# Bridging Generations: The Role of Digital Media in Fostering Intergenerational Collaboration and Knowledge Exchange

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Keywords:     Grandparents, Grandchildren, ICT, Digital Media, Learning, Knowledge Sharing, Intergenerational Relationships, Escape Room.

Abstract:     This exploratory study investigates the role of digital media and technology in shaping intergenerational relationships between grandparents and grandchildren, focusing on knowledge exchange and collaborative interactions. Seventeen participants, consisting of eight grandparents (aged 60–75) and nine grandchildren (aged 10–18), were involved in a gamified escape room activity designed to foster collaboration. The activity required participants to solve riddles using digital tools such as smartphones, mobile apps, and social media, followed by semi-structured interviews to explore their experiences. Results revealed a reciprocal learning process, where grandchildren often guided grandparents in technology use while grandparents shared cultural knowledge and traditional skills. The activity highlighted the complementary strengths of both generations, with grandparents contributing with historical knowledge and grandchildren offering technological expertise. Despite technological anxiety and generational differences in digital proficiency, the study found that structured activities like the escape room can enhance collaboration and strengthen intergenerational bonds. Depending on its use, technology emerged as both a facilitator of connection and a potential barrier. The findings suggest that digital tools can significantly bridge generational gaps, promote mutual learning, and foster deeper intergenerational relationships.

## 1 INTRODUCTION

As in most Western countries, the Portuguese population is aging, given the increase in life expectancy. People over 65 have grown by more than 2% annually since 2019. Portugal is the fourth country in the world with the highest proportion of older adults, and it ranks 2nd among European Union countries with the highest rate of population aging, with 186 older adults for every 100 young people (PORDATA, 2024).

This phenomenon is creating social challenges that need to be addressed. One of these challenges is related to the coexistence between generations, including between grandparents and grandchildren, which now happens more frequently and for extended periods (Fingerman & Birditt, 2020). On the other hand, changes in family structures and work patterns, the institutionalization of education and care, as well as increasingly technological and digitally

interconnected societies are impacting both young and older, resulting in cultural distance, ageism, and the loss of opportunities to knowledge and values transfer (Gallagher, 2019).

Promoting intergenerational relationships, particularly between grandparents and grandchildren, is paramount in these demographic changes and social challenges. Studies show that high levels of co-residence, contact, and care provision between grandparent-grandchild are linked to more stable exchanges and interactions over time (Pasqualini et al., 2021), contributing to the transmission of cultural heritage and historical knowledge, the sharing of memories, and the promotion of active aging and well-being (Ramos, 2013). As observed by Trujillo-Torres et al. (2023) in a recent systematic literature review, promoting intergenerational dialogue is one of the most frequently used strategies to promote meaningful learning, having a positive impact in many areas, such as attitudes, well-being, and

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happiness, improvement of family relationships, promotion of social and human values, and combating the generational digital divide, among others.

On the other hand, and despite the persistence of the digital divide, older adults have increasingly become more willing to use technologies and digital media in recent years, and digital interactions are emerging as a significant form of communication, complementing traditional face-to-face and telephone communication (Barbosa Neves & Vetere, 2019; Arpino et al., 2022). Maintaining a connection with their grandchildren is among the main reasons and motivations for older adults to use technology and social media (Wei et al., 2023; Ivan & Fernández-Ardèvol, 2017), and those can play an important role in supporting intergenerational communication, play and learn (Yuan et al., 2024).

As such, this paper describes research focused on understanding how digital media and technology interfere with reciprocal learning and intergenerational solidarity between grandparents and grandchildren.

## 2 BACKGROUND

Family relations have always been central to creating solidarity and identity and transmitting cultural and moral values. As the UNESCO Institute for Lifelong Learning (2015) highlights, familial intergenerational learning practices are rooted in all cultures and present an opportunity for adults and younger to become lifelong learners. Grandparents, in particular, can play an essential role in their grandchildren's formal and informal education, facilitating children's learning through intergenerational play and creating linguistic and cultural heritage learning spaces (Keary et al., 2024; Kanyal, M., Mangione, D. and Luff, P., 2024; Barragán-Medero et al., 2024). Besides, these interactions and knowledge transfer represent a reciprocal process for both generations, also benefitting grandparents (Mendelová & Zelená, 2021; Harwood, 2007). Research has shown that such interactions can improve cognitive health in older adults, combat social isolation, and provide a sense of purpose (Stephan, 2024; Döring et al., 2022; Lai, Li, & Bai, 2021; Lyu et al., 2020).

Some studies state that adolescence introduces a unique challenge to intergenerational exchange, as teenagers, influenced by peers and digital culture, may sometimes prioritize advice and validation from friends over guidance from family members (Jassogne & Zdanowicz, 2020; Strom & Strom,

2015). However, other authors emphasize that the quality of contact with grandparents, rather than age, is the key factor influencing children and adolescents' views about older adults (Soliz & Harwood, 2003; Harwood, 2007; Strom & Strom, 2015; Flamion et al., 2019). As highlighted by these researchers, the exchange of intergenerational knowledge is influenced by relational proximity, the quality of the bond, and the context of the interaction. When relationships between grandparents and grandchildren lack closeness, knowledge transmission and interactivity are significantly hindered (Forghani & Neustaedter, 2014). This dynamic underscores the importance of fostering strong intergenerational relationships to facilitate the sharing of cultural heritage and practical life skills.

Studies also suggest that grandparents, and especially grandmothers, transmit a wide range of knowledge, from moral and ethical principles to practical skills such as cooking, gardening, and even study habits (Modin, Erikson & Vågerö, 2013; McConatha, McConatha & DiGregorio, 2021). Conversely, grandchildren often serve as *generational bridges*, sharing insights into contemporary culture, acting as tutors to their grandparents regarding social norms, and using new technologies, thus enhancing digital literacy and reducing technology-related anxiety among older adults (Barbosa Neves & Fernandes, 2016).

As far as digital technologies and social media are concerned, research underlies its potential to foster intergenerational engagement, namely between grandparents and grandchildren, in playful and educational activities (Kaplan et al., 2013; Döring et al., 2022; Yuan et al., 2024). For example, video chat has proved effective in ensuring culture-sharing between grandparents and grandchildren during the COVID-19 pandemic, namely by supporting engagement in storytelling and conversations about traditions, holidays, popular culture, and other themes (Piper et al., 2023). However, although a few studies focus on how digital media can facilitate joint media engagement between grandparents and grandchildren (Amaro, Oliveira & Veloso, 2017), research is still limited, focusing primarily on parent-child relationships. As such, this study is particularly interested in how grandparents and grandchildren can collaboratively use technology to solve problems and how learning and knowledge exchange happen in that context.

# 3 METHODS

This qualitative and exploratory study aimed to understand the role of digital media and technological devices in intergenerational relationships between grandparents and grandchildren, particularly in knowledge exchange and collaborative interactions. As such, the following main goals were identified: i) To explore how grandparents and grandchildren perceive the role of technology in their lives and relationships; ii) To analyze intergenerational knowledge exchange mediated by digital media and technology in the context of a gamified escape-room type activity. Thus, data was collected through an escape room activity and individual interviews with grandparents and grandchildren from the Aveiro region.

## 3.1 Participants

The study was conducted with 17 participants, comprising eight grandparents (aged 60–75) and nine grandchildren (aged 10–18), selected through purposive and convenience sampling. These grandparents and grandchildren cumulatively met the criteria of having some technological and digital literacy, having access to or owning up-to-date technological devices, and expressing a willingness to participate. This ensured that the participants had the minimum skills to engage in the challenges proposed during the gamified escape room activity. However, the non-inclusion of participants without technological literacy adds to the limitation of using a small sample, preventing the generalization of the results.

The grandparents selected comprised a group of seven women and one man, with varying academic qualifications - although the majority had more than the 4th-grade primary education - and with levels of digital literacy mostly considered low or medium, as shown in Table 1.

The group of grandchildren was constituted by nine participants (with two sisters among them), seven of whom were girls and two boys with basic digital literacy and aged between 10 and 17. However, the majority were between 10 and 12, as shown in Table 2.

Participants were also characterized by their home proximity and the weekly regularity of face-to-face meetings. As shown in Table 3, all the grandparents and grandchildren lived in proximity and met face-to-face at least 3 times a week, 6 times a week being the most frequent situation.

Table 1: Grandparents characterization.

| GP | Age | Gen-der | Academic Qualifications | Level of Digital Literacy |
|---|---|---|---|---|
| GP01 | 66 | F | Primary education (4th grade) | Low |
| GP02 | 63 | F | Primary education (4th grade) | Low |
| GP03 | 72 | M | Vocational education | Medium |
| GP04 | 66 | F | Higher Education (short cycle) | Medium |
| GP05 | 69 | F | Higher Education (1st cycle) | High |
| GP06 | 68 | F | Higher Education (short cycle) | Medium |
| GP07 | 74 | F | Higher Education (short cycle) | Low |
| GP08 | 67 | F | Primary education (4th grade) | Medium |

Table 2: Grandchildren characterization.

| GC | Age | Gen-der | Academic Qualifications | Level of Digital Literacy |
|---|---|---|---|---|
| GC01 | 12 | F | Primary education (6th grade) | Low |
| GC02 | 10 | F | Primary education (4th grade) | Medium |
| GC03 | 12 | M | Primary education (6th grade) | High |
| GC04 | 12 | F | Primary education (6th grade) | Medium |
| GC05 | 17 | M | Secondary Education (12th grade) | High |
| GC06 | 10 | F | Primary education (5th grade) | Medium |
| GC07.1 | 16 | F | Secondary Education (11th grade) | High |
| GC07.2 | 10 | F | Primary education (5th grade) | Medium |
| GC08 | 10 | F | Primary education (4th grade) | High |

Table 3: Participants' proximity and frequency of weekly meetings

| Pairs of participants | Home proximity | Weekly frequency of meetings |
|---|---|---|
| GP01/GC01 | Neighbors | 6 |
| GP02/GC02 | Same neighborhood | 3 |
| GP03/GC03 | Same neighborhood | 6 |
| GP04/GC04 | Neighbors | 6 |
| GP05/GC05 | Same neighborhood | 6 |
| GP06/GC06 | Same city | 5 |
| GP07/GC07.1 | Same city | 3 |
| GP07/GC07.2 | Same city | 4 |
| GP08/GC08 | Same house | 7 |

## 3.2 Data Collection and Analysis

Data collection occurred in the context of a gamified escape room activity and following semi-structured interviews.

Escape room games are team-based physical games in which teams of players discover clues, solve riddles, and accomplish tasks to find a way to escape a closed room. These experiences usually start with the players meeting their gamemaster, who introduces the backstory and gives them the game's rules. As Nicholson (2015) points out, escape rooms require team members to rely on each other, collaborate, and communicate, being appealing and inclusive for a wide age range and appropriate for intergenerational groups.

For this study, an activity of this type was conceptualized, tested, and implemented, aiming to involve teams of grandparents and their grandchildren in finding clues and solving riddles to get out of a closed room - called the Scientist's Office. The participants had digital media and technology (like mobile devices, mobile apps, QR codes, social media,...) at their disposal so that, together with general knowledge, they could complete the tasks and get out of the room in a certain amount of time.

According to the activity backstory, Portugal had suffered a biological attack, and some citizens were infected by a virus that was activated using technology. The antidote to this virus was hidden in the office of a renowned Portuguese scientist (corresponding to the room where the activity occurred), and to discover it, participants had to follow the clues and unravel the riddles. However, just before entering the office, the blood tests carried out by the Portuguese government revealed that the grandchildren were infected with the virus and, therefore, could not handle any technological devices. The aim was to contextualize that the grandparents had to handle the smartphone handed to the participants before they entered the room, which was prepared to resemble a scientist's abandoned office (Figure 1).



Figure 1: The Scientist's Office.

The activity was validated through a pilot study involving different participants: two pairs of young people aged 17 to 20 to validate the gamified activity mechanics and access logistic issues, and one other pair, with a 63-year-old and a 17-year-old participant, to validate the difficulty level and the potential of clues, riddles, and tasks to elicit communication, cooperation and knowledge sharing. The activity's backstory and rules were presented to participants before entering the room. After carrying out the activity, the participants were asked to point out flaws, the need for changes, or any difficulties they encountered.

Following this pilot application of the gamified activity, some adjustments were made, such as changing the layout of some items in the room and paying attention to some points of operation, such as the dynamic of asking the research team for help if necessary.

During the main study, seven pairs and a trio of grandparents and grandchildren tried to escape the room. In its final layout, the room was separated into three distinct spaces: 'The workbench', in which the participants could find a microscope, pipettes, water heater, periodic table, and other items that scientists use, and where clues 1 and 2 were positioned; 'The desk', containing a typewriter, lamp, folders, documents, and a telephone, and where the fourth clue was located; and finally, 'The locker', that was initially locked and, once opened, contained the antidote.

Five clues were provided, the first of which, when they entered the room, referred to one of the images placed on the room wall: a photo of the famous Portuguese Fado singer Amália Rodrigues. This clue involved reading the QR Code associated with the image, which would lead them to clue number 2. This

second clue consisted of old photos from the main avenue of Aveiro city and a related poem, and participants were asked to identify the location. After unraveling the avenue's name, the participants were directed to an envelope containing the next clue. This third clue asked participants to find an old piece of technology in the room, referring to the typewriter in 'The Desk.' Participants had to turn the platen knob to advance the page, revealing clue number 4. The fourth clue asked participants to identify a Portuguese volcano, including the year it erupted, and post their answers on a Facebook page dedicated to the project. Once the correct answer had been posted, the fifth and last clue was slipped under the door in an envelope with the locker key. This last task involved taking a selfie and opening the locker to find the antidote. Then, the project team would unlock the door to the room.

The activities were recorded using cameras and microphones installed strategically in the room. The furniture, artifacts, and equipment were arranged so that all the spaces in the room, especially those with clues and interactions, were filmed and had space for circulation. The legal aspects of the European General Data Protection Regulation have been duly safeguarded.

The records were analyzed using a set of categories that included the total duration of the activity and time spent on each clue, collaboration dynamics, problem-solving strategies, technological interactions, behaviors, and feelings during the resolution of the riddles. All observations were noted down and tabulated to organize better and facilitate analysis.

After the gamified activity, semi-structured interviews were scheduled to collect deeper demographic and digital literacy-related data and to characterize the quantity and quality of the relationship between these grandparents and grandchildren, their perception of their roles, particularly regarding the transmission of knowledge and mutual learning, as well as their use of media and digital technologies.

The interview script and procedures were validated through a pilot interview with a grandmother and her granddaughter, aged 60 and 11, respectively. The questions and procedures proved to be generally suitable for collecting the necessary data, with only a few adjustments to the language. However, as this pair had not participated in the gamified activity, some questions could not be validated, so it was only possible to check and adjust them during the main study.

The relevant parts of the interviews were transcribed, and themed content analysis was carried out.

# 4 RESULTS AND DISCUSSION

This section presents and discusses the study's results, structured into two subsections: the gamified escape room activity outcomes and the insights gathered from the post-activity interviews. The first subsection analyses participants' performance in the escape room activity, highlighting collaboration dynamics, problem-solving strategies, and technological interactions. The second subsection explores the qualitative data from interviews, offering more profound insights into participants' perceptions of intergenerational learning and the impact of technology on their relationships.

## 4.1 Results from the Gamified Activity

Regarding the total duration of the activity, half of the cases exceeded the maximum duration of 30 minutes, as shown in Table 4. As can also be seen, the shortest time to complete the activity does not always correspond to pairs with higher levels of digital literacy (see, for example, pairs GP03/GC03 and GP04/GC4). However, the pair that took the least time corresponds to a situation in which both had a high level of digital literacy. The age of the grandchildren also influenced the duration of the activity, with the pairs that included older grandchildren being quicker.

Table 4: Time taken to complete the gamified activity.

| Pairs | Time | GP Digital Literacy | GC Digital Literacy |
|---|---|---|---|
| GP01/ GC01 | 00:38:52 | Low | Low |
| GP02/ GC02 | 00:31:22 | Low | Medium |
| GP03/ GC03 | 00:35:13 | Medium | High |
| GP04/ GC04 | 00:36:12 | Medium | Medium |
| GP05/ GC05 | 00:14:48 | High | High |
| GP06/ GC06 | 00:19:49 | Medium | Medium |
| GP07/ GC07.1 | 00:21:35 | Low | High |
| GP07/ GC07.2 | | | Medium |
| GP08/ GC08 | 00:24:32 | Medium | High |

Concerning the tasks proposed for finding the clues, it was observed that those in which participants had to find answers to questions and post on social media took longer to complete. In these cases, difficulties with digital and technological means were also observed to be decisive for the increase in completion time. Regardless of the time they needed and the difficulties they experienced, the participants generally worked together and helped each other to complete the technological and historical tasks.

Handling the smartphone, especially regarding the small size of the keyboard, was one of the main difficulties experienced by the grandparents. These difficulties stemming from the grandparents' physical limitations and others, such as not knowing certain things, like the positioning of the device's camera or what an app is, made the grandchildren sometimes impatient: "*It is an app, don't you know what an app is? It is a mobile application, Grandma.*" (GC06).

Nevertheless, grandchildren showed interest and focus and were responsible for passing on technological knowledge. Grandparents, on the other hand, took on more of a historian role, paying greater attention to the details of the activities, although taking more time to complete them. Grandchildren were quicker than directing the grandparents, even on the clue involving finding the typewriter. It was then the grandparents who, in general, operated the typewriter to reveal the next clue, teaching their grandchildren how to do it. This process sparked interesting conversations about past technology.

The most challenging clue was asking for the volcano's identification and the year it erupted. Participants googled for the information, although most grandparents already knew at least part of the answer. The most significant difficulty for the older generation was using the Google search. Some peculiarities in searching for the answer highlight that knowledge exchange occurs non-linearly. In the case of the pair GP02/GC02, the grandmother, while trying to understand how to use the Google search, ended up doing a voice search. When she called her granddaughter for help, the granddaughter found the situation amusing: "*'Come here' (typed in the search bar)? What is this? Grandma, did you press this little microphone? Well, Grandma, that is for when you want to search, but you do it by voice.*" (GC02).

After finding the answer, participants needed to post it on the project's Facebook page, which was the most significant challenge. Despite most participants being Facebook users, they all experienced difficulties finding the project's page and making the post. They ended up asking for help (a knocking code on the door was previously agreed upon with the

participants in case they needed help or wanted to leave the room for any reason).

Due to the complexity of the tasks, the pressure to perform well, or the limitations of time and knowledge, many grandparents and grandchildren showed signs of impatience. Both generations expressed their feelings differently: the younger generation, which could not use the technology, tended to pace around the room and often rummaged through the space, looking for other clues. In comparison, the older generation focused intently on using their smartphones and searching for a solution. As soon as the last clue was unveiled and the pairs had access to the locker's key, most grandchildren went to get the antidote before taking the selfie. Curiously, four of them took the smartphone from their grandparents as soon as the antidote was taken!

Despite the various difficulties encountered, the exchange of knowledge was evident. It was also noticeable that grandparents did not always need their grandchildren's help but requested or accepted it. This was the case with grandparents like GP03 and GP05, who demonstrated confidence and proficiency with their smartphones throughout the activity but encouraged their grandchildren to assist them.

## 4.2 Results from the Interviews

The interviews showed that, even though they lived in different proximities, all the participants saw the other generation more than twice a week and that these meetings lasted around three to eight hours. What stands out is that four of the eight pairs interviewed reported about six meetings a week due to the grandparents caring for their grandchildren after school. Most grandparents (seven of the eight participants) assume this role when parents are away. The important role that grandparents can play in their grandchildren's education is emphasized by several authors (e.g., Kanyal, M., Mangione, D. and Luff, P., 2024; Barragán-Medero et al., 2024) and was even acknowledged by the grandparent participants: "*But he does not spend most of his time with his parents, he spends most of his time without them, doesn't he? Here, we play a very important role in his education. And if he was here every day, I think it was only fair that we intervened.*" (GP05).

In the interviews, the grandchildren reported a very close and intimate relationship with their grandparents, except in the case of GC03, who reported a low level of closeness with his grandfather, describing it as a more cordial and respectful relationship. Granddaughters GC01, GC4, GC6, and GC08 reinforced their grandmothers' friends and

confidants' status. The other grandchildren reported their friendship with their grandparents, recognizing them as a haven and a source of complementary emotional support and knowledge. Seven of the nine grandchildren interviewed recognize their grandparents as highly qualified to pass on knowledge.

However, as far as the exchange of knowledge and intergenerational learning is concerned, two of the eight grandparents interviewed, because they do not consider their life experience to be knowledge, do not see themselves as being able to teach their grandchildren, given their low level of academic qualifications and because they are "too old." The majority, however, consider that these exchanges of knowledge and learning take place either in the context of their informal socializing or through strategies and moments in which they try to teach their grandchildren values, life lessons, and skills that go far beyond traditional education, such as sewing or other handicrafts (GP01, GP05, GP06).

When considering technological devices, grandparents display diverse perspectives. Among the eight grandparents interviewed, four relied on their grandchildren to resolve issues with technology. They recognize the ease their grandchildren showed, as digital natives, with technology and are even proud of it. On the other hand, half were critical of the excessive use of technology, disapproving, for example, smartphone use at the table during meals: "*Because I think that if it were not for us, he would come to the table with that thing on, watching videos. However, when Grandpa or I arrive, he turns it off. It is a sign of respect, and we appreciate that.*" (GP05). Concerns about misuse and premature access to technology were also prevalent. For example, GP02 said: "*[GC2] has one, but the other does not. Well, [GC2] only got hers this year because she moved to another school, to the fifth grade. However, honestly, I think it is too soon.*"

Regarding technology's role, half of the grandparents viewed digital devices as tools for connection and separation. They acknowledged the Internet's ability to bridge distances and provide access to knowledge. Still, they noted its potential to hinder personal interactions: "*Excessive use creates distance, but at the same time, it helps. Resolving doubts, offering help—it brings people closer.*" (GP04). When directly asked about the role of technology in relationships, opinions varied. Half believed technology was incompatible with meaningful interaction and avoided technology altogether, choosing instead to bond with their grandchildren over shared hobbies: "*No, they are completely incompatible. If they have their phone in hand, we are both sitting in silence.*" (GP03).

The other half saw technology as a topic of discussion and learning in their daily interactions: "*Resolving doubts and helping each other… it brings people closer. In my case, [GC4] helps me, and that is a connection we have.*" [GP4. Grandmothers like GP5 and GP06, frequent technology users, highlighted its role as a tool in their relationship with their grandchildren.

Regarding the impact of technology on intergenerational relationships, the grandchildren's opinions varied. While three of the nine recognized the dual role of technology as both a connector and a divider, they acknowledged that technology could bring people together over long distances but also create barriers during face-to-face interactions: "*Sometimes it can bring people closer when they are far away and talking to everyone. But it can also push them apart when they are all together and on their phones.*" (GC7.1). When asked about the direct role of technology in their relationships, most agreed that it plays a significant role, namely as a resource to support knowledge transfer, helping both generations to understand old and new concepts by providing visual help: "*Yes, because many times they can explain things to me, but I cannot imagine it. Then they can go to the internet, show me pictures or something, and I can understand better.*" (GP06).

In summary, both generations recognize technology as a bridge and a potential barrier in intergenerational relationships. However, most participants acknowledged its active role in fostering learning, communication, and connection across generations.

# 5 CONCLUSIONS

This exploratory study examined the role of technology and digital media in shaping intergenerational relationships between grandparents and grandchildren, focusing on knowledge exchange and collaborative interactions. The research involved grandparents and grandchildren participating in a technology-driven gamified escape room activity designed to foster collaboration and problem-solving, followed by individual interviews to gather more profound insights into their experiences and perspectives.

The results from both the escape room activity and the interviews confirm that grandparents and grandchildren engaged in reciprocal learning processes. Grandchildren often acted as tutors,

guiding their grandparents in navigating technology and digital tools, while grandparents shared cultural knowledge and traditional skills, values, and life experiences. This bidirectional exchange promotes digital literacy among older adults and enhances the younger generation's understanding of heritage and the acquisition of valuable skills. The gamified activity highlighted each generation's complementary strengths and the potential of technology to facilitate meaningful joint endeavors.

Despite these promising findings, the study presents some limitations. The small sample size restricts the generalizability of the results to broader populations, and the inclusion criteria - requiring participants to have some pre-existing familiarity with technology - excluded older adults with no prior digital experience. Future research should consider expanding the sample size and incorporating a wider range of digital literacy levels, including participants with minimal or no exposure to digital tools. This would provide a more comprehensive exploration of the barriers and facilitators of digital intergenerational engagement.

Additionally, while this study focused on a single gamified activity, future work could explore the long-term effects of such initiatives on intergenerational relationships and digital inclusion. There is significant potential to scale up the concept, integrating similar gamified learning experiences into schools, community centers, and digital literacy programs for older adults. Moreover, incorporating augmented or mixed realities could enhance accessibility and engagement, making these activities more immersive and adaptable for diverse populations.

By refining and expanding these approaches, future research, and practical implementations could broaden the impact of digital media in fostering intergenerational collaboration, ensuring that technology serves as a bridge rather than a barrier between generations.

## ACKNOWLEDGMENTS

## REFERENCES

Amaro, A. C., Oliveira, L., & Veloso, A. I. (2017). Intergenerational and collaborative use of tablets: «in-medium» and «in-room» communication and interaction. Observatorio (OBS*), 11(1). https://doi.org/10.15847/obsOBS1102017995

Arpino, B., Meli, E., Pasqualini, M., Tomassini, C. & Cisotto, E. (2022). Determinants of grandparent-grandchild digital contact in Italy. Genus 78, 20 (2022). https://doi.org/10.1186/s41118-022-00167-5

Barbosa Neves, B. (2019). Ageing and Digital Technology: Designing and Evaluating Emerging Technologies for Older Adults. Singapore: Springer. ISBN 9789811336935

Barbosa Neves, B. & Fernandes, A.A. (2016). Generational Bridge. In C.L. Shehan (Ed.). The Wiley Blackwell Encyclopedia of Family Studies, First Edition. John Wiley & Sons, Inc. ISBN: 9781119085621 https://doi.org/10.1002/9781119085621

Barragán-Medero, F., Martín-Hernández, A., Martínez-Murciano, M. C., & Contreras-Madrid, A. I. (2024). The vital role of grandparents in the education and development of grandchildren in the contemporary family. EduSer, 16(1). https://doi.org/10.34620/eduser.v16i1.269

Döring, N., Mikhailova, V., Brandenburg, K., Broll, W., Gross, H.M., Werner, S., & Raake, A. (2022). Digital media in intergenerational communication: Status quo and future scenarios for the grandparent-grandchild relationship. Univers Access Inf Soc., 3, 1-16. https://doi.org/10.1007/s10209-022-00957-w

Fingerman, K., Huo, M. & Birditt, K.S. (2020). A Decade of Research on Intergenerational Ties: Technological, Economic, Political, and Demographic Changes. Journal of Marriage and Family, 82(1), 383-403. https://doi.org/10.1111/jomf.12604

Flamion, A., Missotten, P., Marquet, M. & Adam, S. (2019). Impact of Contact With Grandparents on Children's and Adolescents' Views on the Elderly, 90(4), 1155-1169. https://doi.org/10.1111/cdev.12992

Forghani, A., & Neustaedter, C. (2014). The routines and needs of grandparents and parents for grandparent-grandchild conversations over distance. In Proceedings of Conference on Human Factors in Computing Systems, pp. 4177–4186. Simon Fraser University, Canada. https://doi.org/10.1145/2556288.2557255

Gallagher, C. (2019). The changing lives and relationships of young children and older adults: Implications for intergenerational learning. Intergenerational Learning in Practice. Routledge. ISBN 9780429431616. https://doi.org/10.4324/9780429431616-2

Harwood, J. (2007). Understanding communication and aging: Developing knowledge and awareness. SAGE Publications, Inc., https://doi.org/10.4135/9781452225920

Ivan, L. & Fernández-Ardèvol, M. (2017). Older people and the use of ICTs to communicate with children and grandchildren. Transnational Social Review: A social

work journal, 7(1), 41-55. https://doi.org/10.1080/ 21931674.2016.1277861

Jassogne, C., & Zdanowicz, N. (2020). Real or Virtual Relationships: Does It Matter to Teens? Psychiatria Danubina, 32(1), 172-175. https://pubmed.ncbi.nlm. nih.gov/32890385/

Kanyal, M., Mangione, D. and Luff, P. (2024). The role of grandparents in early education and care in the 21st century: a thematic literature review of the UK research landscape. Norland Educare Research Journal, 2(1), 1-22.https://doi.org/10.60512/repository.norland.ac.uk.0 0000042

Kaplan, M, Sanchez, M, Shelton, C, Bradley, L. (2013). Using Technology to Connect Generations. Penn State University & Washington D.C.: Generations United; 2013. Retrieved from https://aese.psu.edu/outreach/ intergenerational/program-areas/technology/using-technology-to-connect-generations-report

Keary, A.; Garvis, S.; Slaughter, Y.; Walsh, L. (2024). Young Children's Play and the Role of Grandparents as Play Partners during the COVID-19 Pandemic. Education Sciences, 14, 771-785. https://doi.org/ 10.3390/educsci14070771

Lai, D.W.L., Li, J, & Bai, X. (2021). To be or not to be: the relationship between grandparent status and health and wellbeing. BMC Geriatrics, 21(1), 204-213. https://doi.org/10.1186/s12877-021-02052-w.

Lyu, K., Xu, Y., Cheng, H., & Li, J. (2020). The implementation and effectiveness of intergenerational learning during the COVID-19 pandemic: Evidence from China. International Review of Education, 66, 833–855. https://doi.org/10.1007/s11159-020-09877-4

McConatha, J.T., McConatha, M. & DiGregorio, N. (2021). Lessons from My Grandmother's Garden: Intergenerational Learning and Managing Type 2 Diabetes. Journal of Diabetes and Clinical Research, 3(3), 55-58. https://doi.org/10.33696/diabetes.3.039

Mendelová, E. & Zelená, H. (2021). Grandparents and Their Role In The Current Family, *ICERI2021 Proceedings*, pp.149-156. https://doi.org/10.21125/ iceri.2021.0088

Modin, B., Erikson, R. & Vågerö, D. (2013). Intergenerational Continuity in School Performance: Do Grandparents Matter? European Sociological Review, 29(4), 858–870. https://doi.org/10.1093/ esr/jcs064

Nicholson, S. (2015). Peeking behind the locked door: A survey of escape room facilities. White Paper available at http://scottnicholson.com/ pubs/erfacwhite.pdf

Pasqualini, M., Di Gessa, G., & Tomassini, C. (2021). A Change is (not) Gonna Come: A twenty-year overview of Italian grandparents-grandchildren exchanges. Genus 77, 33 (2021). https://doi.org/10.1186/s41118-021-00142-6

Piper, D., Malik, S., Badger, A. N., Washington, C., Valle, B., Strouse, G. A., Myers, L. J., McClure, E., Troseth, G. L., Zosh, J. M., & Barr, R. (2023). Sharing culture in a tech world: Grandparent–grandchild cultural exchanges over video chat. Translational Issues in

Psychological Science. https://dx.doi.org/10.1037/ tps0000358

PORDATA (2024). PORDATA retrata perfil da população Portuguesa. Comunicado de imprensa. Available at https://ffms.pt/sites/default/files/2024-07/PR%20DIA%20POPULAÇÃO%202024_VF.pdf

Ramos, N. (2013). Relationships And Intergenerational Solidarities – Social, Educational and Health Challenges. In A. L. Oliveira (COORD.). Promoting Conscious and Active Learning and Aging: How to Face Current and Future Challenges? COIMBRA UNIVERSITY PRESS. https://doi.org/10.14195/978-989-26-0732-0_6

Soliz, J. & Harwood, J. (2003). Perceptions of communication in a family relationship and the reduction of intergroup prejudice. Journal of Applied Communication Research, 31(4), 320–345. https://doi.org/10.1080/1369681032000132582

Stephan, A.T. (2024). How Grandparents Inform Our Lives: A Mixed Methods Investigation of Intergenerational Influence on Young Adults. J Adult Dev 31, 40–52. https://doi.org/10.1007/s10804-023-09446-7

Strom, R. & Strom, P. (2015). Assessment of Intergenerational Communication and Relationships. Educational Gerontology, 41(1), 41-52. https://doi.org/ 10.1080/03601277.2014.912454

Trujillo-Torres, J.M., Aznar-Díaz, I., Cáceres-Reche, M.P., Mentado-Labao, T., & Barrera-Corominas, A. (2023). Intergenerational Learning and Its Impact on the Improvement of Educational Processes. Educational Science, 13(10), 1019-1035. https://doi.org/10.3390/ educsci13101019

UNESCO Institute for Lifelong Learning (2015). Learning Families: Intergenerational Approaches to Literacy Teaching and Learning. Germany: Institute for Lifelong Learning. ISBN 978-92-820-1199-7. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000234252.

Wei, X., Gu, Y., Kuang, E., Wang, X., Cao, B., Jin, X. & Fan, M. (2023). Bridging the Generational Gap: Exploring How Virtual Reality Supports Remote Communication Between Grandparents and Grandchildren. CHI '23: Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems, pp.1-15. https://doi.org/10.1145/3544548.3581405

Yuan, Y., Jin, Q., Mills, C., Yarosh, S. & Neustaedter, C. (2024). Designing Collaborative Technology for Intergenerational Social Play over Distance. Proceedings of the ACM on Human-Computer Interaction, vol. 8(2), pp. 1-26. https://doi.org/ 10.1145/3687031