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Overcoming the digital divide with a modern approach to learning digital skills for the elderly adults

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Abstract
As digital multimedia devices increasingly pervade people's lives, including the lives of older adults, the need to provide relevant training for these age groups grows. Older adults, not due to their frailty or age, often find it difficult to use digital devices like smartphones, and they often lack the basic digital literacy required to use multimedia interactive devices with touchscreen technology. This is the major reason why they are experiencing the sharp digital divide in the twenty-first century. In this study, older adults from four European countries participated in a two-phase process: playing interactive games on a large touchscreen tablet and learning how to use a smartphone to access digital services. The attitudes and the difficulties associated with adopting the skills to operate the device and use the digital services were observed and discussed. The findings and recommendations for an effective approach to this problem are discussed at the end of the paper.

Keywords Digital divide · Digital literacy · Older adults · Education · Digital skills · Game playing

1 Introduction

The appearance of the knowledge society at the beginning of the twenty-first century triggered a discussion among IT professionals and educators about what kind of skills and understanding a citizen must have when working and living in the knowledge society. The broadest interpretation of the term includes information management, collaboration, communication and sharing, creation of content and knowledge, problem solving and technical operation (Ferrari 2012). Similar views were applied when skills

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descriptions (Van Laar et al. 2017) were introduced for the term digital literacy. Besides the skills to operate a digital device in order to perform tasks and solve problems in a digital environment (Ng 2012), the digital literacy concept distinguishes three interesting dimensions, which are classified as technical, cognitive and social-emotional. Overall, digital literacy in the literature is understood and described as a mindset that enables users to perform tasks in digital environments and to both easily and effectively access the wide range of knowledge embedded in the digital environment (Martin 2008; Van Laar et al. 2017). According to the factsheet presented at the EU Digital Summit in 2017 (EuDiPro 2017), 44% of the European population lacks even basic digital skills in terms of digital literacy, although in the near future nine out of ten jobs in Europe will require digital competence. Despite the improvements in citizens' cyber education and a clear commitment on the political side to further support it, Europe still lacks the digitally skilled citizens to fill the gaps, which is estimated to be 500,000 experts (Eurostat 2016a). The problem with the older adult population seems to be even more critical, as only 55% of individuals aged 65 or over among the EU's population use the Internet, according to an EU statistical report (Eurostat 2016b), while around 85% of the whole European population uses the Internet (Eurostat 2016c). In the USA the numbers are similar, as only 57% of people older than 65 are using the Internet (Tsai et al. 2017). These facts identify the first level of the digital divide, known as simple access to the Internet. However, these numbers do not say much about the second level of the digital divide, which deals with issues related to Internet skills and efficacy in the use of digital services (Tsai et al. 2017). The skills and the efficacy in technology use affect the people who need to access services such as e-health, e-travel, e-shopping, e-government or information gathering, etc. Acquiring these types of skills is part of many policy initiatives in the USA, such as the BTOP program, (BTOP 2013) and the European Innovation and Cooperation program (EACEA –ERASMUS 2018). With an increase in the use of mobile devices for accessing digital services, the scope of digital literacy has extended to include the use of mobile devices (Knowles, 2011). Digital literacy in that context can be understood as the ability to use, access and understand the information from mobile devices like smartphones (Wang et al. 2011). The importance of digital skills among older adults became apparent with the appearance of Internet-based services, such as e-health, e-government, e-learning and others, as they are considered as enablers that extend the period during which the elderly can stay in their own homes before the need to move to retirement homes.

The problem of a lack of basic digital literacy among older adults is related to the fact that older adults do not have the knowledge to effectively use digital devices where the communication with the user normally involves touchscreen technology. Among the newer digital devices, of major importance for older adults are smartphones, as they are tools that enable social communications and a variety of tasks in everyday life. Digital skills, in addition to socialising, are increasingly required for performing instrumental tasks, such as searching for contacts, medical help, measuring medical indicators in e-health services or paying bills, and taking part in democratic processes. The problem of learning digital skills among older adults has its origins in the way they learned in their youth and during their professional lives, as most of them had no opportunity to interact with modern digital technology and to create the knowledge for effective use at the time when interacting with the Internet became part of everyday life. Feeling that they are outsiders in terms of the digital culture became a part of their

personality. When the elderly need to use digital services they often visit public day centres where they can find assistance when performing even very simple tasks. These attitudes of the elderly clearly point to the second type of digital divide where the elderly people are left behind. In the EU, 63% of the population accesses the internet via mobile phones (Eurostat 2016c), and the use of a mobile phone to access digital public services is increasing every day and is becoming the most important tool for communication with and access to digital services. Measured by dimension indicators, this type of access showed remarkable growth in 2017 in most of the EU countries, with Austria among the leaders, followed by Estonia and the UK (Eurostat 2016b).

This paper aims to provide an insight into the adoption of touchscreen technology with entertaining video games as a tool that supports the acquisition of digital skills as part of digital literacy for the elderly population. The results presented in the paper are based on experiments with groups of elderly citizens. Entertainment sessions with game playing were offered to the elderly who had no experience of computers or tablets, with the aim to study the effect of playing games on skills acquisition by the elderly and their reaction to the new touchscreen technology. The study was carried out in two phases: the first focused on the problems that the elderly from the four countries face when they are exposed to a new technology, and the second phase was designed to find the effect of game playing on their effectiveness when using smartphones in everyday life in one of the participating countries.

The study was carried out with groups of elderly people from both developed and developing countries. The country selection was based on the percentage of the aged population and the population of the elderly that use the Internet (EuDiPro 2017). The UK and Austria have relatively high proportions of an aged population that demonstrate some digital skills. In the UK the figure is 42%, while in Austria it is 35%. The numbers for the other two countries are low: in Slovenia only 27% of the elderly population use the Internet, while in Macedonia the figure is only 13%.

This paper is organized into five sections. The next section briefly introduces an overview of the literature, the theoretical background of the study and the research questions. The third section presents the study's design and the demographic characteristics of the sample population. The fourth section introduces the results and the findings. Section five then discusses the results and the findings. The paper ends with a final section of conclusions.

2 Theoretical background

2.1 Brief overview of the adoption of digital game playing in education

The current developing research field of digital literacy education for the elderly mainly involves the needs of practitioners to identify the conditions (attitudes, values, skills and practices) for cooperation and building positive relationships between the institution caring for the elderly or families and the elderly themselves (Gerling et al. 2011). The research includes the design of activities that enable professionals or volunteers to work productively and proactively with the elderly to support their acquisition of digital skills. This includes understanding the potential role of digital services in everyday living for the elderly and understanding the needs of the elderly, in terms of their

reduction of physical capabilities, the loss of memory, and the decline in auditory acuity (IJsselsteijn et al. 2009). Motor skills are found to be important as well, especially if their impairment has a diverse nature and cause. In studying the elderly's acquisition of skills, some authors in the early period of the Internet suggested that elderly users must unlearn some of their accumulated knowledge if it does not fit the properties of the new technologies (van Hees 1994). Some authors found that multiple skills are being learned in parallel, which makes the learning process for digital skills even more challenging (Czaja and Sharit 2012) and additionally difficult (McDougall et al. 2018). The learners usually struggle with complex interface actions, which triggers requests for assistance from the teaching staff or from the involved practitioners. The need to understand the learners' difficulties and the provision of care make this work much harder. Most of the studies found that despite the difficulties, acquiring digital skills can improve older adults' social inclusion (Khosravi et al. 2016).

The advent of tablet computing devices, first adopted by young people, offered an opportunity to bridge the digital inclusion gap for older adults by offering them entertaining content (Al Mahmud et al. 2008). It was evident that the tablets were simpler to use and offered a variety of games and other play-based applications for entertainment and offered the promise of easy learning. Biagi and Loi (2013) confirmed these findings by analysing the Pisa survey results, which showed that playing digital games was the only ICT application that had a positive correlation between intensive gaming and the test scores in languages and mathematics for the surveyed European students. As this technology is fairly new, the number of studies that address the actual process when the elderly try to learn by using these devices is relatively low, although some exceptions are reported in the studies of Delello and McWhorter (2015). Research reports about learning in order to overcome a lack of digital literacy and the use of smartphones by the elderly and playing games on a touchscreen tablet are still rare (Häikiö et al. 2007) or almost non-existent (Jahn and Krems 2013). Gaming was used mainly in studies to see whether playing games enhances the cognitive ability of the elderly (Toril et al., 2014), (Zelinski and Reyes 2009).

The literature relating to playing digital games applied to the learning processes, especially the classic educative processes, is much richer (Barab et al. 2005). This is evident from the study of Connolly and co-workers (2012), which provides a good review of the use of serious games (games used in the education process) in education. The study lists several academic papers that discuss the benefits of playing digital games and their use in education (Van Staalduinen and De Freitas 2011). Other researchers have found that game-based learning is used across many curricular areas, most notably in health, business and social areas (Baldaro et al. 2004). The interest in gaming within the learning context is usually justified by the learner's motivational reasons. Games were found to be "motivating and enjoyable". On the other hand, playing games can coincide with learning and the expected learning outcomes. This happens especially if the learnability property of the game is high (Jerman-Blažič and Jerman-Blažič 2015). Other studies have found that cognitive abilities (knowledge creation, organization, and application) are mainly related to the games that are presented to learners as solvable problems and challenges, especially when they are used to obtain a specific learning outcome (Van Staalduinen and De Freitas 2011). Educational games are usually designed to be adaptable to the skills and the level of the learner's knowledge (Barab and Squire 2009). On the other hand, the game-learning

components associated with technical or motor skills are related to the game's attributes, known as the learner's participation and interaction, learner engagement, control and navigation (Jerman-Blažič and Jerman-Blažič 2015). Motivation has a positive association with the game's attributes, which are usually considered during the game's design and are the goals and rules of the game. The same applies to its fantasy component and the provision of specific feedback to the learner (Garris et al. 2002). Given the positive effects of playing digital games, older adults are considered as having "great potential in accepting" digital game-based learning (Damodaran and Sandhu 2016).

Kaufman et al. (2016) additionally describes the motivational aspects and other additional benefits for older adults who play computer games, including the "mental experience", "dealing with loneliness or depression" or "developing confidence". Since playing computer games "does not require specific skills" learners can start playing at a low competence level and can "gradually accumulate other types of skills, while improving their gaming skills". However, the reported studies do not examine the effects of the digital games on acquiring digital skills beyond the self-reporting of the study participants (Wilson et al. 2008).

2.2 The applied theoretical method

Rather than applying different approaches used in the study of the elderly's behaviour when facing digital technology, the researcher team decided to apply the Grounded Theory as the theoretical background. According to several authors (Crooks 2001, Bryant and Chamaz 2007) this theory is ideal for exploring integral social relationships and the behaviour of a group of people where little exploration of the contextual factors that affect the individuals' lives are known. The Grounded Theory developed by Martin and Glaser (Martin and Turner 1986; Glaser and Strauss 1967) in the late 1970s, enables exploratory studies to resolve different research questions, but equally importantly it makes it possible to generate issues and questions during the ongoing investigation that can be answered after the experiment is completed (Easterday et al. 2018; Strauss and Corbin 1998). The theory was later improved and developed to meet the needs of qualitative research in sociology (Moghaddam 2006). The approach enables the simultaneous collection and analysis of data, the creation of analytical codes and categories developed from data without pre-existing conceptualizations (Schreiber 2001. The sensitivity of the analytical methods provided by the theory makes it possible to discover the basic social processes within the data and to refine the selected or identified categories.

In order to be convinced that the elderly do not refuse to use digital technology when it is presented to them in a way that is close to their views, the initial approach of the presented study was to look at categories related to the behaviour of older adults with respect to digital technology, e.g., touchscreen tablets, by observing the emotions expressed by the participants during and after the experiment of playing games. The type of positive emotions that was supposed to formulate the categories was found to be the pleasure expressed by the person when playing the game, the satisfaction with the performed tasks during the play and the social interactions. The game playing, i.e., the gaming experiment, was conducted with pairs of older adults and with a group of elderly in the same room.

The developed positive emotions were also expected to reduce the fear with respect to the digital technology and to contribute to the easier adoption of the digital skills (Hafeez et al. 2018). The process of recording the emotions and reactions during the study experiment is known as "coding", and the short descriptor phrase of the collected data as a code (Allan 2003). The coding of the data in our study involved coding the observed behaviour from videotapes that were recorded during the experiments.

The study tried to find answers to several questions, with the following considered to be the most important:

a) Are there any issues or difficulties with learning and training digital skills for older adults when they are exposed to multimedia touchscreen devices with large screens?
b) Will the older adults` express positive emotions towards the digital technology and the gaming?
c) Does the population of older adults display differences in the adoption of digital technology due to the different digital environments where they live?
d) How do the skills acquired during gaming influence the adoption of the digital skills required to manage the use of digital services with a mobile device?
e) Did the experience of gaming have any influence on the effectiveness of using a smartphone?

The answers to the questions were sought with the coding analysis of the experiment's videotapes, the analysis of the collected post-experiment survey data obtained from the questionnaires and from the open-ended interviews. It is important to note here that national survey data from the EU Member States (Eurostat 2016c) show that older adults who are not users of computers are not normally willing to explain their behaviour and lack of interest in modern digital technology. This position is not necessarily straightforward, as the lack of interest might obscure some other underlying lack within the same population. That was the reason why the suggested methods of the Grounded Theory were used in our study (Piantanida et al. 2002). The first phase of the experiment was run in four different European countries, involving academic entities and institutions working with the elderly. All of them were partners in the ERASMUS project GIRDA (Game Play for Inspiring Digital Adoption, www.girda.eu). The project was coordinated by Middlesex University, UK and the study protocol, the setting of the of the experiments, the tools used (touchscreen tablets and games), the questionnaires for the participants after the gaming sessions (translated into each country's language), the instructions to the facilitators and the coding of the videotaped material were designed within the coordination of the project work The experiment in the first phase was carried out in the four countries, it followed the same study protocol and had the same questionnaires, which were answered after the gaming session. The study classes were led by experienced academic staff with the support of younger researchers that had the role of mentors and facilitators. This approach allowed the findings from the questionnaires and the coding to be compared.

3 The study

3.1 The experimental setting

The study approach considered the three dimensions of digital literacy. In particular, the technical dimension was present with learning how to operate a digital device as the participants learned how to master the use of a Lenovo touchscreen tablet. The cognitive dimension was present by learning how to play the games on the touchscreen tablet, meaning that participants learned the gaming rules, and solved some tasks that could help them in accessing information in the digital environment. The social-emotional dimension was included with the collaborating environment set up during the experiments. As the participants played in a pair, collaboration with the partner during the play was encouraged and was evident. The support from the involved members of the group was loud when encouraging the players or helping them to successfully solve the tasks and complete the game.

The study was carried out in two phases: groups of older adults who played the games and participated in the interviews and answered the questionnaires, and the training courses designed for the older adults to learn how to use smartphones. The second phase of the study was only carried out in Slovenia. The participants were divided into two groups: a group that played games for 45 min before the smartphone class started, and the second group that took the same training course but did not play games before the training course. In the first part of the study coding was applied to analyze the behavior of the participants and to follow how the selected games enabled practice of the skills that are critical for using touchscreen technology. For example, tap, drag, and rotate objects on the screen, moving the objects on the tablet and learning how to use the operating tablet keys. The games offered were expected to promote the development of cognitive and motor skills along with the participation of and interaction with the other participants. The games that were chosen were expected to be known by the participants in the real world, like puzzles or card games. Regarding the previous knowledge of the participants, the study team decided to select participants without any previous skills in playing games on touchscreen devices and with no knowledge or practice of using computers. The recommended age of the participants was over 65. The games offered for playing were selected in order to cover the three dimension views of the digital literacy adoption:

a) Introductory game – “drawing on the Lenovo tablet” introduced the player to the digital device and enabled the player to learn how to operate the device. They used their fingers for free drawing and to push the touch operating keys that enabled a change of the color or a re-start of the game.
b) The second game was a digitalized puzzle that enabled the player to get some cognitive and motoric skills while completing the image from small parts on the tablet. The task completion requested recognition of the image parts, their rotation, moving and placing them in the right locations for the completion of the image.
c) The third game required very fast coordination of the player, e.g., the vision, the cognitive and the motoric skills. The main task was to recognize the current situation on the tablet’s screen and to react very quickly with a finger as the game scene changed frequently. The game scene was made up of very busy parallel roads

on which heavy trucks were travelling very fast. The player's task was to push the pedestrian figure to cross the busy roads without being crushed by the motor vehicles. The moment for crossing the road was a temporarily empty road that appeared for only a few seconds, so the player's reactions and movement of the object needed to be very fast.

The first-phase experiment was designed to register the emotions shown towards the digital technology by the elderly who were facing such a touchscreen device for the first time in their lives. The second objective was to determine whether there was a readiness for further learning and adopting digital skills after the game-playing sessions. However, the expectation was that some digital skills would be learned as well. In the second phase the focus of the study was to find out whether the playing of games on a large touchscreen tablet influenced the skill level and the knowledge adopted during the course of smartphone learning regarding the efficiency and the speed of performing the task in the knowledge environment.

The first phase was carried out with two players on a single touch-table device (basically a giant tablet, e.g., a Lenovo table, see Fig.1) in an environment familiar to the participants, e.g., retirement homes or a similar environment. The introduction to the touchscreen functionality was made by the mentors in an immersive, low-pressure environment. The fact that the participants were learning digital skills was actually "hidden" from them, because the participants were invited to an "entertainment session". The Lenovo touch table used in the study offered games that can support from one to four people playing simultaneously, so the playing in pairs of mixed gender was introduced. Exploring the diverse range of game categories available on a Windows touchscreen device presented certain challenges to the study group as the wrong selection could be off-putting for the new users trying to find their way in using the tablet's screen functionality. Another important criterion in the game selection was the expectation that the game would create a non-stressful, enjoyable path for learning and acquiring motor skills (Gerling et al. 2011). This implied that the selected game types should not present a very heavy cognitive burden for the learner, as the difficulties in playing a demanding game usually detract from the skill-learning process (Wang et al. 2011). The same applies to games with a complex set of rules that might burden the player's working memory (Kaufman et al. 2016). Popular games on the market were found to be overly sophisticated; known 'educational' games are mainly aimed at pre-

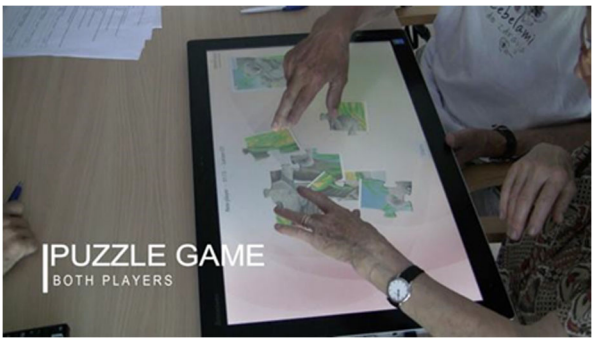


Fig. 1 The puzzle game

school and primary-school aged children, while "adult games" were found to be inappropriate for this type of experiment. More useful were the genres that included puzzles, board games and casual games.

It was decided that the first game to be introduced to the participants would employ a basic drag action as the introductory lesson for using a touchscreen device. The drawing game was selected first, as it looked to be the most appropriate for users who had no previous experience with touchscreen technology or any other type of digital games. The simple drawing tool in the game's repertoire was an introductory element so that the participants could have a first experience of just touching the tablet and getting an immediate visual result – be it a fingerprint-sized dot, a line, a house or a ship. The drawing game on the Lenovo tablet allows the users to change the color using the tablet keys. The second game introduced to the participants was aimed to help them learn the rotate action and the moving of objects on the screen. This was a puzzle game that requires the players to complete an image. Puzzles are popular games, and the idea was that not much of an explanation would be needed to play a simple puzzle game. However, this game enabled the learning of other skills, like moving, rotating and dragging objects to come to the right position so as to assemble an image. The third game was selected from the list of games with in an-situ judgment, such as the very popular heavy-traffic road-crossing game known as Crossy Road. In Crossy Road the player is moving an object across very busy roads, while trying to prevent the object from being crushed under fast-moving vehicles. If a collision happens before the object can reach the other side of the last road, the game closes and starts again. This game focuses on coordination of the vision/cognition and motor activity of the player's fingers. The actions often cause rapid system responses that are out of proportion with the input actions. This rapidity requires the participant's ability to observe and recognize quickly, and to behave as a very active user. The selected games proved to be useful in identifying the key variations and the pros and cons of learning how to act on a tablet's touchscreen.

The second phase of the study was carried out with the two other groups of older adults who enrolled in a training course to learn how to use a smartphone. The study was carried out in cooperation with the Simbioza Genesis 2018 institution, which maintains an inter-generation center in Ljubljana and is offering smartphone courses for the elderly. Other countries participating in the first phase of the experiment have set up a similar cooperation with institutions working with the elderly, e.g., in the UK it was the Good Things Foundation, in Austria, it was the Association for Older Adults in Upper Austria, while in Slovenia and Macedonia the cooperation was set up with retirement homes. The gaming on the Lenovo giant tablet was organized an hour before the lessons of the smartphone course started. These lessons were spread over 1 month, twice a week. At the end of the course each attendee was asked to answer a questionnaire, which included the same questions as for the groups of older adults in the first phase of the study; but the main assignment they were expected to perform was to solve five different tasks by accessing some digital services. Both participating groups, i.e., the group that had no experience of playing games on giant touchscreen tablets before the course and the group that did not play games before the course lessons were asked to solve the same tasks, presented below.

1. We would like you to apply for financial social assistance with the on-line Social Service. You do not know how to do it, so you need first to contact the Social Work Centre. Locate the appropriate public service to find a contact through the web. Use your smartphone.
2. The course mentor sent you, as an enroller, a reminder about the terms of the course. You have found out that you will not be able to come to some of the course's specified elements. Write an SMS to him as an apology.
3. You have many interesting pictures in your phone's gallery. We would like you to send some of them as Multimedia Messages, e.g., videos or photos of your close relatives. Open the gallery or photo/video application and select the file you would like to send and then send it to the specified telephone number.
4. You would like to borrow a book from a nearby library. You need to know the address of the library so that you know how to reach it. Find the address of the library closest to where you live.
5. Today is Wednesday, and on Friday you would like to go on a trip to the neighboring hills or a touristic spot. It worries you that the weather might be bad. Find a forecast for Friday by using the application on your smartphone.

3.2 The demographics of the participants

The age of the participants in both phases of the experiment ranged from 57 to 85, however, the ages differed slightly among the participating countries, but the average age was quite similar, i.e., 75 in the UK, 79 in Macedonia, 73.2 in Slovenia and 73.9 in Austria. The demography of the Slovenians in the first-phase experiment is presented in Table 1. The group of 26 people divided in two groups of 13 people. The group that participated in the second phase was younger, as the players' ages ranged from 55 to 75, and the average age was 69.8. Females dominated as group members in the first experiment and they were more engaged in the playing process. Most of them had no previous experiences with digital technology, since for the experiment, novices were requested to form the groups. The level of the participants' education ranged from high school to a master's degree. A number of the participants had weaknesses in some of their motor abilities, and this governed the way the data were collected after each of the completed sessions. The presence of witnesses, i.e., friends interested in the gaming, is usually considered as a key dynamic of co-learning. Participants take clues from watching their partner's interaction with the system and the resulting system response. One of the study tasks was to observe how people interacted with each other as well as

Table 1 The demography of the Slovenian sample

	Female	Male	all
Number of participants	37	23	60
Average age	74.4	73.5	
Age range	65–85	64–85	65–85

with the technology, and how the choice of the game or activity influenced the changes in these interactions.

In the UK the participants were selected with the assistance of the Good Things Foundation. The emphasis for the UK team was to involve in the experiment older people close to retirement, or post-retirement, from socially deprived areas. Most of the UK participants (40 people) were from Stockport, in the north-west of England, while the other selected group came from the London area, with help from a local group supporting isolated women (20 people). The participants in the Slovenian part of the first-phase study were recruited from three retirement homes (60 people). The Austrian participants were selected with assistance from the Association for Older Adults in Upper Austria (26 people). The groups of older adults who attended the smartphone training course consisted of 24 people aged from 55 to 75 years. Both genders were present, 14 men and 10 women; both groups had little or no prior experience with touchscreen devices. The group that played the game in the second phase was offered the same selection of games as in the first experiment. They played for 45 min before the training course started; the second group entered the course lessons directly without playing.

4 Data collection and analysis

4.1 Playing games on the Lenovo tablet

In applying the Ground Theory approach, a video recording was made for each of the playing sessions that were later used to produce the coding. The coding intended to identify the emotions together with an analysis of the answers in the questionnaire and the collected data from the open interviews, but the main objective in the first-phase study was to identify the problems that the players experienced when they were maneuvering using the touchscreen. The requests for help and support from the facilitators were considered as important input. The questions in the questionnaire were developed in line with the guidelines recommended by Braun and Clarke for carrying out qualitative research in psychology (Braun and Clarke 2006).

The videotape coding identified the specific needs of older adults in learning and adopting digital technology and they are used for the development of mentor guidelines for this type of training and learning. Specific attention was paid to the problems related to motoric skills when the elderly was faced with problems on the touchscreen tablet. Other information sought from the videotapes was the level of the players' immersion in the game, the collaboration between the individuals playing in a pair of players and solving the game's tasks.

A coding example and analysis is presented at the end of the paper in Appendix Table 2. In general, it was found that the learning difficulties experienced by the participants can be summarized in three types of players' actions:

- Request for support from the mentor/facilitator in cases when the game appeared to be locked,
- Support/help to be provided by the mentor/facilitator in cases when the touchscreen of the tablet did not react to the participant's movement,
- A request for help from the gaming partner in the pair.

These actions usually followed a failure associated with a lack of the appropriate motor control over the tablet and in cases of errors when a color used for drawing was changed, fixing the tablet in the expected position or re-activating the game in the case of failure. When the game Crossy Road was played, the request for support and help most frequently happened due to a participant misunderstanding the rules of the game and the difficulties arising from the lower level of motoric and cognitive skills of the elderly. However, when playing the whole set of games, supportive activities among the pairs were noticed as well the support provided from the observing members of the group, which points to the social-emotional dimension of the environment.

The study provided positive answers to the research questions. However, difficulties were encountered and they should be considered. Enjoyment and engagement during the game playing were also noticed as players reacted with positive emotions. The interviews after the playing session in the first phase of the study took place on an individual basis. The majority of the participants (82%) described the playing session as pleasant and full of fun. However, 18% of them found the gaming somewhat tiresome. The most enjoyed game was the puzzle, followed by the drawing game. Crossy Road appeared to be tiresome for some of the participants and maybe too demanding with respect to the level of the player's motor skills and vision. This was explained by the required speed of action and the coordination of the motor skills with recognition of the scene situation. Most of them (75%) said that they do not find the use of the touchscreen difficult; others (25%) declared that they had encountered some difficulties, especially in the Crossy Road games due to the speed required to move the pedestrian object. An important finding was that they did not experience any physical discomfort when using their fingers during the game on the tablet (95%). The same positive attitudes and feelings were shown by the participants when they were asked about how they accepted the novelty of the technology represented by the touchscreen table. Playing games was not found to be difficult by the majority (80%) and the attractiveness of the approach was also assessed as very high (90%). The participants agreed that playing on a touchscreen tablet is attractive to them. The participants also declared that they would describe this experience to others as fun and as a good entertainment. The collaboration – playing as a pair and with support of the group – was also accepted positively by most of the participants. The collected data from the post-test questionnaire was analyzed and examples of the processed data from all the involved countries are presented in Appendix 2. The data from the question as to whether some fear appeared among the participants when facing the touchscreen is not presented in the chart as almost all the participants reported that they felt no fear at all. In general, the entire experiment was assessed by the participants as a very positive experience.

One of the main findings from the study was that the older adults from different countries expressed very common attitudes, e.g., they did not show any fear in the case of playing games on a touchscreen and they were willing to learn by playing and having fun. The answers regarding the enjoyment they experienced when playing were distributed between "strongly agree" and "agree". The Macedonian group provided only "strongly agree "answers to this question. The same result

appeared in the answers to the second question "I have learned something about using a touchscreen" was positively confirmed by the majority of the participants. The statement "I would be interested in playing more games" got the most positive answers in the UK and Macedonia (only "strongly agree" and "agree"). The answers from the participants in Austria and Slovenia were more scattered; however, the largest number of positive answers was still given to the wording "strongly agree" and "agree". The statement "I now feel more positive about using digital systems after this" was approved in all four countries with the wording "strongly agree" and "agree". Older adults from European countries do have positive emotions towards playing digital games on a large touchscreen tablet, so the answer to the research question b) is "yes". The answer to the research question c) is "no", as no large differences were observed between the answers collected from the participants' different countries.

4.2 Playing games on a touchscreen tablet and learning the practical use of a smartphone

In the second phase of the study the objective was to find out how game playing and learning to use the touchscreen tablet influenced the adoption of the digital skills required to access and use digital services. The two groups of elderly people took part in the smartphone-use course and after the course, which lasted for one month, they were asked to perform the tasks specified in Section 3.1. The time required for a successfully performed task for each of the participants was measured and these data were compared between the two groups. The playing was arranged in the same manner, meaning the same games were offered and the playing was in pairs on the large Lenovo tablet. The entertaining session (with hidden intention) was offered prior to the smartphone-use course. The data collected showed clearly that the group that played the games adopted and demonstrated much better performance skills, as they needed much less time to complete correctly the complex tasks specified in Section 3.1. The first and the fifth tasks presented in Section 1 were simple, and the differences in the efficiency of performing these tasks by the particular learners from both groups did not differ very much. The average timing for the members of both groups was close to 1 min (0.58) for the first task and 0.3 min (0.23) for the fifth task. However, the differences among the timings for tasks no. 2, 3 and 4 were remarkable. The average timing for task 2 was 1.196 min for the group that practiced gaming and 3.471 for the other group that did not play the games; task 3 required 1.178 min for a successful completion by the gaming group and 2.272 min by the control group; and task 4 required 0.492 min for the gaming group and 1.16 min for the control group. This gaming group performed task no.2 three times faster, task no.3 twice as quickly, and the task no. 4 1.4-times faster. The members of the gaming group were interviewed and asked to answer the same questions in the questionnaire as was used in the first experiment. The collected data gave very similar findings and confirmed the positive influence of the game playing on touchscreen tablets for adopting digital skills by older adults. So, the research questions d) and e) received positive answers.

5 Discussion

5.1 General view

The observations of the experiment facilitators and the code study revealed that the majority of the learners adapted easily to the touchscreen technology, regardless of their motor skills. Evidence from the coding also suggests that the 'right' game to be played when the objective of the offered entertainment is the adoption of some digital skills being part of the digital literacy depends on a number of factors, and that perhaps will lead to a game-selection method that will consider the players' attitudes, their skill levels and their relationships with their potential playing partners, as was pointed in the study of Wortley et al., (2017). Most of the participants in the above studies understood the games easily; some of them outperformed the others, especially when playing the second game – the Koala puzzle. All of them were capable of drawing a figure on the tablet and changing the colors. The fact that sometimes several trials were necessary to touch the right place on the screen and perform the right move should not hinder the benefit of the game playing for the adoption of skills (Wang et al. 2011). Some of the problems in the playing observed among the participants might be attributed to the fact that the players with some motor weaknesses seemed to encounter more problems when interacting with the Crossy Road game (see Fig.2), as the game requires fast reactions to push the object on the road without being in a crash. Collaboration among the players, coming both from the partner in the pair or from the group that was giving loud advice about how to act on the tablet, was very noticeable and was supportive. Observations during the sessions suggested that the cognitive load of managing the session sometimes required more than one facilitator. Despite the obvious age-related cognitive and physical changes, all the participants were able to play and to understand the questions in the questionnaire. More research regarding the test criteria, such as the reliability and internal consistency of the study, seems to be necessary in the future, especially when further learning is in place and when the playing is followed by smartphone-use courses (Hill et al. 2015).

The coding of the video clips from the playing sessions revealed the problems that older adults face when they try to use the digital touchscreen technology for

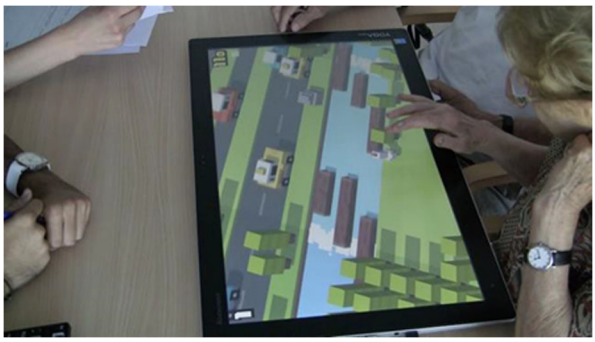


Fig. 2 The Crossy Road game

the first time in their lives. Depending on the problem, the facilitators usually decided first to use explanation, demonstration or instruction as support methods. Questioning as a method for helping people to continue the task was used several times; however, the support provided by the group members was not always correct. This finding points to the need for experienced facilitators to be engaged or a special manual to be developed. This type of problem re-occurred quite often and the facilitator's support and help was sought again, but the majority of the participants did not give up the gaming and they continued to play.

These issues clearly point out that in trying to remove the digital divide for the elderly, more attention should be paid to the preparation of the training session. Facilitators must be educated and prepared to work with the elderly. More information needs to be collected about the needs of older adults and the necessary instructions for how to solve the problems that appear as a result of the poor motor skills and sometimes the lower cognitive capability or visual capacity of the learners (Loos 2017) These findings contribute to the answer to the first research question. Yes, older adults need additional attention in preparing the environment and in terms of support during the educational sessions dedicated to the adoption of digital skills.

The interviews with the participants in both parts of the experiment showed that the acceptance of new digital systems is not problematic for older adults. However, there were obstacles when an explanation for how to handle some game hint or looking for a solution to some task on the smartphone was not immediately provided to the players by the support team. The coding of the video tapes revealed these problems. Social influence was welcomed, but it was expected to be positive and helpful in the training. The completion of the game also appeared to be more important for older people than the provision of low effort, as was also found by Al Mahmud et al. (2008). These findings give a positive answer to the second research question: In our experiments, older adults showed positive emotions towards the gaming.

The answers to the questions in the questionnaire further confirmed the findings from the videotape analysis. In general, the entire experiment was assessed by the participants as a very positive experience. The charts in Appendix 2 provide the comparison of the data collected from the questionnaires and they show that the older adults from the countries studied have very common and similar attitudes towards new challenges and the possibility to learn through gaming and having fun as no large differences were found. The results from the second-phase experiment gave positive answers to the research questions d) and e). The more efficient performance of the tasks displayed by the members of the gaming group clearly showed that playing games could be a very useful tool in facilitating the training of digital skills for older adults learning to use a touchscreen device like a smartphone. Fun experiences during game playing clearly help with quicker and more successful, relaxed learning of digital device use, which leads to faster skills adoption as well. The reported fun when playing games contributes to the development of positive emotions with respect to digital technology by the elderly as this approach helps to remove their fear of not

being able to participate in modern society and thereby contributes to the removal of the digital divide.

5.2 Limitations of the study

The presented study has some limitations and the source of this is the selection and the number of participants. It was envisaged that the number of participants from each country should be 60, which would make a total of 240 people. However, the final number was lower due to difficulties in attracting participants by the focus group that carried out the experiments. Another limitation was the social status of the participants and the level of education, which was not questioned with any depth. The only request followed during the selection was the lack of any experience of working with computers or similar technology by each participant.

6 Concluding remarks

Demographic ageing is an important trend in most developed countries. It has implications for public and private organizations as the growing numbers of elderly people are left behind in the process of the digitalization of society that is taking place in Europe and worldwide. Several researchers have reported (Niehaves and Plattfaut 2013) that the elderly have different attitudes, beliefs and intentions when it comes to digital technology usage, which is manifested as fear and a refusal to use it. Other research in the area (Hill et al. 2015) pointed out that digital technology is a life facilitator for the elderly, by enabling them to overcome physical barriers, such as distance, personal mobility, social contacts and general well-being. All these challenging life factors can be addressed through the use of digital technology, which can change the position of elderly people with respect to the digital divide.

This paper has shown that playing games on a touchscreen tablet can help in overcoming these problems. The big difference compared to the conventional teaching of digital inclusion is that games on touchscreen tablets can be very appealing, entertaining and incredibly easy to learn. In the case of the training of older adults, tablets and games need to be accommodated to meet the elderly's specific needs. In fact, the easier and more familiar they are with the devices, the better it is for the elderly learner to begin with their use. The rules for learning these types of games are not the rules of the game itself or the rules for winning the game, but the rules for how to interact with a digital device. As Khostavi et al. (2016) found only a limited number of studies have assessed the effectiveness of new technologies on the social inclusion of the elderly and most of the known studies used small sample sizes, suggesting more research is needed in this area. Therefore, future studies should develop models and guidelines that consider the elderly user contextually and his/her individual characteristics/capabilities. Future research is also expected to create tailor-made games that will help older learners to overcome their lack of confidence and the feeling that the use of touchscreen devices is risky and complicated.

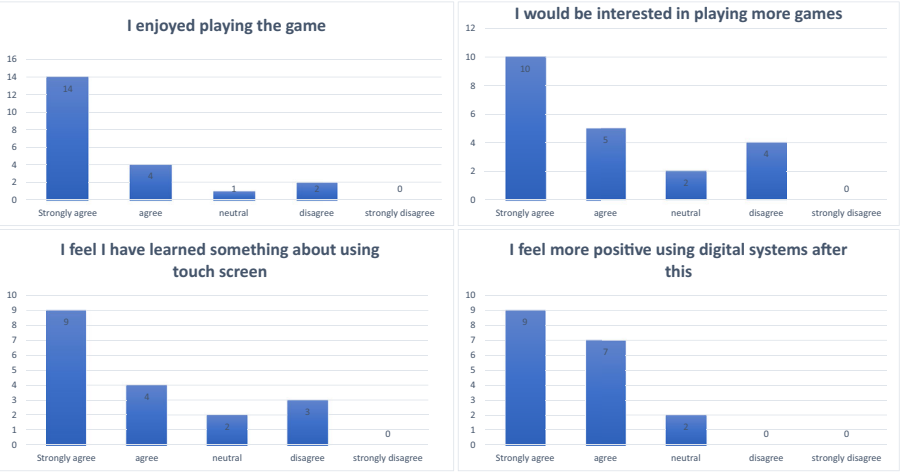
Appendix 1

Table 2 Coding sample from the drawing-game video tape in the Slovenian study

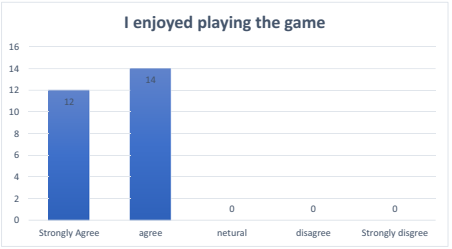
Issue/problems	Frequency	Description
Methods of motor control	2	Most of the learners used the index finger of the right hand for drawing and tapping. *Learner switches between the index finger of the right hand and the thumb of the left hand (06_720,00:06:48)*
Failure of motor control	3	Problems appeared in color changes as the learners did not use the exact button on the Lenovo tablet. Swiping the toolbar was not possible. *Learner tries to swipe but can't activate the button (12_710, 00:03:02) (10_720, 00:05:01),* • Tapping not exact enough. *Learner wants to choose a color but does not tap exactly enough so it does not work (10_700, 00:05:11)* • Using fingernails for drawing *Learner uses the fingernail for drawing; no results were produced (10_710, 00:03:16)*
Errors	2	This issue is triggered for different reasons, which are all related to the use of the tablet:

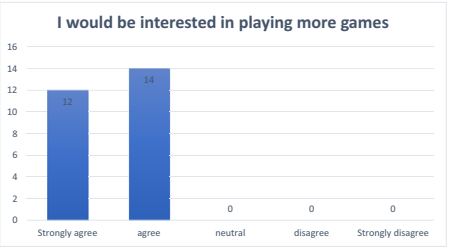
Data from the post-experiment questionnaire

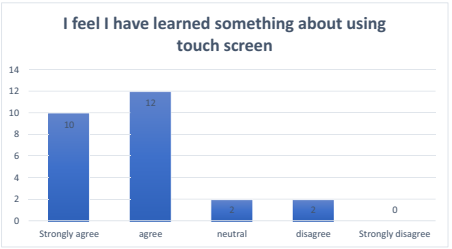
Austria data (the first two tables are from S. Oppl and C. Stary paper in Universal Access in the Information Society https://doi.org/10.1007/s10209-018-0638-0v).

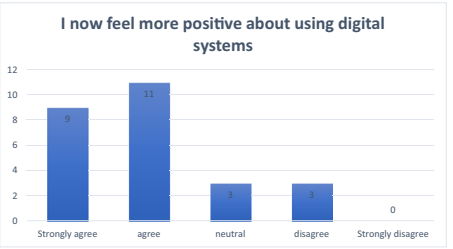


United Kingdom Data (the data a from the questionnaires answers in the project GIRDA Freedcam portal).

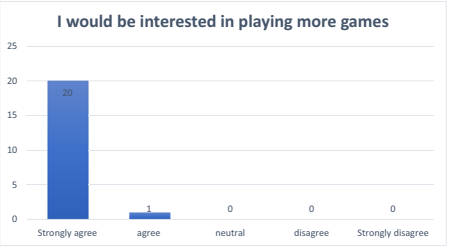


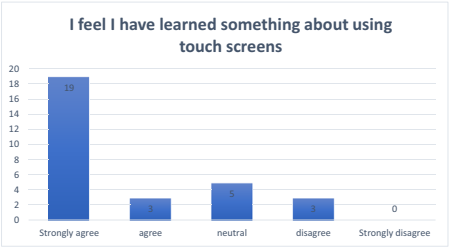


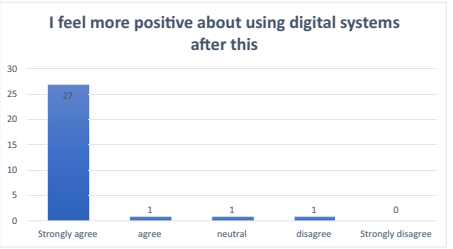




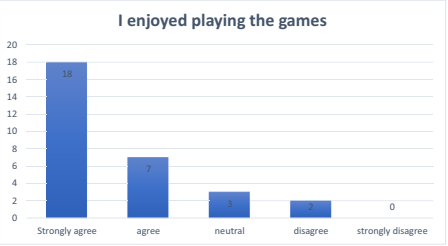
Macedonia data (the data from the questionnaires answers in the project GIRDA Freedcam portal**).**

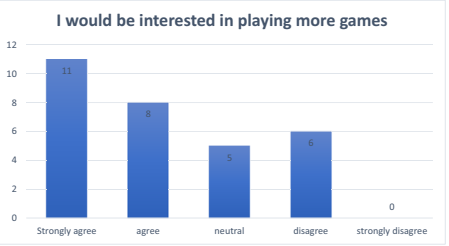


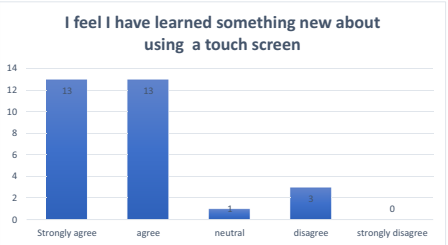


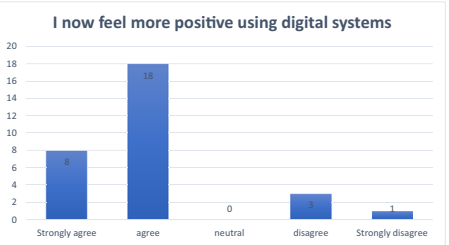


Slovenia data (the data from the questionnaires answers in the project GIRDA Freedcam portal**).**









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