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## Personalized interactive multimedia systems to support meaningful activities in dementia care: A systematic review To be published in: Archives of Gerontology and Geriatrics

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### HIGHLIGHTS

- Personalizing these technologies can convey the narratives of people with dementia.
- Family involvement in personalization aids both care staff and dementia patients.
- Assess caregivers' needs before implementing technology-based interventions.
- Training, support, and integration of multimedia tools should be sensitive.
- Evaluate social benefits and caregiver burden to measure intervention efficacy.

### ARTICLE INFO

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Dementia  
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Meaningful activities  
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### ABSTRACT

**Background and Objectives:** Interactive multimedia systems are widely used to enhance participation in meaningful activities for older people living with dementia. This review aims to analyze and synthesize current evidence regarding personalization of these systems, by considering the type of content included, the selection process and the experience of people living with dementia when interacting with the content.

**Materials and Methods:** In accordance with PRISMA guidelines (PROSPERO registration number blinded for review), a systematic search was undertaken across 4 databases. Meta-aggregation pooled data for synthesis.

**Results:** A total of 520 articles were identified from searches in four databases, and 15 were included in this review. Two classes of content were identified: personal, often autobiographical; and curated, carefully chosen generic content appropriate for a wider group of people in the demographic. Variety of content can act as a trigger for autobiographical memories. Personalized music enhanced a desire to engage and prompted meaningful interactions among participants.

**Discussion and Implications:** Despite some differences in the selected studies, the findings enabled us outline key points to consider when personalizing interactive multimedia systems for people living with dementia. Further research should focus on studying the social condition of the target users during the personalization process and on the benefits for caregivers.

### 1. Introduction

Dementia has been declared a public health priority by the World Health Organization (WHO) due to its global socioeconomic impact. Dementia is a leading cause of mortality and morbidity, particularly in

Western countries (WHO, 2012). People living with dementia are physically, psychologically, socially, and economically affected, as are their primary caregivers, families, and society at large (WHO, 2012). The ability of people living with dementia to communicate is affected from an early stage and is related to a progressive decline in cognitive

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ability (Banovic et al., 2018). Impaired communication can trigger problematic behaviors that contribute to increased workload and emotional stress for caregivers, impacting the quality of care received. This leads to conflicts such as social isolation, depression in one or both parties, stress for the caregiver, increased behavioral and psychological symptoms (BPCD) and risk of early institutionalization (Savundranayagam et al., 2005). As there is yet no cure for dementia, interventions focus on controlling and reducing BPCD. In recent years there has been an increased interest in non-pharmacological interventions due to the associated benefits, considering that pharmacological therapies have secondary consequences (Johnston & Narayanasamy, 2016). These interventions mainly consider (1) the active participation of people living with dementia, (2) the inclusion of content related to their interests, and (3) the basic psychological needs of identity and belonging (Genoe & Dupuis, 2014).

Multimedia technologies are widely used to improve participation in meaningful activities by people with dementia, particularly in nursing homes (Neal et al., 2020). These systems allow the coordinated storage, processing, transmission, and retrieval of multiple forms of information (audio, still and/or animated images, text, hypertext and video) through desktop computers or mobile terminals, tablets and other portable devices (Bhatnagar, 2002). If the user can control which (and when) elements are displayed, the system is referred to as interactive multimedia. In this case, communication is bidirectional - between the sender and receiver - and will be configured by the level of interactivity of the system, dynamic personalization and adaptability to users. In recent years, the development and application of these systems in dementia-related psychosocial care has increased. Many of these interactive multimedia technologies are derived from the Computer Interactive Reminiscence and Conversation Aid (CIRCA) (Gowans & Campbell, 2004), which was developed by researchers at the Universities of Dundee and St Andrews in Scotland and has been shown to support reminiscence therapy, encourage verbal and non-verbal communication and stimulate conversation between people living with dementia and their carers.

Tom Kitwood's Model of Personhood has profoundly influenced contemporary approaches to dementia care, arguing that dementia care should go beyond clinical symptoms and consider the emotional, psychological, and social dimensions of the person (Kitwood, 1997). Moreover, Baldwin ((2008)) also called for the development of services that encourage opportunities for expression and co-construction of narrative in care institutions, as the role of others has been well established in maintaining a sense of identity amongst people living with dementia. Particularly, studies of digital life books suggest that they can encourage the delivery of person-centered care and improve quality of life in people with dementia; even in later stages of dementia, digital story apps can help to support a sense of self-identity and empowerment amongst individuals (Goodall et al., 2021).

For these systems to have an impact on well-being, people must be able to interact with them and be willing to do so on a voluntary basis. In people living with dementia, cognitive difficulties can further affect both their ability to interact with the technology and their motivation to remain engaged in the activity (Fabricatore et al., 2019). Platforms including multimedia have evolved from systems that only display screen-based information to alternative routes, such as visualization through light, projection, and soundscapes; however, inadequate design and poor facilitation of many of these systems leads to a failure to address specific needs and preferences of the users (Toohlen et al., 2020). Due to age-related challenges, designs must provide, among other features, sufficient auditory amplification, screen illumination and high visual detail (Nayer & Coxon, 2020). There are also some possible challenges related to the type of material used and the associated dynamics, including sensory overstimulation (Goodall et al., 2020) and susceptibility to negative affect in people with depression tendencies (Garrido et al., 2018). The Good Practice Guide of the Interdisciplinary Network for Dementia Using Current Technology (INDUCT) group

points out that care should be taken not to generate negative impacts on family members, who often must act as assistants in the use of technology and as informants (Dröes et al., 2020). In this regard, a recent review on technologies to enhance participation in meaningful activities highlighted that the personalization process requires additional dedication on the part of caregivers, which often makes implementation difficult (Goodall et al., 2020).

Since the socio-environmental changes due to the COVID-19 pandemic (mandatory confinement, preventive social distancing) multimedia technologies have been highlighted as tools with renewed potential for dementia care, particularly to support social and leisure activities (Cagnin et al., 2020; Simonetti et al., 2020). Nevertheless, no studies have yet focused only on the personalization of interactive multimedia systems. This study systematically reviews data on personalizing interactive multimedia systems to support meaningful activities in dementia. To further explore the findings, the review will consider the following research questions: (a) What type of content is included? (b) How is it selected? and (c) What is the experience of people living with dementia when interacting with the content? (d) What is the acceptance of these technologies by people living with dementia? Additionally, this study analyzes various facilitators and barriers to the implementation of these technologies.

## 2. Materials and methods

### 2.1. Protocol and registration

This systematic review was conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Knobloch et al., 2011). A review protocol was published with PROSPERO (registration number blinded for review).

### 2.2. Eligibility criteria

The Population, Phenomena of Interest, Context (PICO) (Lockwood et al., 2015) framework was applied, as there was no specific outcome or comparator to be considered.

- Target population: older adult (age  $\geq$  65 years) with a diagnosis of dementia.
- Phenomenon of interest: implementation of personalized, interactive multimedia systems aimed at use by people living with dementia to support meaningful activities in dementia care. The review aims to focus specifically on interactive multimedia systems involving devices such as tablets, touch screens, and custom multimedia applications. The exclusion of technologies such as virtual reality (VR) or serious games was justified as involving immersive environments, often requiring specialized equipment and more complex rules and objectives.
- Context: institutions such as nursing homes, day-care centers, social clubs and community centers, and community-dwelling people living with dementia.

Studies were included if they met all of the following criteria: (a) uses an interactive multimedia system designed or adapted for people with dementia, (b) describes how the content is personalized, (c) reports on outcomes related to the well-being of the person with dementia.

Studies were excluded if they met any of the following criteria: (a) the technology is used by the caregiver, without the active participation of the person with dementia in any of the stages; (b) reports only on the well-being of caregivers, (c) reports on the technology rather than on the person with dementia; (d) involved VR or serious games.

### 2.3. Search strategy

The search was conducted in the Scopus (Elsevier), MEDLINE

(EBSCOhost), PsycINFO (EBSCOhost) and CINAHL (EBSCOhost) databases. A combination of Boolean operators and truncation was used (see Supplementary Material for the complete search strategy).

To focus on more recent technologies, it was deemed appropriate to limit the results to those published in 2011 or later. Case studies, observational studies, randomized clinical trials, quasi-experimental designs, questionnaires, and focus groups were selected according to the inclusion criteria, whether quantitative, qualitative, or mixed research. Reviews, letters to the editor, conference or symposium abstracts, editorial material, book chapters and corrections were excluded from the review. Only studies published in peer-reviewed journals and written in English or Spanish were considered. The database search was conducted in November 2021.

#### 2.4. Selection process

After duplicates were removed, the articles underwent an initial screening process. This consisted of screening titles and abstracts for the inclusion and exclusion criteria. The articles included were then further assessed for eligibility, which involved reading each article in full. Co-authors independently checked the final selection of articles against the inclusion and exclusion criteria. There were no discrepancies, and therefore the final selection of articles was approved by all authors.

#### 2.5. Data extraction

The data-charting form was developed by one author and assessed by another to determine which variables to extract. The first author extracted the general details of studies: target population, phenomena of interest, context, technology, type of intervention and main outcomes. A second member of the review team reviewed each completed form. This analysis considered reports on (1) the type of content included, (2) the selection process, (3) the experience interacting with each content. It also considered reports on the experience and acceptance of these technologies by older adults living with dementia.

#### 2.6. Risk of bias assessment

The risk of bias (quality) in studies was assessed using the Mixed Methods Appraisal Tool (MMAT), a checklist developed to provide a quality appraisal tool for quantitative, qualitative, and mixed methods studies included in systematic mixed studies reviews (Pluye & Hong, 2014). For each study, the risk of bias was assessed by the first author and another member of the review team (N.D.), based on instrument guidelines.

#### 2.7. Synthesis methods

The Enhancing transparency in reporting the synthesis of qualitative research (ENTREQ) (Tong et al., 2012) statement was used to summarize the findings (Page et al., 2021). This methodology is based on meta-aggregation (Lockwood et al., 2015). Studies were eligible for summary if they reported findings on any of the items mentioned. Data synthesis consisted of the following steps: (a) Verbatim extraction of themes / findings from all included studies with an accompanying illustration and allocated level of plausibility for each finding; (b) Development of categories of findings with at least two findings per category; and (c) Development of one or more synthesized findings of at least two categories.

### 3. Results

#### 3.1. Study selection

The initial search returned 520 articles: 277 from Scopus, 127 from MEDLINE, 58 from PsychInfo and 58 from CINAHL. After eliminating

146 duplicates of the initially identified records, the remaining 374 records were analyzed by title and abstract, and 75 studies remained potentially relevant. Of these studies, 60 were excluded considering the previously established criteria. Finally, the review process resulted in the inclusion of a total of 15 articles. An overview of the study selection process is shown in Fig. 1.

A total of 1455 participants with dementia were included in these studies. The average age was 80.0 years (4.9 SD). The severity of dementia varied across the studies and included mild, mild-moderate and moderate levels. Most of the studies did not clarify the etiological subtype. Only four studies specified that the subjects were people with AD (Hultgren et al., 2016; Ladly & Chadha, 2020; Park et al., 2017) and with AD or vascular dementia (Toohlen et al., 2020). An overview of study characteristics is given in Table 1, which summarizes the study design, context, participant information, multimedia technology, measures, and main findings.

Data quality was assessed by the MMAT (Pluye & Hong, 2014), and the scores for the publications ranged from 50 to 100% (mean [SD] = 88.3 [15.6]) (see Supplementary Material for details of quality assessment for each study). Of the 15 studies included in the review, 10 fully met the MMAT criteria, and 4 met 75 % of the criteria. Only one study met 50 % of the MMAT criteria (Davison et al., 2016). However, including this study offers a broader understanding of the current research landscape.

#### 3.2. Results of synthesis

The synthesis was presented as a progression of data concentration from larger number of findings to decreasing numbers of categories and synthesized findings (See Supplementary Material for Complete Synthesis). We describe the synthesized findings in detail below.

##### 3.2.1. What type of content is included?

Studies included in this review refer two classes of content: (1) personal, often autobiographical, based on interests and history, and (2) curated, carefully chosen generic content appropriate for a wider group of people in the particular demographic.

Eight studies included only personal content (Critten and Kucirkova, 2019; Davison et al., 2016; Goodall et al., 2021; Ladly & Chadha, 2020; Laird et al., 2018; Park et al., 2017; Ryan et al., 2020). The selected material included photographs, movies, favorite music and audio recordings or audio messages from family members. Four of these studies involved access to the Internet to find external material (Critten and Kucirkova, 2019; Park et al., 2017; Ryan et al., 2020; Samuelsson & Ekström, 2019). The camera incorporated in mobile devices made it possible to take pictures and add records from the current experience. Likewise, the embedded audio-recorder facilitated building a convenient register of participants' reminiscences and inclusion of their voices (Critten and Kucirkova, 2019).

Four studies involved only curated content (Samuelsson & Ekström, 2019; Samuelsson et al., 2021; Gilson et al., 2019; Hultgren et al., 2016; O'Sullivan et al., 2022). Samuelsson et al. (2021) selected the CIRCA (Gowans & Campbell, 2004), an app containing generic material that could potentially be of interest to participants. Hultgren et al. (2016) designed an interactive multimedia book including a theme considered a collective memory of a generation. Two studies focused on a tablet-based intervention with pre-existing apps for people living with dementia, which were selected in accordance with personal history and lifestyle (Gilson et al., 2019) and through a participatory and iterative framework including several pre-tests (O'Sullivan et al., 2022).

Three studies combined personal and curated contents (Hicks et al., 2020; Toohlen et al., 2020; Yu et al., 2019). Hicks et al. (2020) combined gaming technologies, based on each participant's interests and preferences, with songs and photographs that were meaningful to them. Yu et al. (2019) implemented Memory Matter, a matching game with images from 1930s to 1960s, with which games or slide shows can be

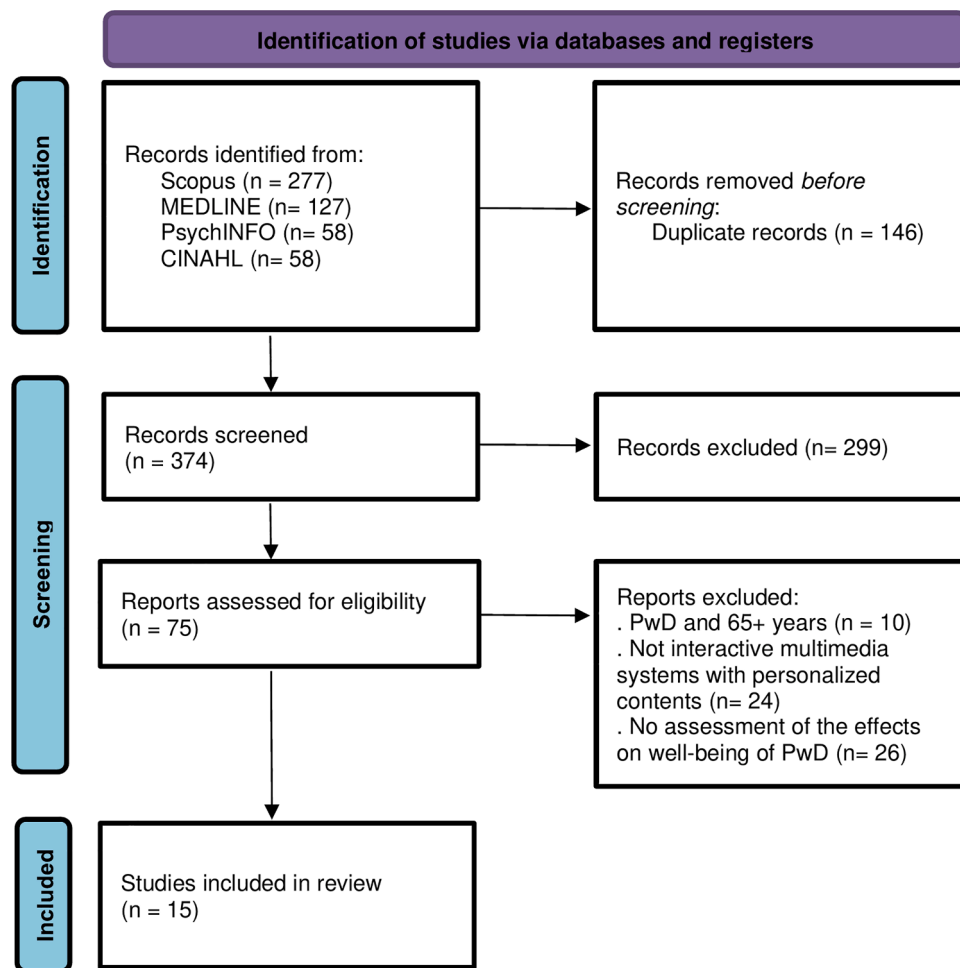


Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram showing the pathway used in the review.

created using personal and family photos. Toohlen et al. (2020) designed and implemented AmbientEcho, an interactive system that offers personal and curated media through different types of interactions.

Finally, Samuelsson and Ekström (2019) implemented two web-based applications which included different types of material: the previously mentioned CIRCA and the Computer Interactive Reminiscence and Communication University of Sheffield (CIRCUS). While both applications are specifically designed to support interaction involving people with dementia, they differ regarding the type of material provided. While CIRCA contains curated material, CIRCUS is designed for inclusion of the user’s own material.

### 3.2.2. How is the content selected?

Research groups used participatory methods to select the multimedia content. This implied an active intervention in decision-making by one or more of the participants: people living with dementia, professional caregivers, family members and researchers. While curated content was selected by researchers in accordance with collective interests based on literature or prior tests, personal content was mainly sourced from the person with dementia and their family members who were given support in creating short digital video messages.

Interviews were conducted to gather baseline data about the participants’ use of technology, storytelling practices and other pertinent information. Training sessions were provided to help carers to gather personal information and upload the material to the platforms. O’Sullivan et al. (2022) counted on trained staff members to guide participants throughout each technology-based intervention session and helped whenever needed. An uploading function was used to personalize

the content, which allowed the users to include their own personalized media (Ladly & Chadha, 2020; Laird et al., 2018; Samuelsson & Ekström, 2019). This feature enabled dyads - people living with dementia and their carers - to upload their photos, videos, and audios.

### 3.2.3. What is the experience of interacting with each content?

Personalized music enhanced the desire to engage and prompted meaningful interactions among participants. The participants felt like dancing or singing when they heard a song or watched a video in the application (Ladly & Chadha, 2020). Even when their memory was notably impaired, people living with dementia still managed to engage with the music (Goodall et al., 2021). It prompted meaningful interactions between caregivers and participants with dementia. The caregivers also experienced strong emotional experiences, particularly in response to seeing the person with dementia singing (Goodall et al., 2021).

Images and videos from the past were also preferred among participants with dementia. Photographs of family members, family holidays, and early life together were particularly special to them (Critten and Kucirkova, 2019; Ryan et al., 2020). People with dementia recall childhood memories (Samuelsson & Ekström, 2019), often adding a new meaning when being recollected in the present (Goodall et al., 2021). However, a mixture of emotions was attached, connected with nostalgia and a sense of loss (Goodall et al., 2021; Samuelsson & Ekström, 2019; Ryan et al., 2020), sometimes related to their current situation (Thoolen et al., 2020).

Curated content acted as a trigger to autobiographical memories, a positive moment of self-recognition. Curated images, sounds, and music

**Table 1**  
Study characteristics.

Author	Study design	Context	Participants with dementia				Multimedia technology	Measures	Findings
			N	Mean age	Type	Severity			
Critten and Kucirkova (2019)	Qualitative case study	Dementia club / Home	3	83.3	–	Mild to moderate	Our Story. iPad app for creation of personalized multimedia stories.	Semi-structured interviews, field notes, and observations.	The app made it easy to retrieve, store and share special memories. It favored positive feelings: confidence, empowerment and increased self-esteem.
Davison et al. (2016)	Randomized single-blinded cross-over study	Nursing home	11	86	–	Mild to severe	Memory Box. Computer with simplified interface to help people with dementia access material independently. Designed for people with dementia.	Self-reported measures, questionnaires, interviews, observations.	Significant reduction in depression and anxiety scores. No significant change in agitation scores.
Gilson et al. (2019)	Non-randomized pilot trial	Nursing facilities and in-home	1089	–	–	Nursing facilities and in-home	Software apps available in the public domain.	5-question survey, visual analogue mood scale (VAMS)	The intervention improved in mood in older adults and enhanced caregiver perceptions about their care recipient interactions.
Goodall et al. (2021)	Qualitative interview study	Long-term residential care	12	84	Various	Moderate-severe	SENSE-GARDEN. Room that combines immersive technologies, digital media and multi-sensory stimuli. Designed for people with dementia.	Semi-structured interviews.	SENSE-GARDEN can stimulate emotional experiences, help preserve narrative identity and foster interpersonal relationships between people living with dementia and their caregivers.
Hicks et al. (2020)	Exploratory/ Descriptive study	Social club in the rural area	22	Over 65	–	–	Individual tailored computer game technology (e.g. iPad, Nintendo Wii and Microsoft Kinect).	Video interviews, observations, and records.	Maximized cultural capital, providing enabling activities in non-threatening settings and using empowering approaches.
Hultgren et al. (2016)	Qualitative case study	Nursing home	8	Over 80	AD, mean MMSE	–	Interactive multimedia book. Designed for people with dementia.	Audio recordings and observations.	Acted as a favourable medium for reminiscence therapy and motivating communication between caregivers and people living with dementia.
Ladly and Chadha (2020)	Qualitative two-stage study design	Nursing home	4	74	AD, mean MMSE	Early-stage dementia (ESD)	Postcard Memories. Web-based, virtual memory-sharing mobile application. Designed for people with dementia.	Audio recordings and observations.	Self-confidence of the people living with dementia increased regarding the use of new technologies and favoured the quality of the relationship with family members.
Laird et al. (2018)	Quasi-experimental feasibility study	Home	30	79	–	Early to moderate	InspireD. iPad app. Designed for people with dementia.	Initial interview and self-reported measurements.	Significantly increased mutuality, quality of carer-patient relationship and subjective well-being.
O'Sullivan et al. (2022)	Cluster-randomized controlled trial	Nursing home	162	85	–	Moderate to severe.	Multi-component tablet-based intervention: comprised seven applications specifically developed for people with dementia.	Apathy Evaluation Scale, Quality of Life in Alzheimer's Disease scale, Neuropsychiatric Inventory, Geriatric Depression Scale, and psychotropic medication (secondary outcomes). Momentary quality of life was assessed before and after each activity session.	Beneficial impact on global and momentary quality of life in nursing home residents with dementia. Although we found no clear advantage of TBI compared to CAS, tablet computers can support delivery of non-pharmacological interventions in nursing

(continued on next page)

Table 1 (continued)

Author	Study design	Context	Participants with dementia				Multimedia technology	Measures	Findings
			N	Mean age	Type	Severity			
Park et al. (2017)	Multi-site case study design	living in the community	8	–	–	Early-stage dementia (ESD)	WeVideo, free online program for iOS and Android.	Observational field notes and audio recorded workshop sessions and interviews	homes and facilitate regular assessment of fluctuating momentary states. Findings showed that overall participants enjoyed the process of creating digital stories, despite some challenges with communication, memory and using technology.
Ryan et al. (2020)	Qualitative study	Home-based	15	78	–	Mild-moderate	InspireD.	Semi-structured interviews, videorecording.	Six themes: usability, revisiting the past, home use; impact on the person with dementia; gains and abilities; impact on relationships.
Samuelsson and Ekström (2019)	Qualitative case study	Home-based	3	–	–	–	CIRCA and CIRCUS. Designed for people with dementia.	Video recordings and semi-structured interviews	CIRCA and CIRCUS support conversation topics, personal photographs in CIRCUS are more engaging.
Samuelsson et al. (2021)	Qualitative study	Residential care home	5	76	–	Mild to severe	CIRCA. Designed for people with dementia.	Interviews, audio recordings, and thematic analysis.	Use of digital communication support may enhance group activities - the group activity seemed more important and beneficial for the participants, than the specific use of the application.
Toohlen et al. (2020)	Qualitative case study	Nursing home	3	77.5	AD, Vascular dementia	Moderate-severe	AmbientEcho. Interactive system that offers media content through different modalities. Designed for people with dementia.	Semi-structured interviews and participant observation	Facilitated the resurgence of identity and stimulated social participation through shared experiences.
Yu et al. (2019)	Pilot randomized controlled trial	–	80	82.1	–	–	Memory Matters (MM), an iPad reminiscence game. Designed for people with dementia.	Initial interview and self-reported measurements.	Improved social interaction and mood.

Note:  
 Symbol “-” indicates not specified.  
 AD: Alzheimer’s Disease.

helped “trigger” autobiographical memories and allowed people with dementia to talk about their memories, even though they may not have had direct experience with the material shown (Huldtgren et al., 2016; Samuelsson et al., 2020; Thoolen et al., 2020). Among curated content, music stood out as a powerful trigger of affective memories (Yu et al., 2019). YouTube was highlighted for having great potential for personalization because of the almost unlimited number of topics available (Gilson et al., 2019).

3.2.4. How do older adults living with dementia accept these technologies?

The experience of interacting with multimedia technologies was positive: pleasant, fun, socially good, engaging, meaningful and comfortable (Critten and Kucirkova, 2019; Hicks et al., 2020; Davison et al., 2016; Ladly & Chadha, 2020; Thoolen et al., 2020; Park et al., 2017; Samuelsson & Ekström, 2019; Yu et al., 2019). Participants felt engaged after seeing the personal content and were also comfortable with the technology (Thoolen et al., 2020). The technology was central in providing novel and meaningful activities as it allowed the participants to express themselves and re-connect with modern society (Hicks

et al., 2020). Some stated that they liked being able to access their stories whenever they wanted (Park et al., 2017).

Participants looked forward to the meetings. Goodall et al. (2021) reported they were willing to participate in the SENSE-GARDEN sessions and engage with the activities inside the space. Park et al. (2017) also highlighted that participants enjoyed the sessions and looked forward to the next meetings. Samuelsson and Ekström (2019) reported that both staff and people with dementia wanted to continue using the applications after the end of the study.

Participants with dementia could use the technology with relative ease, although the experience varied according to different factors. Critten and Kucirkova (2019) found that the process was different for each participant, depending on the stage of their dementia, family circumstances and ability to handle the device independently. Davison et al. (2016) noted that some people with dementia were unable to participate due to cognitive or sensory issues, such as vision problems or difficulty with using screen buttons, although most preferred these to touch screens. Huldtgren et al. (2016) highlighted a diversity of reactions when pressing the buttons to playback sounds: some were

curious and pressed the buttons themselves without any invitation by the caregivers. However, most waited until the caregiver asked them to push another button. Samuelsson et al. (2021) distinguished two categories concerning the degree of difficulty and the learning ability when using the tablet: (1) difficult to use; (2) very easy to use.

The presence of another person enhanced participation. Lady and Chadha (2020) highlighted that one of the most outstanding features was organizing postcards cooperatively within the application, having lively discussions and participating in memory-sharing activities. Yu et al. (2019) stated that technology alone was not enough to motivate people with dementia to take the initiative to use it: the presence of another person was essential for participation. Other studies highlighted that although participants with dementia found the tablets difficult to use, they could engage and enjoy the activity due to the social nature and group belonging (Park et al., 2017; Samuelsson et al., 2021).

### 3.2.5. Implementation factors

Of the selected studies, nine included training sessions: three focused on people living with dementia and five on caregivers. Davison et al. (2016) conducted four 30-minute pre-training sessions using spaced retrieval learning. Laird et al. (2018) offered three sessions for autonomous content upload and app use. Ryan et al. (2020) included reminiscence and IT training without specific details.

For caregivers, Goodall et al. (2021) provided week-long training on information gathering, user profiles, media upload, content workflow design, and immersive environment control. Gilson et al. (2019) trained caregivers to select activities based on personal history and lifestyle for engaging multisensory tablet activities. O'Sullivan et al. (2022) trained staff to use tablets for participant activities. Yu et al. (2019) provided training following the study protocol. Samuelsson and Ekström (2019) gave basic tablet and application instructions.

Laird et al. (2018) also supplied face-to-face IT training in participants' homes. Some studies reported ongoing support: Critten and Kucirkova (2019) assisted in creating digital narratives, and Park et al. (2017) provided close facilitator support.

Device placement varied: Davison et al. (2016) used MemoryBox in bedrooms for privacy, Hicks et al. (2020) placed devices for interaction, and Toohlen et al. (2020) installed AmbientEcho in semi-open spaces for accessibility.

Hicks et al. (2020) addressed stigmas associated with age and dementia and the difficulties this brings regarding the use of technologies. At the suggestion of some of the participants, the word 'technology' was removed from the brochures disseminating the activity and replaced with terms such as 'devices' or 'artifacts' (gadgets). Additionally, they referred to the proposal as "social clubs" instead of "ICT workshops" to highlight the opportunity for social interaction.

Cost details were scarce. Davison et al. (2016) noted high initial costs for MemoryBox prototypes (\$12,000 for four units) with potential reductions through mass production. Laird et al. (2018) estimated their intervention cost at £2570 per dyad. Goodall et al. (2021) highlighted the need for evaluating cost-effectiveness, sustainability, and scalability, citing practical challenges like staff time constraints. Yu et al. (2019) mentioned increased costs due to travel and coordination, leading to funding shortfalls. O'Sullivan et al. (2022) noted that ICT devices, while potentially reducing staff workload, were underutilized due to high staff turnover and resource limitations.

## 4. Discussion

The results of this review study indicate that the personalization of interactive multimedia systems for people living with dementia is a currently developing field. Despite some differences between the studies included, the synthesis of results enables us to outline some key points to consider when personalizing multimedia technologies for people living with dementia.

### 4.1. Type of content

Some variations in criteria for selecting the type of content to include, whether personal, curated or a combination of both, were identified. The following criteria stand out: (1) offering the opportunity to choose the most appropriate material to stimulate social interaction, (2) favoring the evocation of personal memories and conversation topics beyond the fear of possible forgetfulness or not recognizing the familiarity of faces or places and (3) offering an alternative for those who do not have autobiographical material. This aligns with Kitwood's Model of Personhood, which emphasizes maintaining social relationships and recognizing individual histories. Furthermore, features like the embedded camera and audio recorder allowed incorporation of content related to the present and updating memories by combining material from the past with current stories or photographs, which stimulated conversations and promoted interpersonal relationships. Align with Kitwood's Model, this could be a way to preserve and maintain personhood, understood as "a standing or status that is bestowed upon one human being by others in the context of particular social relationships and institutional arrangements" (Kitwood, 1997, p.7).

### 4.2. Selection process

Most of the content was selected in collaboration with people living with dementia. Participants with dementia and their family members were the principal sources of information. The presence of another person was essential for people living with dementia, not just to participate but to enjoy the moment, act upon an objective cooperatively, have lively discussions and participate in memory-sharing activities. This collaboration content relevance and fosters social connections and shared experiences, crucial in Kitwood's Model. Personalization let carers reconnect via storytelling, respecting each person's experiences (Berendonk et al., 2017).

Internet was a key source of content when the person with dementia has no photos, videos or personal multimedia content. This was key when no family members provided content, or in cases when they may not have any available. In this regard, it would be interesting to work collaboratively with local museums, libraries, and neighborhood centers, which may have more relevant, specific material. Thus, the social participation of people living with dementia could be promoted while making the population aware of the implications of dementia as a condition and how to collaborate with those affected. It could also allow their stories to be valued as a legacy for the community's historical memory. In this regard, it is worth highlighting the usefulness of the ecopsychosocial approach as a theoretical framework (Zeisel et al., 2016), cited by Hicks et al. (2020), as this considers the centrality of the use of local and community resources to favor active participation in the space of belonging.

### 4.3. Experience of interacting

The reported experience of interacting with multimedia content indicates that music is one of the most valued materials. Music acted as a powerful trigger for affective memories, enhanced the desire to engage and prompted meaningful interactions among participants. The act of group singing provided a sense of togetherness and group cohesion. Lady and Chadha (2020) observed that "participants felt like dancing or singing when they heard a song or watched a video within the application" (p. 111). It is worth noting that the results are consistent with those of previous studies on how music can trigger autobiographical memories with emotional content, most belonging to the field of music therapy research (Cady et al., 2008; Clements-Cortes & Bartel, 2018; Kelly & Ahessy, 2021). The findings also suggest that although people with dementia prefer images and videos from the past, these may lead to nostalgia and a sense of loss. Nevertheless, after the first encounter, the interaction with the memorabilia allowed reconnection with the person

with dementia, and feelings behind the pain were addressed. In line with the findings of Goodall et al. (2021), the outcomes of this analysis suggest that personalized multimedia technologies enable renewal of narratives, as triggered memories can be reflected upon in the present moment, loaded with new meanings.

#### 4.4. Acceptance of the technology

Regarding acceptance of the technology, participants reported feelings of confidence, empowerment, and increased self-esteem. Findings indicate that the social dimension of the intervention was one of the most appreciated by the participants with dementia. Cooperation allowed participants with dementia to enjoy the use of technologies: despite difficulties in using devices, they were able to participate and enjoy the activity due to its social nature and group membership. The associated benefits are improved mood and quality of relationships and strengthening of sense of identity. As well as taking personal preferences into account, interventions involving interactive multimedia technology should consider mental health history, specific symptoms, previously evaluating the implementation spaces - standards, resources, practices - and the present needs of family and professional caregivers. Indeed, favorable results are associated with previous adaptation of devices according to the individual and contextual characteristics (Davison et al., 2016; Toohlen et al., 2020; Goodall et al., 2021). Tangible technologies emerged as promising for people with dementia (Huldtgren et al., 2016). These include, for example, packaging collections of narratives as physical memories or augmented technologies that allow linking and reproducing multimedia assets from photographs and printed photo albums. Immersive environments also favored integration. The potential of this type of system lies in the possibility of combining multimedia and sensory modalities (Goodall et al., 2021; Toohlen et al., 2020). The potential of these technologies in terms of usability remains unexplored, especially considering that they allow combining a variety of familiar and analogue formats with the storage capacity and suitability of current digital technologies. Design of the systems should take sociocultural identity in a broad sense into account: values, traditions, symbols, beliefs and ways of relating to other people and with others.

#### 4.5. Implementation factors

The implementation of multimedia technologies in dementia care presents a complex interplay of barriers and facilitators.

##### 4.5.1. Training and support

Tailored training programs facilitate effective use. Goodall et al. (2021) and Gilson et al. (2019) showed that comprehensive training helps caregivers gather information, design content, and engage with care recipients. However, training is resource-intensive and challenging to sustain, especially in high-turnover environments (O'Sullivan et al., 2022). Laird et al. (2018) highlighted the personalized nature required for dyads, which can be logistically challenging. Continuous support is crucial for successful implementation.

##### 4.5.2. Placement and contextual integration

Thoughtful device placement and sensitive intervention framing promote acceptance and usability. Hicks et al. (2020) and Toohlen et al. (2020) recommended integrating technology into communal areas to foster social interactions. Reframing terminology to reduce stigma, as suggested by Hicks et al. (2020), enhances acceptance. Davison et al. (2016) used private settings, limiting broader interactions, while communal spaces balance privacy and accessibility. Addressing stigmas is critical for effective implementation.

##### 4.5.3. Costs and resources

High initial costs and resource constraints are significant barriers.

Davison et al. (2016) and Laird et al. (2018) noted substantial costs for prototypes and interventions. Many studies lack detailed cost information, emphasizing the need for cost analyses and sustainable funding (Goodall et al., 2021; O'Sullivan et al., 2022). Large-scale production could reduce costs (Davison et al., 2016). Detailed cost planning and innovative strategies to address staff motivation and time constraints are essential for feasibility and sustainability.

#### 4.6. Limitations

Some limitations of this review must be noted. Firstly, we narrowed our scope to identify common themes and draw more precise conclusions regarding the content, selection process, and user experience with more conventional interactive multimedia systems. These findings may not be applicable to VR and serious games, which involve different factors influencing content creation and user interaction. While narrowing our scope allowed us to draw more precise conclusions, it limits the applicability to these excluded technologies. Nevertheless, we acknowledge their potential relevance. Additionally, the rapidly advancing multimedia landscape suggests that some of the included studies may already be outdated, potentially excluding newer technologies that provide enhanced outcomes for people living with dementia.

Notably, 33 % of the articles included in this study did not meet 100 % of the MMAT quality criteria. However, we deemed it important to include them to identify aspects that could be of interest for future research on system customization of interactive multimedia for people with dementia. Consequently, our conclusions should be considered as a suggested guide rather than definitive or final.

## 5. Conclusions

The review suggests that personalizing interactive multimedia systems is key to successful implementation, aligning with Kitwood's Model of Personhood by focusing on the individual's identity, personality, and social relationships. This personalization helps participants reconnect with loved ones and can also benefit care staff who may have other commitments. Consistent with Goodall et al. (2021), personalizing these technologies can convey the narratives of people with dementia, aiding in narrative identity construction and fostering relationships.

Acceptance of the technology is closely related to its social dimension, but potential difficulties must be addressed in advance. Assessing mental health history, symptoms, spatial characteristics, and the needs of caregivers is crucial. Despite barriers, strategic training, continuous support, sensitive integration, and sustainable funding can facilitate implementation. Clear guidelines and extended familiarization periods should be included in training to address challenges.

Future studies should evaluate the control group's social condition and assess the technology's efficacy in alleviating caregivers' burdens. Research should explore detailed training protocols, cost analyses, and community resource integration to enhance feasibility, sustainability, and person-centeredness. Quantitative analyses are needed to estimate effect sizes and the impact of multimedia interventions, using standardized methodologies to improve clinical efficacy evaluation.

Finally, due to the diversity in intervention types and delivery methods, this review did not assess the overall efficacy or impact of multimedia interventions on clinical outcomes such as cognition and neuropsychiatric symptoms. Additionally, some studies did not clearly report the severity or subtypes of dementia, which may influence engagement and technology usage, thereby limiting the generalizability of the findings. Future research should provide detailed reporting on these factors to better understand their impact on the efficacy and usability of multimedia interventions.

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Ethical approval or informed consent was not required for this systematic review.

### CRedit authorship contribution statement

**Noelia Gerbaudo-González:** Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Raquel Rodríguez-González:** Formal analysis, Methodology, Writing – original draft. **David Facal-Mayo:** Formal analysis, Methodology, Supervision, Validation, Writing – original draft. **Manuel Gandoy-Crego:** Data curation, Formal analysis, Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing.

### Declaration of competing interest

The author(s) declared no potential conflicts of interest regarding the research, authorship and/or publication of this article.

### Supplementary materials

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