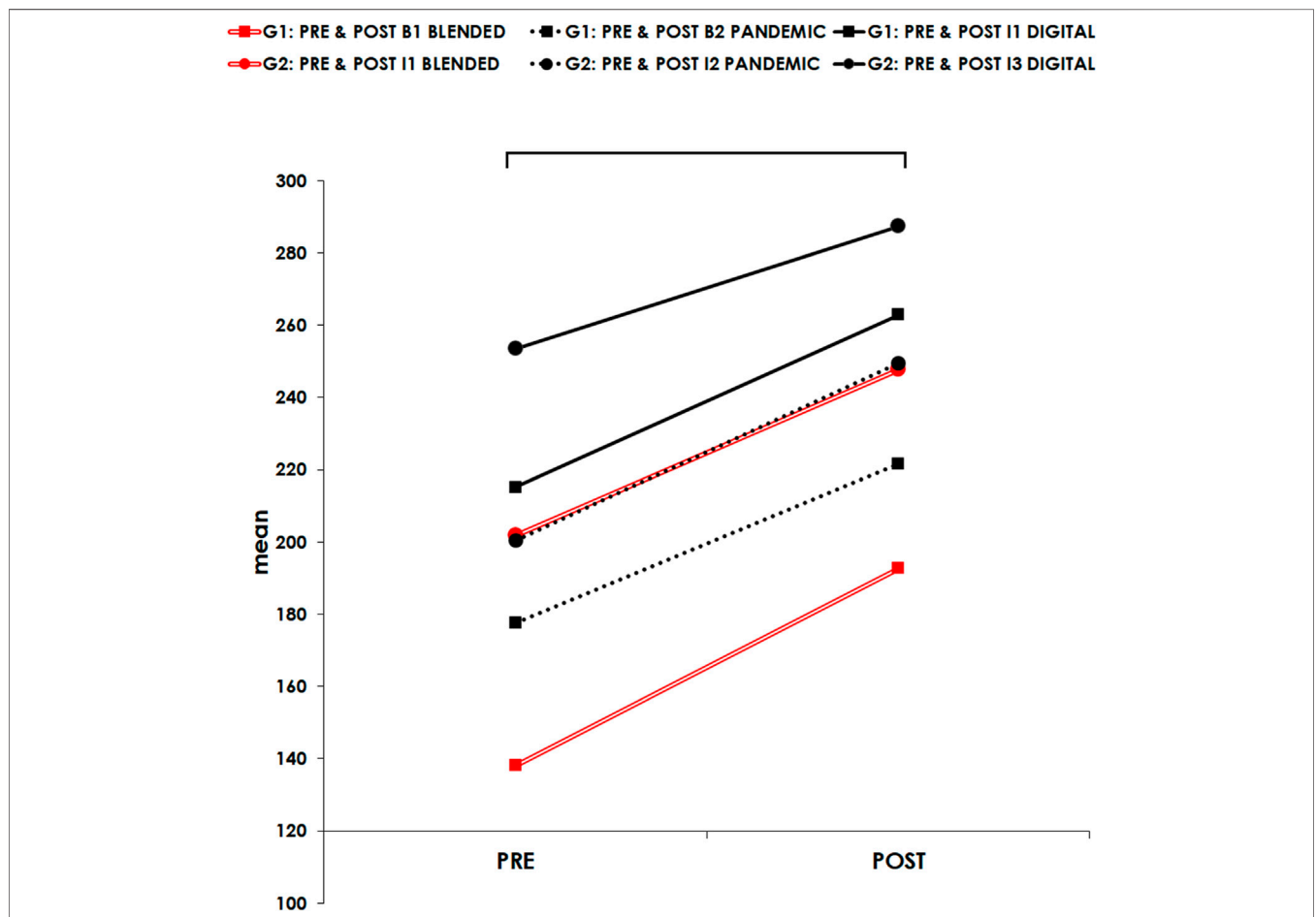|	BL PRE Mean (SD) B1	BL POST Mean (SD) B1	t	p	TP PRE Mean (SD) B2	TP POST Mean (SD) B2	t	p	DI PRE Mean (SD) I1	DI POST Mean (SD) I1	t	p
G1 (n = 11)	138.09 (18)	192.72 (16)	6.87	<0.001	177.72 (25)	221.63 (14)	4.95	<0.001	215.18 (12)	262.91 (18)	8.92	<0.001
G2 (n = 9)	I1 201.88 (4)	I1 247.77 (9)	11.57	<0.001	I2 200.44 (2)	I2 249.55 (11)	9.91	<0.001	I3 253.55 (16)	I3 287.33 (14)	11.71	<0.001

FIGURE 8 | A general trend for mean scores increasing over time on the Digital Literacy Evaluation (DILE) according to treatments is presented. All pre vs. post mean scores on the DILE were statistically significant (double lines were assigned for the blended treatment; square markers for G1 and round markers for G2; pointed lines indicate the mean scores of the transition to pandemic treatment; square markers represent G1 and round ones G2; straight lines correspond to the totally digital treatments and the same type of markers as before represent G1 and G2, respectively).

DISCUSSION

The pandemic has had and continues to have wide reaching consequences across the world, specifically in the elderly population, given that there are several latent or indirect risks to their health and wellbeing that emerge from socio-cultural and demographic factors (Dwivedi et al., 2020). Jointly, the phenomenon of ageism is neither new nor surprising in the elderly population. There is widespread structural exclusion from opportunities in education, employment, housing, transport, health care, social services and legislation (World Health Organization, 2015). The authors recognize this exclusion and

TABLE 6 | Descriptive statistics for each treatment (pooled analysis). Group 1 (G1); Group 2 (G2); Basic 1 (B1); Basic 2 (B2); Intermediate 1, 2 and 3 (I1, I2, I3, respectively).

Pooled groups for each treatment

—	*n* = 115		*n* = 69		*n* = 39		*n* = 13		*n* = 15	
	B1_PRE	B1_POST	B2_PRE	B2_POST	I1_PRE	I1_POST	I2_PRE	I2_POST	I3_PRE	I3_POST
Mean	129.21	187.52	156.46	212.72	204.74	257.15	199.38	250.15	251.60	290.00
SEM	1.82	2.30	3.43	2.46	3.02	2.94	4.16	5.19	3.69	3.08
Median	128	196	152	210	202	254	202	250	249	293
Mode	110	196	148*	201*	198	254	202	250	248*	293*
Standard deviation	19.53	24.75	28.57	20.46	18.90	18.41	15.01	18.74	14.30	11.93
Variance	381.57	612.62	816.34	418.93	357.35	338.97	225.43	351.30	204.68	142.42
Range	123	112	109	104	117	92	68	80	54	49
Percentil 25	113	166	135	200	198	245	198	240	242	282
Percentil 50	128	196	152	210	202	254	202	250	249	293
Percentil 75	146	201	187	225	212	263	202	259	256	296

*Standard Error of Mean (SEM); *multiple modes exist. The smallest value is shown.*
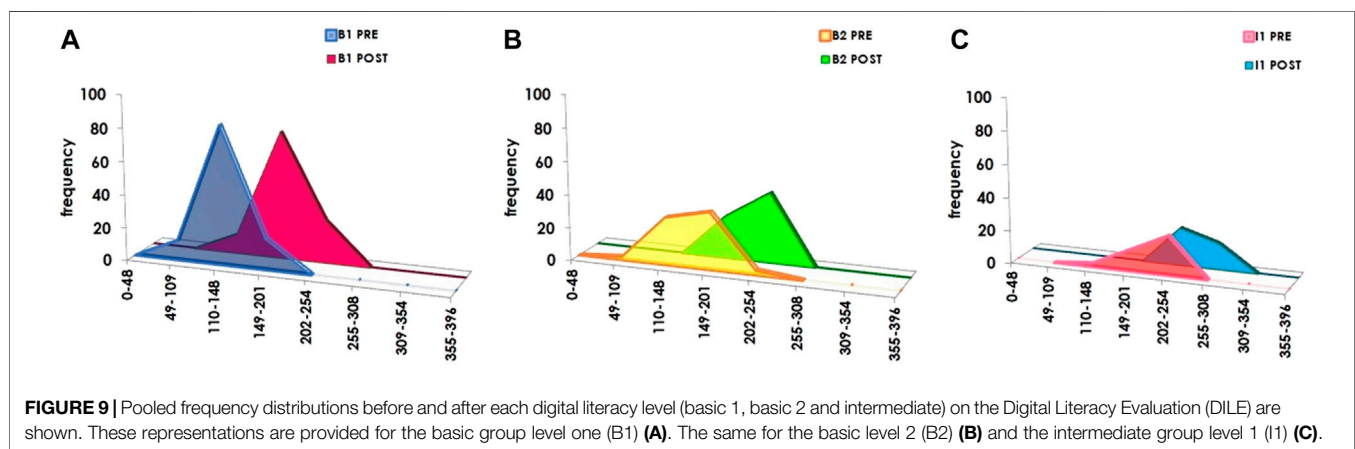

FIGURE 9 | Pooled frequency distributions before and after each digital literacy level (basic 1, basic 2 and intermediate) on the Digital Literacy Evaluation (DILE) are shown. These representations are provided for the basic group level one (B1) **(A)**. The same for the basic level 2 (B2) **(B)** and the intermediate group level 1 (I1) **(C)**.

the link to the digital illiteracy of older adults and would like to make a case for an approach where older adults should become part of the global response, creating a more inclusive society.

This article describes three treatments that were developed in the TAD (blended learning, transition and digital), evaluating the effects of the pandemic, from a longitudinal perspective considering only those older adults whose active presence was completed during three consecutive semesters. Also, a comparison between means of pre and post scores of the DILE was undertaken, and for each type of digital literacy treatment, groups were pooled with those older adults who at least could complete in achieving the entire semester of digital literacy.

The study established four hypotheses that may or may not have occurred due to the COVID-19 pandemic. The first hypothesis "*the number of people interested in becoming digitally literate would be lower*" was not fulfilled, since, in the digital treatment, the number of registered older adults was very similar to the other treatments, including the basic level groups, which were the largest number of students. A significant fact that was experienced during 2020 due to the pandemic, was the increase in the use of telephone calls and video calls, which allowed older adults to communicate with friends, family and social workers, largely allowing to mitigate the isolation and

feelings of disconnection (Gorenko et al., 2020; Van Orden et al., 2020). Conger and Griffith (2020), indicate that elderly adults may have a harder time transitioning to digital services and require step by step assistance. However, the channels of interaction, once established, can be quite satisfactory for the elderly (D'cruz and Banerjee, 2020).

The above leads us to the following hypothesis: "*the basic level groups would be the most affected during the pandemic*". Our results showed that in the transitional treatment, the elderly enrolled in basic levels did not have the necessary digital skills to continue with their training in ICT, or they did not even have access to a computer from home, which is why they were the most affected during the pandemic. The elderly in the workshop who remained during the transition period (mainly those enrolled in levels B2 and I2), had the opportunity to put into practice the skills acquired in previous levels, and was thus easier to use online applications such as Zoom and Google Meet to continue their digital literacy sessions. Therefore, the digital literacy process of an older adult can be considered a gradual process, that should understand the motivation and the factors that impact on the learning of this population (Castilla et al., 2018). A recurring demand of the elderly who decide to enroll in the basic levels of the workshop is that they be given support and guidance considering that they have no or basic knowledge of the use of

the computer and the Internet. Thus, it is necessary to teach them the step by step of each action to be carried out, such as how to turn a computer on and off, how it functions (operating system, mouse, keyboard), what computer programs are useful for them and how they can navigate safely on the Internet. Some studies indicate that the Internet is a new way of opening to the world, facilitating communication and cognitive activity for older adults and, in turn, it encourages and contributes to the elderly enjoying superior autonomy (Llorente-Barroso et al., 2015).

The third hypothesis "*the dropout rate during the pandemic would be higher compared to blended learning treatment*" is consistent with our results. If transition treatment is considered (Feb–Jun 2020), attrition was higher compared to blended learning and online treatment, reaching 79.16%, especially for B1 groups. The dropout rate before the pandemic had been 57.97%. Some studies indicate that individual characteristics and the living environment are both related to technology usage among the oldest age groups. While technology use in healthy older adults has been increasing in recent years (Schulz et al., 2015), the situation differs for those in advanced old age and with multiple morbidities and functional impairments. This represents a challenge, as the internet and devices such as smartphones could be important resources for vulnerable older adults (Fang et al., 2018; Schlomann et al., 2020). Berkowsky et al. (2015) and Rikard et al. (2018) found that older age, increased frailty (measured through daily-living activities limitations), and participation in non-ICT activities were related to discontinued ICT use. Older adults' special learning needs (Czaja et al., 2019), as well as their skills, must be considered in their digital literacy process. Similarly, ensuring that technology is easier to maintain over time in relation to changing interfaces, passwords, and maintenance will be critical for ensuring that older adults can stay online once they go online (Cotten, Forthcoming).

This seems especially plausible given the unpreparedness of instructors for this new teaching context, which could have caused them not to establish continuity in the digital literacy, without fully adapting to the digital context. For their part, the authors Tomczyk et al. (2020) conducted a study where they determine the needs of educators working in the area of inclusion of the elderly. In their study they mention that most of the digital literacy activities for elderly adults are carried out by instructors who do not have formal training; in other words, they do not have methodological or pedagogical support in relation to the education of the elderly. Furthermore, they do not establish continuity in the digital literacy of the population, which could cause exclusion, marginalization, and discrimination in terms of use of new technologies. That is why, within the TAD, designing different levels of digital literacy has provided the elderly with the possibility to maintain formal and continuous training. At the same time, having instructors who have gerontological training (which allows them to understand the processes of aging and learning in an older person) and who take training courses in ICT, allows the TAD to establish itself as a reliable digital literacy strategy.

Finally, the results showed that the three pretreatments and the three posttreatments each for G1 and for G2, respectively,

were statistically significant. Therefore, the fourth hypothesis "the post-DILE score would be lower compared to the blended treatment and the online treatment itself" was not fulfilled. The analyses demonstrated that in the case of older adults who have continuous training level by level increase their score, indicating that the advancement of their digital skills is progressive, similarly, that older adults who repeat the level of digital literacy maintain similar scores in their pre and post evaluations. This article presents some strategies focused on the digital inclusion of older adults during the COVID-19 pandemic, describing the experiences of students enrolled in the Digital Literacy Workshop for elderly adults in different periods of time (before, during and after the pandemic).

In addition, in the search to establish learning strategies that allowed to maintain the level of digital literacy of the elderly, we can say that the study has shown that an integrated approach to digital literacy -personalized counseling, educational materials, and ongoing training-works better for the elderly as they can acquire skills more easily. Also, the provision of simple written instructions and/or recorded messages is important to help the elderly navigate the transition to digitizing services during the pandemic (World Health Organization, 2020). In the particular case of the workshop, providing students with recorded sessions, personalized advice and constantly repeating procedures and instructions, allowed the elderly to feel more confident in their digitization process.

It should be noted that we also describe the digital literacy process in elderly adults, taking into account four skills which are integrated in the three phases of literacy: informational, digital, and digital intelligence. The first training that older adults receive at the basic levels is related to the basic use of a computer, the Internet and social networks. For this reason the skills that are included in the first levels are considered to be instrumental and socio-affective, meaning that the elderly acquire the basic and necessary skills to know how to use the computer, surf the Internet and start with the creation of affective and emotional ties through the use of social networks or email. At the intermediate levels, the elderly take a step forward, since they are able to understand that the use of technology can help them make their lives better, even become more productive and efficient members of the society. It is important to remember that the elderly who make up the intermediate groups already have one year of previous training in ICT. In intermediate levels, the basic use of the cell phone, mobile operating systems, installation of applications and instant messaging are introduced. They also learn to use the office automation tools provided by the G Suite (or Google Suite). It can be said that, within these levels, adults eliminate physical barriers between people and make it possible to establish new ways of communicating, learning the basic use of applications for virtual meetings such as Zoom and Google Meet.

Therefore, it could be said that the skills that are covered at the intermediate levels are the socio-affective and axiological, referring to the development of behavioral norms that imply a more present digital attitude when carrying out actions such as sharing files online, interacting in social networks and make video calls or virtual meetings, while remaining aware regarding the information provided on the Internet and the media. At this point, after 2 years of digital literacy, the elderly not only observe

the way to socialize in new settings, but also become active members of the information and knowledge society.

One of the challenges that the elderly face is to stay active and updated in the use of technology, so, at the advanced level, they delve into the management of online meetings, the creation of blogs and virtual stores, and in the use of digital applications for content creation. At the same time, they become more independent and develop better cognitive skills, such as attention, concentration, and recovery, allowing them to search, select, analyze, interpret and create information, giving it a meaning and use in their daily life. Therefore, the dimension that is worked on within the advanced level is the cognitive-behavioral (ability to act and perform actions within the network and digital devices) which allows the elderly to have greater independence and presence in ICT.

Therefore, a digitally literate older adult develops four skills throughout the five levels of the workshop. However, it is important to highlight some points about their ICT training process and the development of their digital skills:

- Although each digital literacy level has an approximate duration of 4 months and carries a progressive sequence of the topics that are developed (maintaining constant revisions), the elderly are not obliged to perform the levels progressively, that is, if they require to repeat a certain level, they are given the opportunity to do so.
- When we say that a digitally literate person has the ability to search for information, to discern between false and true information, to process, condense and produce results from it and communicate them effectively, we are determining that there is a constant update to stay active in today's society. Therefore, the elderly who are at an advanced level can come to be considered digital literates, and it is only a matter of continuing their ICT training to maintain themselves as such.
- To complement the teaching and training in ICT, the elderly must stay motivated (updated, independent, with a sense of belonging) and know the purpose of performing certain actions and tasks on a computer and the Internet. Remaining constantly and progressively within the workshop is a complex and difficult task, since there are several external factors that can affect adherence to continue within the workshop. However, when the elderly already understand the benefits that technologies bring to their life and know the consequences of being digitally excluded (basic levels), it can be said that the awareness among them to remain in a more inclusive society is fulfilled.
- The need to communicate with other people and belong to a tmore digital society is a characteristic of most elders registered from the first levels; however, the ties of friendship and communication are strengthened in the more advanced groups promoting independence and autonomy (as far as possible), as well as social relations with other people who share their interests and experiences.
- From the experience of carrying out the workshop, it may be said that four skills that are developed in the digital literacy

process were established: instrumental, socio-affective, axiological, and cognitive-behavioural, which, once developed and articulated, can constitute the digitally literate profile.

While going digital literacy is now a necessity more than ever before, it alone is insufficient since it is necessary to consider several factors such as access, educational and socioeconomic level, among others. Government agencies, for-profit and non-profit organizations, and community volunteers are required to ensure the accessibility and usability of effective programs and interventions, for older adults. Toward this end, we recommend the following norms for digital inclusion for older adults.

- Ensure older adults' access to the equipment and connectivity necessary to use Internet services, which may include arranging to offer Internet hotspots in neighborhoods with low-income elderly adults or do not have a computer;
- Training to improve older adults' digital literacy, through volunteers; this should include cybersecurity advice to ease concerns about the privacy of your personal information;
- Support older adults stay connected with friends they typically interact with at senior centers or churches, through applications for virtual meetings. Initiatives exist – for example, the Institute for Successful Longevity (ISL) at Florida State University has launched a Zoom initiative to help older adults fight social isolation (Institute for Successful Longevity (ISL) at Florida State University, 2020);
- Put within reach intuitive informatics tools (apps for mobile devices and intelligent voice assistants) that promote intergenerational interactions among family members;
- Training volunteer people who have knowledge of and digital skills to support older adults within resource-limited communities to maintain communication through some digital medium;
- Family members should try to provide technical support to older loved ones who may be using new devices or platforms during the pandemic to stay connected (Moore et al., 2020).

Limitations

While this study has several strengths, some limitations should be considered. First, in the longitudinal study few subjects were included in the analysis, which diminishes the statistical power. Meanwhile, in the pooled study, there was a good number of subjects to obtain the norms. Second, when studying an aging population, the mortality rate is high, especially considering that they are a vulnerable population to COVID-19, therefore, carrying out more longitudinal studies of their literacy process may not be so feasible.

CONCLUSION

Throughout this article, we have described the digital literacy process of the elderly enrolled in the Digital Literacy Workshop for the Elderly, highlighting that the students who carry out an on-going progress acquire an adequate level of digital skills. However, it is also a reality that as the levels advance, the percentage of adults decreases, leaving behind those who, due

to variables (for example, health problems, internet and digital equipment failures, etc.) outside the workshop, cannot continue.

Likewise, the study showed that elderly adults progressively increased their digital literacy despite the COVID-19 pandemic and jumped into the digital age. Furthermore, the number of students enrolled in the digital treatment was not affected, providing evidence that there is an interest of adults to be included in the digital world and to be trained to obtain digital skills. Therefore, the elderly who are at an advanced level can come to be considered digital literates, and it is only a matter of continuing their ICT training to maintain themselves as such.

In conclusion, societies must consider access to ICT to be a basic human right, and therefore must ensure that everyone has timely access, skills, and technical assistance to effectively navigate a fully digital world. For the elderly, doing so may require access to technology and training tailored to their different levels of experience, disability, and cognitive ability.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Ethics committee of the Instituto de Ciencias de la Salud, Universidad Autónoma del Estado de Hidalgo and it is registered in the Research Directorate with the key UAEH-DI-ICSA-GE-CF-006. All subjects gave written informed consent. The protocol was approved by the Research Directorate of the Universidad Autónoma del Estado de Hidalgo. The patients/participants provided their written informed consent to participate in this study.

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