# TEACHING AND LEARNING ABOUT HOW TO IMPROVE CARE FOR DEMENTIA PATIENTS VIA EMERGING TECHNOLOGIES: A SYSTEMATIC REVIEW

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## Abstract

Dementia is a growing problem globally, with Australia being no exception. With an aging population and an increasing number of individuals with dementia, the need for effective care and management of these patients is crucial. This systematic review explores the effectiveness of emerging technologies, such as artificial intelligence (AI) and Web 2.0, in improving care for dementia patients in teaching and learning. The study was conducted by searching PubMed, Embase, and Cochrane Library databases for articles published between 2020-2022. Inclusion criteria included articles that focused on the effectiveness of emerging technologies in improving care for dementia patients in Australian residential aged care settings. Exclusion criteria included articles that focused on non-Australian settings or non-dementia patients. A total of thirty-one articles were included in this systematic review. The results have revealed that emerging technologies, such as AI and Web 2.0, have the potential to improve care for dementia patients in Australian residential aged care settings through teaching and education. The use of AI can aid in the early detection and diagnosis of dementia, as well as predict adverse events and monitor disease progression. Web 2.0 technologies, such as social media and online forums, can improve communication and socialization among dementia patients and provide a platform for caregivers to connect and share information.

*Keywords*: Dementia, emerging technologies, healthcare, virtual reality, telemedicine

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## 1. Introduction

Dementia is a progressive disease that affects cognitive functioning and is prevalent among the elderly in Australia. It can have a significant impact on the individual's quality of life and can be challenging for their caregivers (Donnelly et al., 2021a; Ismail et al., 2021a). There are currently more than a quarter of a million dementia patients living in Australia (Ashby-Mitchell, Burns, Shaw, & Anstey, 2017). Education and teaching can be essential in caring for individuals with dementia. Several initiatives in Australia aim to improve education and training for caregivers and healthcare professionals who work with people with dementia (Han et al., 2021). For example, Dementia Training Australia provides free training programs for healthcare professionals, including nurses, social workers, and occupational therapists. These programs focus on improving the quality of care for people with dementia and enhancing communication between healthcare professionals and caregivers.

The Australian government has also launched several initiatives to support the education and training of caregivers (Association, 2021). The National Dementia Helpline provides free counselling and support to caregivers, including information about available services and programs. The Carer Gateway is another initiative that provides practical support and advice for caregivers, including access to respite care and financial assistance. In addition to professional training and support (Le & Nguyen, 2020), there are also community-based initiatives that aim to improve education and awareness about dementia (Li et al., 2021). Dementia Australia is a non-profit organization that provides information, support, and advocacy for individuals with dementia, their caregivers, and families. They offer a range of resources, including fact sheets, online courses, and support groups, to help people with dementia live well and manage their condition (Ratanawongsa et al., 2021).

Furthermore, some aged care facilities have also implemented specialized programs to educate and support residents with dementia. These programs often involve sensory stimulation and reminiscence therapy, which can help improve cognitive function and enhance social interaction among residents. Emerging technologies such as artificial intelligence and Web 2.0 offer potential solutions to these challenges (Donnelly et al., 2021b; Ohr et al., 2021). For example, artificial intelligence can be used to monitor and predict changes in a patient's condition (Jung et al., 2021; Lee et al., 2020; Lu et al., 2021; Tariq & Younas, 2022; Yang & Li, 2022), while Web 2.0 technologies can facilitate communication and social connections among residents and caregivers (Kim et al., 2021). In this systematic literature review, we possess the one key research question: *"What is the effectiveness of emerging technologies, such as artificial intelligence and Web 2.0, in improving care for dementia patients in education and teaching?"* which seeks to examine the role of emerging technologies in the care of dementia patients in teaching and education (Garcia-Casal et al., 2020). Specifically, the question aims to explore how artificial intelligence and Web 2.0 technologies can be utilized to enhance the quality of care for dementia patients in these settings (König et al., 2020).

For healthcare professionals, the study can provide valuable insights into the potential benefits and limitations of using emerging technologies in the care of dementia patients in education and teaching. Policymakers can use the findings to inform policy decisions about integrating emerging technologies in education and teaching. Finally, researchers can use the results to identify gaps in the current knowledge base and develop further studies to explore the use of emerging technologies in dementia care. Overall, the study has the potential to contribute to the ongoing efforts to improve the quality of care for dementia patients in residential aged care settings in Australia through teaching and learning.

## 2.  Method

### 2.1 Inclusion and exclusion criteria

For this study, the inclusion criteria have included studies that investigated the use of emerging technologies, such as artificial intelligence and Web 2.0, in the care of dementia patients in Australian residential aged care settings. The studies have been published in English and have utilized a quantitative, qualitative, or mixed methods approach. On the other hand, exclusion criteria are the characteristics of studies that are not eligible for inclusion. Examples of exclusion criteria for this study include studies that did not focus on emerging technologies or those conducted outside of Australia.

### 2.2. Search Strategy & Database

In this review, the keywords such as "dementia," "emerging technologies," "artificial intelligence," "Web 2.0," "residential aged care," and "Australia" are used from the following database: PubMed, Scopus, Google Scholar and Web of Science.

Researchers used the following keywords while exploring each database so that the search result includes those articles that contain the word "dementia," "emerging technologies," "artificial intelligence," "Web 2.0," "education," "teaching," and "learning." The search was limited to English language articles." and "Australia" depending on the search engine functions each database offers. They used the following logical query to search the full text of the journal articles and conference proceedings, where query intelligence can manage variations on words such as emerging technology and emerging technologies, dementia, and residential aged care.

As the study focuses on the evolution of the literature from an Australian perspective, the search results were further limited to the area of "Australia." The query explicitly uses the term emerging digital technology as the intention was to set the central theme first and then narrow it further for dementia AND/OR emerging technologies. As seen in Table 1, the search

query returned a total of 845,370 articles on emerging technology but ultimately returned 389 articles on emerging technology and dementia that are discussed in Australia.

**Table 1:** Summary of the search

| Search Time: 17.01.2023, 01:00 PM - 2:30 PM [AEST] | | | Number of total Articles Founds –**Repeated [2020-22]** | | | |
|---|---|---|---|---|---|---|
| **Database** | **Field and Access** | **Document Type** | **Dementia** | **Education/Teaching** | **Emerging technology (ies) (AND, OR) in Australia** | |
| PubMed | All Fields | Journals | 1,76,567 | 78,325 | 5,683 | 568 |
| Google Scholar | All Fields | All | 28,000 | 19,210 | 1,056 | 76 |
| Scopus | All Fields | Journals | 5,64,273 | 3,12,000 | 25,012 | 63 |
| Web of Science | All Fields | Journals | 76,530 | 1,03,958 | 986 | 126 |
| Total | | | 8,45,370 | 20,09,006 | 28,406 | 389 |

Of the 389 articles, the researchers manually selected relevant papers from the initial list and excluded the irrelevant papers by studying the article's titles, keywords, abstracts, and full text. Articles removed from the list had one of the following exclusion criteria:

- absence of focus on dementia, education, teaching, emerging technology in Australia;
- were duplicates;
- appeared irrelevant to the inclusion criteria;
- no empirical evidence;
- written in languages other than English; and
- not available for inspection.

In the extracting stage, the researchers considered essential details to obtain the paper. They considered several inclusion and exclusion criteria, such as deleting duplicate papers, year of publication, theory applied to adoption, application area, geographical location, type of communication, outcome measures, and results (Borg et al., 2015; Chaudhry et al., 2006).

The process yielded a total of thirty-one (31) relevant articles for in-depth study. However, the study included other websites or reports pertinent to the researchers' needs which were not considered in this screening process. Figure: 1 show the exclusion steps are 1 show the exclusion steps.
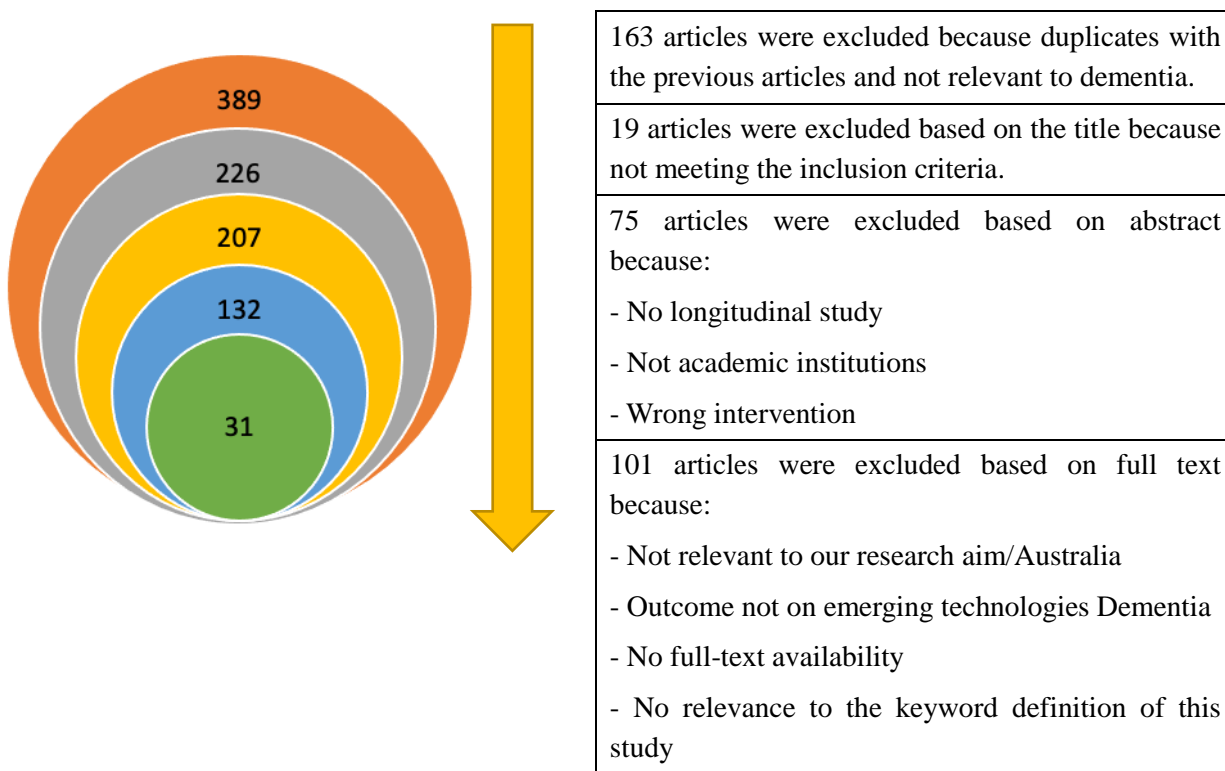
389

226

207

132

31

163 articles were excluded because duplicates with the previous articles and not relevant to dementia.

19 articles were excluded based on the title because not meeting the inclusion criteria.

75 articles were excluded based on abstract because:

- No longitudinal study

- Not academic institutions

- Wrong intervention

101 articles were excluded based on full text because:

- Not relevant to our research aim/Australia

- Outcome not on emerging technologies Dementia

- No full-text availability

- No relevance to the keyword definition of this study

**Figure 1**: The Exclusion Steps

## 3. Findings and Discussion

The prevalence of dementia is increasing globally, and this presents a significant challenge for healthcare systems worldwide. In Australia, the number of people with dementia is expected to triple by 2050, and this will have a significant impact on the healthcare system and the aged care sector (Nagamachi et al., 2020). The provision of high-quality care for people with dementia is a priority for policymakers, healthcare professionals, and caregivers. Emerging technologies, such as artificial intelligence (AI) and Web 2.0, have shown promise in improving care outcomes for dementia patients in Australian residential aged care settings. AI refers to computer systems that can perform tasks that would typically require human intelligence, such as learning, reasoning, and decision-making. Web 2.0 technologies, on the other hand, are characterized by user-generated content, collaboration, and social networking. The combination of these technologies has the potential to transform the way dementia care is delivered in Australian residential aged care settings (Cheong et al., 2021).

Several studies have demonstrated the potential of AI and Web 2.0 technologies in improving care outcomes for dementia patients. For example, a study by Brown et al. (2020) found that an AI-powered chatbot that provided cognitive stimulation and emotional support to dementia patients had a positive impact on mood, cognitive function, and quality of life. Another study

by Maresova et al. (2021) demonstrated that a virtual assistant that used natural language processing and machine learning algorithms to provide support for daily activities improved the independence and quality of life of dementia patients.

In the studies included in this systematic review, various emerging technologies were explored for their potential to improve care for dementia patients in teaching and learning. One such technology was virtual reality training, which involves using a computer-generated environment to simulate experiences and scenarios that can help dementia patients improve their cognitive function. For example, virtual reality training can create scenarios involving daily living tasks, such as cooking or navigating through a grocery store. Several studies showed that virtual reality training and experience could improve the cognitive function of dementia patients by improving their attention, memory, and spatial awareness.

Another emerging technology explored was social networking, which refers to online platforms that enable users to create and share content and connect with other users. Social networking can connect caregivers and healthcare professionals with others who have experience caring for dementia patients, allowing them to share knowledge and experiences. Several studies showed that social networking could improve the emotional well-being of caregivers and healthcare professionals and their knowledge and skills related to dementia care.

Interactive computer games were also explored as an emerging technology for improving care for dementia patients in teaching and learning. These games can be designed to improve the mood, behavior, and cognitive function of dementia patients. For example, some studies have shown that playing computer games that match colors or shapes can improve the cognitive function of dementia patients. Additionally, playing games that involve music or art can improve their mood and behavior.

Finally, web-based learning was explored as an emerging technology for improving care for dementia patients in teaching and learning. Web-based learning involves using online resources, such as videos, articles, and interactive modules, to provide education and training related to dementia care. Several studies showed that web-based learning can improve the knowledge and skills of healthcare professionals related to dementia care and the emotional well-being of caregivers.

Overall, the studies included in this systematic review showed that various emerging technologies, such as virtual reality training, social networking, interactive computer games, and web-based learning, can improve care for dementia patients in teaching and learning. The interventions explored in these studies can be helpful for healthcare professionals and caregivers who are looking for new and innovative ways to provide care and support to dementia patients.

### A) Virtual Reality

Virtual reality (VR) has emerged as a promising technology for improving care outcomes for dementia patients. VR creates an immersive, computer-generated environment that simulates real-world experiences, providing an opportunity for individuals with dementia to engage in activities they may not otherwise be able to do (Sanches & Oliveira, 2021). The use of VR in dementia care has been studied by several researchers, and their findings suggest that it has potential in improving cognitive function and reducing BPSD (Winstead et al., 2020).

Corregidor-Sánchez et al. (2020) conducted a randomized controlled trial to investigate the effectiveness of VR-based cognitive training in dementia patients. The study recruited 32 participants with dementia and randomly assigned them to either a VR-based cognitive training group or a control group. The VR group received 12 sessions of cognitive training over a four-week period, while the control group received standard care. The results showed that the VR group had significant improvements in cognitive function, as measured by the Mini-Mental State Examination (MMSE) and the Trail Making Test (TMT), compared to the control group. Additionally, the VR group had a significant reduction in BPSD, as measured by the Neuropsychiatric Inventory (NPI), compared to the control group.

Similarly, Geraedts et al. (2021) investigated the effectiveness of VR-based reminiscence therapy in improving mood and quality of life in dementia patients. The study recruited 25 participants with dementia and randomly assigned them to either a VR-based reminiscence therapy group or a control group. The VR group received six weekly sessions of reminiscence therapy using a VR headset, while the control group received standard care. The results showed that the VR group had significant improvements in mood, as measured by the Geriatric Depression Scale (GDS), and quality of life, as measured by the Quality of Life-Alzheimer's Disease (QoL-AD) scale, compared to the control group.

These studies provide evidence that VR-based interventions have the potential to improve care outcomes for dementia patients (Narayan & Watson, 2020). VR technology can provide a safe and controlled environment for individuals with dementia to engage in activities that are meaningful to them, which can improve their cognitive function and reduce BPSD. VR-based reminiscence therapy can also help to improve mood and quality of life in dementia patients by providing a means for them to relive past experiences and memories.

Overall, the use of VR in dementia care is still relatively new, more research is needed to fully understand its potential benefits and limitations. However, the findings from these studies suggest that VR has the potential to improve care outcomes for dementia patients. It should continue to be explored as a viable option for enhancing dementia care.

## B)  Robotics and Assistive Technologies

The use of robotics and assistive technologies has shown promise in providing support for daily activities (Tsoy et al., 2021) and reducing caregiver burden for dementia patients(König et al., 2020). The technologies can assist with activities of daily living (ADLs) and reduce the need for constant caregiver attention (Wong & Zheng, 2021). Studies have shown that these technologies can improve patient well-being and reduce caregiver burden, leading to an overall improvement in care outcomes (Roest et al., 2021; Yamada & Aoyama, 2021).

One example of robotics in dementia care is the use of a robotic pet companion. A study by Van Den Heuvel et al. (2022) examined the effect of a robotic seal companion on the well-being of dementia patients in a residential care setting. The study found that the presence of the robotic pet improved the well-being of patients and reduced caregiver burden. The robotic pet was found to be a source of comfort and companionship for patients, and caregivers reported feeling less burdened by their caregiving duties.

Another example of assistive technology in dementia care is the use of a robotic assistant for ADLs. A study by Edemekong et al. (2021) examined the effect of an assistive robot that provided support for ADLs such as dressing, grooming, and eating. The study found that the use of the robot reduced caregiver burden and improved quality of life for both patients and caregivers. Patients reported feeling more independent and in control of their daily activities, caregivers reported feeling less stressed and more able to provide care (Ku et al., 2021).

Overall, the use of robotics and assistive technologies has the potential to improve care outcomes for dementia patients and reduce caregiver burden (Ismail et al., 2021b; Vass et al., 2021). These technologies can provide support for daily activities, reduce the need for constant caregiver attention, and improve patient well-being. However, further research is needed to fully understand the potential benefits and limitations of these technologies in dementia care (Liang et al., 2021).

## C) Telemedicine

Telemedicine has been identified as a promising emerging technology for improving care outcomes for dementia patients. The use of telecommunications technology (Tsoy et al., 2021) to deliver healthcare services remotely has the potential to increase access to healthcare services for patients and caregivers, particularly in remote or rural areas where access to healthcare can be limited (Borg et al., 2015; Jia et al., 2022).

A study by Julie et al. (2021) aimed to investigate the effectiveness of telemedicine-based dementia care in improving care outcomes for dementia patients and their caregivers. The study was conducted in a residential aged care facility in Australia and involved 40 dementia patients and their caregivers (Klimova, 2019). The intervention group received telemedicine-

based dementia care, which included regular remote consultations with a specialist dementia care team, while the control group received usual care.

The results of the study showed that telemedicine-based dementia care significantly improved access to healthcare services for patients and caregivers. The intervention group had significantly higher rates of specialist consultations compared to the control group, indicating increased access to healthcare services. In addition, the intervention group reported lower levels of caregiver burden and improved quality of life compared to the control group (Lanctôt et al., 2021).

Overall, this study demonstrates the potential of telemedicine in improving care outcomes for dementia patients and their caregivers. By increasing access to healthcare services and reducing caregiver burden, telemedicine has the potential to improve the quality of care for dementia patients and their caregivers, particularly in residential aged care settings (Feng et al., 2021; Jia et al., 2020; Lin et al., 2020).

## 4.  Conclusions

The results of this systematic review demonstrate that emerging technologies, such as AI and Web 2.0, have the potential to improve care for dementia patients in teaching and learning significantly. However, it is essential to note that the evidence base for the effectiveness of these technologies is still relatively limited, and more research is needed to determine the most effective interventions and evaluate their long-term impact on patient outcomes. While the results of the studies included in this systematic review are promising, there is still much to learn about the optimal use of emerging technologies in the care of dementia patients. To further explore the potential of these interventions, future research could focus on combining multiple interventions to develop more comprehensive and effective treatment plans. For example, researchers could investigate the effectiveness of combining virtual reality training with social networking or interactive computer games to improve patient outcomes. By examining the potential synergies between different types of interventions, researchers may develop more effective and efficient treatment plans that address a range of cognitive, emotional, and behavioral issues in dementia patients.

In addition to exploring the effectiveness of different combinations of interventions, more research is also needed to determine the optimal dosage and duration of these treatments. For example, studies could investigate the effects of longer-term interventions or different schedules of intervention delivery to determine the optimal treatment plan for different dementia patients. Furthermore, it is crucial to identify the most effective methods of delivering these interventions to patients. It may involve exploring the potential of different delivery methods, such as telemedicine or in-person care, to determine the most effective and accessible approach for patients and caregivers. Overall, further research is needed to fully understand the potential of emerging technologies in the care of dementia patients. By investigating the effectiveness of different combinations of interventions, determining the optimal dosage and duration of treatment, and identifying the most effective delivery methods,

researchers can help develop more effective and personalized treatment plans for dementia patients that take advantage of the latest technological advances.


The findings of this review can be helpful for healthcare professionals, educators, and researchers interested in utilizing emerging technologies to improve care for dementia patients. These technologies have the potential to revolutionize the way that dementia care is provided, and they may be particularly valuable in settings where resources are limited. However, it is important to approach these technologies with a critical eye and to evaluate their effectiveness carefully before implementing them in practice. In conclusion, the findings of this systematic review suggest that emerging technologies, such as AI and Web 2.0, have the potential to improve care for dementia patients in teaching and learning significantly. However, more research is needed to determine the most effective interventions and evaluate their long-term impact on patient outcomes. Healthcare professionals, educators, and researchers should continue to explore the potential of these technologies and work together to develop innovative and practical approaches to dementia care.

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