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# Exploring Communication Tools to Enhance Social Inclusion of Marginalised Communities in Schools Through a Human-Centred Approach: A practice-Based Review Focusing on the Turkish Context

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## Abstract:

**This paper, underpinned by Human-Centred Design (HCD), presents secondary research examining communication tools to enhance interactions between Turkish teachers and Syrian immigrant parents – marginalised communities displaced by the Syrian war -, with the aim of enabling their participation in their children's educational process. Limited preparedness for integrating Syrian students into Turkish schools has created educational challenges with long-term consequences for students' educational attainment and future participation in society. This paper reviews 18 purposively selected practice- and research-based studies, covering commonly used tools such as interpreter services, video remote interpretation (VRI), mobile applications and pictorial booklets. Using case study analysis and SWOT evaluation, the appropriateness of these tools for this**

**group was assessed in light of existing literature, with thematic mapping applied throughout. The findings contribute to the design context by illustrating how HCD principles support the development of contextually appropriate practical communication tools. Interpreter services were identified as the most effective means of facilitating teacher–parent collaboration, while translation-enabled digital platforms provided practical alternatives in contexts where interpreter services were unavailable. Their effectiveness can be further enhanced through targeted strategies informed by practical examples. The study underscores the need for further research with key stakeholders, and highlights the role of HCD in contributing to participatory practices with marginalised communities for social inclusion and educational equity.**

**Keywords:** ***Human-Centred Design; Communication Practices;Language Barriers; Inclusion of Marginalised Communities; Immigrant Parent-Teacher Communication***

## 1. Introduction

**This paper presents research grounded in Human-Centred Design (HCD), focusing on the Inspiration stage of the design process outlined by IDEO (2015), which guides the generation and refinement of design solutions that are inclusive, contextually appropriate, and ethically accountable. Given the demonstrated effectiveness of HCD in addressing social challenges, this research applies its principles to review relevant case studies, with particular attention to problems in educational contexts affecting vulnerable groups, specifically**

**immigrant families. While this study focuses on evaluating communication channels between Turkish teachers and Syrian immigrant parents, its broader analytical contribution lies in advancing participatory practices with marginalised communities (Theme 1). Rather than treating communication tools—such as VRI services or translation apps—merely as transactional language instruments, we frame them through the lens of social innovation literature. As argued by Manzini (2015) and the broader DESIS Network (Manzini & Staszowski, 2013), design for public services must foster 'relational platforms' that empower vulnerable populations to participate as active stakeholders in public institutions, as considered within the scope of this paper.**

**Background research shows that communication between Turkish primary school teachers and Syrian immigrant parents—many of whom fled the Syrian war—is frequently ineffective, and there is limited scholarly attention to this issue. Migration studies highlight that the nature of migration strongly influences migrants' experiences in the host country: while some individuals move voluntarily, others are displaced suddenly and without preparation. This study focuses on the latter group, whose unmet educational needs can have lasting effects, as these students often encounter difficulties in local schools that hinder their academic achievement (Amthor, 2019; Rong & Preissle, 2008, p. 205). These difficulties also impact society more broadly, since higher levels of education are associated with lower crime rates, stronger economic performance, and better living conditions (Barro, 2013; Duman, 2019; Zgaga, 2005; Seetanah, 2009; Bhardwaj, 2016). Given that 3.76 million of Türkiye's 5.5 million immigrants are Syrian (Ministry of Interior, 2023), Syrian students constitute a substantial proportion of the school population, making**

**Syrian immigrant families a central focus of this research (Kiremit, Akpınar, & Akcan, 2018; Ergen & Şahin, 2019).**

**Parental involvement, understood as parents and teachers working together to support children's learning, is widely recognised as essential to students' academic development (Đurišić & Bunijevac, 2017). This cooperation is especially important for children from migrant backgrounds, who frequently encounter obstacles such as language differences, unfamiliarity with the education system, and cultural mismatches (García, Pujol-Ferran, & Reddy, 2013). Because primary school represents the foundation of formal education, parental engagement at this stage influences not only children's academic success but also the overall well-being of the wider community (Driessen, Smith, & Sleegers, 2005).**

**In Türkiye, where primary education is compulsory and native and immigrant students learn together, Syrian students often require extra support; many experience delays in literacy development, lower academic performance, and behavioural issues that cannot be resolved solely through teachers' efforts. Research consistently highlights the importance of parental engagement, particularly ongoing communication and collaboration with teachers through regular meetings, in addressing these needs (Aykırı, 2017; Bulut, Soysal, & Gülçiçek, 2018; Kiremit, Akpınar, & Akcan, 2018; Ergen & Şahin, 2019). Yet language barriers frequently prevent Syrian parents from participating effectively (Tümkaya & Çopur, 2020), underscoring the need for targeted strategies to enhance communication, boost student outcomes, and foster long-term community well-being.**

**Within this context, a range of established approaches exists for addressing language barriers, each varying in its suitability depending**

**on the situation. Interpreter services involve professional interpreters converting spoken language in real time (Wadensjö, 2014, pp. 4–12), while VRI provides similar services remotely through video technologies such as webcams or videophones. Complementing these, mobile applications, designed for smartphones and tablets (Liao & Ho, 2021), facilitate multilingual communication and offer flexible, cost-effective alternatives to human interpretation. Pictorial booklets, which combine text and illustrations to convey information (Talhouk et al., 2016), enhance comprehension by supporting communication visually. Together, these tools form the basis for the investigation, which is structured around case studies drawn from diverse contexts to assess their effectiveness and applicability in educational settings.**

**Ultimately, this paper explores how different communication tools facilitate or hinder meaningful dialogue, and how strategic channel selection forms the baseline for participatory engagement between displaced families and school systems. The central question guiding this analysis is: which communication approaches best respond to the contexts, and support effective communication between parents and teachers, taking into account the realities of these groups (e.g., limited social inclusion, limited language capacity, relatively low education level) (Tümkaya& Çopur, 2020). In line with this objective, this study is structured into five sections in total. Following the background presented in this introduction, the next section outlines the methodological approach, followed by the findings and discussion in Section 3. Section 4 then briefly summarises the study in the conclusion, and the final section is devoted to future research.**

## 2. Method

**The methodology employed a Human-Centred Touchpoint Evaluation (using SWOT analysis) to systematically critique existing communication channels — apps, VRI, booklets, and interpreters — based on their ability to support active two-way participation. This evaluation establishes the baseline information for the Inspiration phase, as shown in Figure 1 below. The Inspiration phase, as defined by IDEO (2015), focuses in this research on developing a comprehensive understanding of the target group — Syrian immigrant parents and as well as investigating potentially useful communication solutions accordingly. that could mitigate these problems, including language barriers at school.**

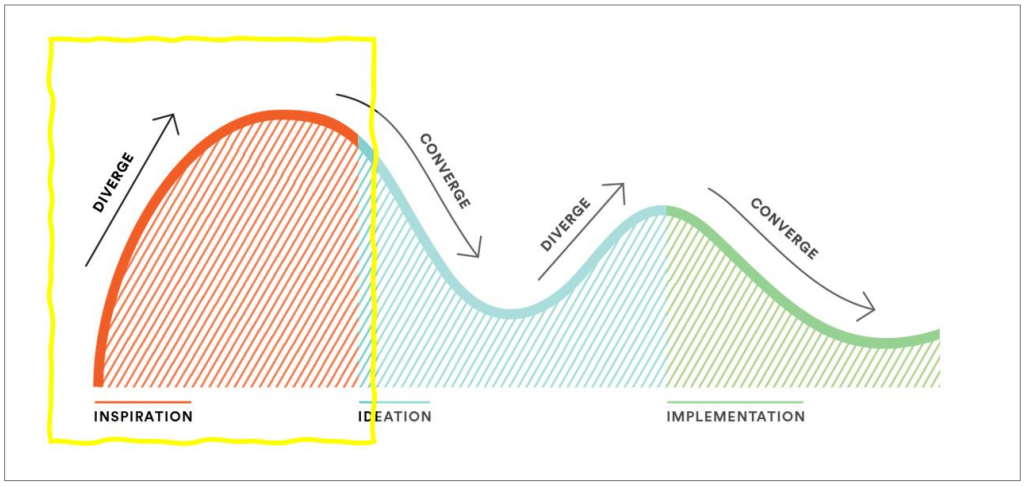



***Figure 5Employment of HCD in the Inspiration stage to explore potential solutions for enhancing communication between immigrant parents and Turkish primary school teachers***.

**The investigation is organised around two primary sub-topics to provide a comprehensive examination of both practical implementation and theoretical foundations: (1) Case Studies from Practice, which focus on example applications, and (2) Research-Based Case Studies, based on certain criteria. Case studies, both practice and research-based, were selected using parallel eligibility criteria. Inclusion required that cases from practice: explicitly focused**

**on mitigating language barriers, offered practical solutions applicable to real-life contexts, and demonstrated adaptability across diverse settings. Conversely, cases were excluded if they focused on issues other than language barriers, remained purely conceptual without actionable solutions, or presented single-use solutions that could not be modified. Inclusion required that research-based cases: prioritised reducing language barriers, proposed practical solutions suitable for real-world implementation, and demonstrated adaptability across multiple contexts. Excluded were studies that lacked a focus on language barriers, remained strictly theoretical without offering practical solutions, or offered inflexible solutions restricted to a single context.**

**The literature review was conducted primarily through Google Scholar, using the keyword 'language barriers.' This term was deliberately kept broad, rather than narrowed to education- or migration-specific phrasing, in order to capture the full range of strategies developed across disciplines for addressing language barriers, rather than only those already framed around schools or displaced populations. Sources were reviewed in reverse chronological order, from the most recent to the oldest, with the search conducted in 2024. Saturation was reached after approximately 18 sources, beyond which no newcommunication strategies emerged; the case studies included in the final analysis are presented in Tables 1 and 2.**

**Data were analysed using SWOT analysis — a technique for identifying Strengths, Weaknesses, Opportunities, and Threats (Teoli, Sanvictores and An, 2019) — applied here based on the thematic relevance of each case to the target group. SWOT was selected for its**

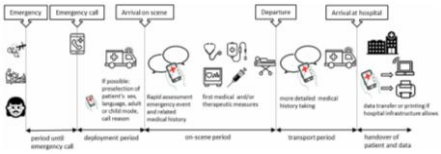
**capacity to synthesise heterogeneous practice- and research-based case studies into a consistent comparative structure, without requiring primary data collection at this stage of the project. The findings from this analysis are presented in the following section, following the presentation of the reviewed case studies.**

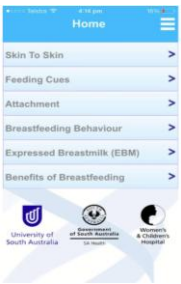
**Notably, the research will proceed to the Ideation stage by incorporating expert insights, before translating the integrated findings from both primary and secondary data into practical outputs for school administrators, as further elaborated within the final section, Future Research. These outputs will take the form of a structured guideline designed to facilitate more effective communication between parents and teachers, thereby fulfilling the Implementation stage of the HCD process.**

## 2.1 Review of Example Applications (Case studies from Practice)

**These examples are particularly valuable, as they providedetailed insights into the practical application of these methods within specific settings, illustrating their processes, challenges, and outcomes. The analysis included a total of nine practice-based cases as provided in Table 1. Inclusion criteria required that the cases focus on mitigating language barriers, offer practical solutions applicable in real-life contexts, and be adaptable across different settings. Conversely, cases are excluded if their focus did not address language barriers, whether they offered only conceptual rather than practical solutions, or if their solutions were restricted to a single, non-transferable context.**

*Table 1 Reviewed Practice-Based Case Studies*

| Research title | Context & Tool | Relevant image |
|---|---|---|
| **Designing an App to Overcome Language Barriers in the Delivery of Emergency Medical Services: Participatory Development Process (Noack et al., 2021)** | **Healthcare settings**<br>**App** |  |
| **Beyond the language barrier: Recommendations for working with interpreters in individual psychotherapy (Martin et al., 2020)** | **Healthcare settings**<br>**Interpreter service** | ***Not given*** |
| **Overcoming language barriers in paramedic care: a study protocol of the interventional trial 'DICTUM rescue' evaluating an app designed to improve communication between paramedics and foreign-language patients (Noack et al., 2021)** | **Healthcare settings**<br>**App** |  |
| **Inclusive Co-design Toolkit (Bridgeable, 2019)** | **General use**<br>**Pictorial booklet** |   |
| **Better communication, better care. A provider toolkit for** | **Healthcare settings** | |

| | | |
|---|---|---|
| **serving diverse populations (L.A. Care Health Plan, 2018)** | **Pictorial booklet** |   |
| **Strategies for overcoming language barriers in healthcare (Squires, 2018)** | **Healthcare settings**<br>**Interpreter service** | ***Not given*** |
| **Beyond the Language Barrier 'Speak','See','Help Me' (Badruddin & Arif, 2017)** | **Healthcare settings**<br>**Pictorial booklet** |  |
| **Overcoming the language barrier in mobile user interface design: A case study on a mobile health app (Ross & Gao, 2016)** | **Healthcare settings**<br>**App** |   |

## 2.2 Review of Empirical Examples (Research-based Case Studies)

**The examination of research-based case studies provides an opportunity to gain in-depth insights from studies conducted with clearly defined target groups, offering a nuanced understanding of the effectiveness and limitations of various communication solutions in practice. A total of nine research-based case studies were examined,**

**as detailed in Table 2, with inclusion criteria requiring that the primary focus of each study address language barriers, while studies outside the scope of language-related issues are excluded.**

***Table 2 Reviewed Research-Based Case Studies***

| Research title | Context | The mechanism assessed |
|---|---|---|
| **Language barriers in multilingual Saudi hospitals: causes, consequences, and solutions (Alhamami, 2022)** | **Healthcare settings** | **Interpreter service** |
| **Enhancing patient safety through the quality assured use of a low-tech video interpreting system to overcome language barriers in healthcare settings (Kletečka-Pulker et al., 2021)** | **Healthcare settings** | **VRI** |
| **Successful Verbal Communication Using Google Translate to Facilitate Awake Intubation of a Patient with a Language Barrier: A Case Report (Kapoor et al., 2020)** | **Healthcare settings** | **App** |
| **The "Battle" of Managing Language Barriers in Health Care (Steinberg et al., 2016)** | **Healthcare settings** | **Interpreter service** |
| **Language barriers and patient safety risks in hospital care-A mixed methods study (van Rosse et al., 2016)** | **Healthcare settings** | **Interpreter service** |
| **Using mobile technology to overcome language barriers in medicine (Chang et al., 2014)** | **Healthcare settings** | **App** |

| | | |
|---|---|---|
| **Prevention is the Best Medicine: Development of a work and health toolkit for new immigrants using settlement services in Ontario (Kosny et al., 2014)** | **General use** | **Booklet (Toolkit)** |
| **The effects of a language barrier in a South African district hospital (Schlemmer and Mash, 2006)** | **Healthcare settings** | **Interpreter service** |
| **Bridging the language barrier: the use of interpreters in primary care nursing (Gerrish, et al., 2004)** | **Healthcare settings** | **Interpreter service** |

## 3. Findings and Discussion

**The analysis of the case studies suggests that interpreter services constitute highly effective channels for mitigating language barriers, with multiple studies underscoring their practicality and reliability. For example, Alhamami (2022) identify interpreter services as among the most efficient solutions, and Van Rosse et al. (2016) emphasie professional interpreters as the most effective mediators. Video remote interpreting (VRI) offers additional advantages, including rapid accessibility, compliance with data protection regulations, suitability when in-person meetings are impractical, the absence of external influences, legal assurance, and cost efficiency (Kletečka-Pulker et al., 2021). Despite these benefits, challenges such as high costs and time constraints have been reported (Schlemmer & Mash, 2006; Steinberg et al., 2016); nevertheless, the overall advantages of interpreter services justify their prioritisation where feasible. Their effectiveness can be further enhanced by applying insights from case**

**studies, including the collection of regular feedback from diverse stakeholders, the development of context-specific solutions such as optimised service schedules, and the provision of cultural competency training for interpreters (Squires, 2018; Martin et al., 2020). Key recommendations also include fostering a triadic relationship that positions interpreters as integral team members, offering targeted cultural and contextual training, and establishing clear termination policies and operational guidelines (ibid).**

**The review of case studies on interpreter services and video remote interpreting (VRI) demonstrates that this option is widely preferred because it ensures smooth interaction and enhances engagement between parties. However, these services can impose a significant economic burden on institutions, and strategies should therefore be considered to maximise their benefit where their use is feasible — for instance, guidelines that could enhance service effectiveness and maximise benefits within limited timeframes (e.g., Squires, 2018; Martin et al., 2020). Key insights from these practical examples highlight the importance of: (1) structured planning of the entire conversation, including preparatory requirements (e.g., introducing meeting processes), technical considerations to improve service effectiveness (e.g., using concise statements), and concluding protocols (e.g., final questions before closing the session); and (2) considering all stakeholders involved (e.g., service providers, clients, and interpreters) and providing guidance tailored to their respective roles. Drawing on these insights, similar guidelines could be developed to address the needs of school staff and parents, with these case studies serving as inspiration for designing strategies to improve communication within educational settings.**

**The reviewed case studies on apps indicate that such tools are effective in reducing language barriers across diverse contexts, offering key advantages - including practicality, temporal flexibility, and cost efficiency - as they enable communication in multiple languages without reliance on interpreter availability, thereby providing a more economical alternative to human translation or interpretation (Chang et al., 2014; Noack et al., 2020). Building on this, Noack et al. (2021) identify additional strategies relevant to educational settings, including the adaptation of fixed phrases, the incorporation of rapid-communication features such as audio playback and supplementary text displays, and the systematic maintenance of communication records to support future interactions. Complementing these insights, Ross and Gao (2016) emphasise the value of integrating visual elements, such as national flags, with textual supports, demonstrating how visual–textual combinations can further strengthen communication effectiveness.**

**With regard to the use of pictorial booklets, the examined case studies mostly highlight the limitations. While image-only booklets, such as those produced by international companies, can effectively convey procedural information, they are less suitable for facilitating nuanced communication. Case examples specifically designed for communication support, including the Inclusive Co-design Toolkit (2019) and L.A. Care Health Plan (2018), demonstrate that effective pictorial booklets combine widely used phrases and context-specific terminology in multiple languages with images that clarify actions or behaviours. These resources offer advantages such as portability, ease of use, support for direct communication through fixed phrases, and cost-effectiveness due to low production and distribution costs. However, their predefined content limits flexibility, constraining**

**spontaneous dialogue, and they require regular updates to remain relevant, with delays potentially leading to user dissatisfaction. Consequently, while pictorial booklets can serve as valuable supplementary tools for reducing language barriers, they are insufficient as standalone communication mediums.**

**Table 3 subsequently presents a comparison of widely used communication tools. Interpreter services facilitate direct interaction and, when conducted in person, can strengthen parent–teacher relationships within this research context, making them a priority where feasible. This is consistent with the Human-Centred Touchpoint Evaluation (using SWOT analysis), given that Syrian parents are often socially isolated, meaning that encouraging their presence in schools may be particularly valuable. Although this evaluation is grounded in the context of Syrians in Türkiye, it could equally be applied to other groups facing similar challenges of social isolation, where comparable inclusion strategies may be required. However, their implementation can be expensive for schools, underscoring the need for viable alternative solutions.**

**Among the other viable solutions, mobile applications may serve as a supplementary tool, facilitating communication in contexts where interpreters or video remote interpretation are unavailable. On the other hand, pictorial booklets are comparatively less effective, as their dependence on highly restricted phrases constrains meaningful dialogue. Building on these assessments, practical examples offer additional guidance for implementation. For instance, interpreters should possess familiarity with educational terminology and sensitivity to cultural nuances, and their integration as collaborative staff members within schools can enhance service effectiveness. Dedicated guidance, such as collections of recommendations for**

**optimising interpreter use, can further support their role. Similarly, the adoption of apps can draw on insights from case studies, addressing the needs of both school staff and parents - for example, incorporating features to track previous conversations or schedule meetings. The design of these tools should also consider usability principles, including the use of intuitive icons, symbols, and differentiated colours, in alignment with best practices identified in the reviewed examples.**

***Table 3 Analysis of the communication tools***

| Key elements | Mood of communication | | Potential time constraints | | Reliance for external facilitators | |
|---|---|---|---|---|---|---|
| | Mostly direct | Mostly indirect | Mostly limited | Unrestricted by temporal constraints | Generally necessary | May not be required |
| Interpreter services/VRI | | X | X | | X | |
| Apps | X | | | X | | X |
| Pictorial Booklets | X | | | X | | X |

**Taken together, analysing these cases through the lens of Human-Centred Design (HCD) fostered an empathy-driven understanding of Syrian parents' circumstances, extending beyond the Inspiration stage's typical positioning (IDEO, 2015). By adapting SWOT analysis into a design-relevant framework — assessing each communication tool against criteria drawn from Syrian parents' documented**

**circumstances, such as limited social inclusion, which potentially requires more in-person interaction to diminish it — this study ensured a structured comparative evaluation as its core analytical tool. In doing so, this comparative evaluation echoes Bason's (2014) characterisation of the 'insight' stage of design-for-policy, wherein design research methods are used to surface user needs and constraints prior to ideation.**

**Overall, this design research makes a distinct contribution by identifying translation as a priority need for enhancing communication between immigrant parents and teachers in Turkish schools, while also surfacing the contextual considerations required to provide it appropriately within the school setting. Through this process, in-person communication supported by a professional translator emerged as potentially the most effective approach, enabling direct and meaningful interaction. Yet the research also brought into focus practical constraints, such as limited staff availability and financial resources, that may restrict this option's implementation. Rather than positioning translation as a single fix, the design research's contribution is in reframing it as part of a broader, adaptable toolkit, pointing schools toward complementary tools such as translation applications where in-person interpretation is unavailable or impractical. In doing so, the research moves beyond simply identifying a priority need to demonstrate how that need can be met feasibly and appropriately across varying school contexts.**

## 4. Conclusion

**This research addressed the Inspiration stage of Human-Centred Design, following the framework proposed by IDEO (2015), thereby identifying suitable practical communication tools for marginalised**

**groups that can help enhance immigrant parent–teacher interactions in schools, based on case-study research. The review of practical case studies and research-based examples provided insights into the effectiveness, advantages, and limitations of various communication tools for the target research group, while also identifying potential strategies to enhance their utility in school settings. The analysis suggests that interpreter services represent the most effective and convenient option for facilitating parent–teacher communication. However, in contexts where these services are unavailable, supportive tools such as translation applications may serve as complementary channels, with features specifically designed to support parent–teacher interactions incorporated into a dedicated app if developed. In contrast, pictorial booklets appear to offer limited communicative value and are therefore not recommended as an alternative solution.**

## 5. Future research

**Primary research is also needed to identify the most suitable communication channels for the target group and to inform strategies for enhancing their use. Methods such as card sorting and semi-structured interviews will gather input from key stakeholders and experts, aligning with the 'Exploration' stage of HCD. Findings from both the primary and secondary data will be synthesised into a guideline for school managers, providing practical recommendations to reduce language barriers. As a final outcome of the study, the guideline reflects the implementation stage of the Human-Centred Design process through an inclusive intervention.**

**Acknowledgements:** **Artificial intelligent, specifically ChatGPT, was employed solely to improve the clarity and formal quality of the English language in the manuscript. Importantly, it was not used to generate content, provide comments, or contribute to the intellectual development of the work; its assistance was limited exclusively to language enhancement only.**

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*van Rosse, F., de Bruijne, M., Suurmond, J., Essink-Bot, M. L., & Wagner, C. (2016). Language barriers and patient safety risks in hospital care: A mixed methods study. International Journal of Nursing Studies, 54, 45–53. https://doi.org/10.1016/j.ijnurstu.2015.03.012*

*Zgaga, P. (2005). The importance of education in social reconstruction. Six Years of the Enhanced Graz Process: Developments, Current Status and Future Prospects of Education of South-East Europe. Ljubljana & Wien: University Od Ljubljana, Faculty of Education.*

# APPENDICES

## A.1 Databases and Search Details

Table A. 1: Databases and search details

| | |
|---|---|
| **ACM** | **[[Title: "automated chat agent"] OR [Title: "chatbot"] OR [Title: "conversation agent"] OR [Title: "conversational agent"] OR [Title: "conversational ai"] OR [Title: "conversational assistant"] OR [Title: "conversational interface"] OR [Title: "conversational user interface"] OR [Title: "digital personal assistant"] OR [Title: "embodied agent"] OR [Title: "intelligent agent"] OR [Title: "intelligent assistant"] OR [Title: "personal assistant"] OR [Title: "personal digital assistant"] OR [Title: "smart assistant"] OR [Title: "smart speaker"] OR [Title: "virtual agent"] OR [Title: "virtual assistant"] OR [Title: "voice assistant"] OR [Title: "voice interface"] OR [Title: "voice user interface"]] AND [[Abstract: "ageing"] OR [Abstract: "aging"] OR [Abstract: "old"] OR [Abstract: "older"] OR [Abstract: "older adult"] OR [Abstract: "older adults"] OR [Abstract: "elder"] OR [Abstract: "elders"] OR [Abstract: "elderly"] OR [Abstract: "senior"] OR [Abstract: "seniors"] OR [Abstract: "geriatric"] OR [Abstract: "geriatry"] OR [Abstract: "geriatrics"]] OR [[Title: "ageing"] OR [Title: "aging"] OR [Title: "old"] OR [Title: "older"] OR [Title: "older adult"] OR [Title: "older adults"] OR [Title: "elder"] OR [Title: "elders"] OR [Title: "elderly"] OR [Title: "senior"] OR [Title: "seniors"] OR [Title: "geriatric"] OR [Title: "geriatry"] OR [Title: "geriatrics"]] AND [[Abstract: "automated chat agent"] OR [Abstract: "chatbot"] OR [Abstract: "conversation agent"] OR [Abstract: "conversational agent"] OR [Abstract: "conversational ai"] OR [Abstract: "conversational assistant"] OR [Abstract: "conversational interface"] OR [Abstract: "conversational user interface"] OR [Abstract: "digital personal assistant"] OR [Abstract: "embodied agent"] OR [Abstract: "intelligent agent"] OR [Abstract: "intelligent assistant"] OR [Abstract: "personal assistant"] OR [Abstract: "personal digital assistant"] OR [Abstract: "smart assistant"] OR [Abstract: "smart speaker"] OR [Abstract: "virtual agent"] OR [Abstract: "virtual assistant"] OR [Abstract: "voice assistant"] OR [Abstract: "voice interface"] OR [Abstract: "voice user interface"]]** |

| | |
|---|---|
| **Scopus** | **( TITLE-ABS-KEY ( "Automated chat agent" OR "Chatbot" OR "conversation agent" OR "Conversational agent" OR "Conversational AI" OR "Conversational assistant" OR "Conversational interface" OR "Conversational User Interface" OR "digital personal assistant" OR "embodied agent" OR "Intelligent agent" OR "intelligent assistant" OR "personal assistant" OR "Personal Digital Assistant" OR "smart assistant" OR "smart speaker" OR "virtual agent" OR "virtual assistant" OR "voice assistant" OR "voice interface" OR "voice user interface" ) AND TITLE-ABS-KEY ( "ageing" OR "aging" OR "old" OR "older" OR "older adult" OR "older adults" OR "elder" OR "elders" OR "elderly" OR "senior" OR "seniors" OR "geriatric" OR "geriatry" OR "geriatrics" )** |
| **IEEE Xplore** | **("All Metadata":"Automated chat agent" OR "All Metadata":"Chatbot" OR "All Metadata":"conversation agent" OR "All Metadata":"Conversational agent" OR "All Metadata":"Conversational AI" OR "All Metadata":"Conversational assistant" OR "All Metadata":"Conversational interface" OR "All Metadata":"Conversational User Interface" OR "All Metadata":"digital personal assistant" OR "All Metadata":"embodied agent" OR "All Metadata":"Intelligent agent" OR "All Metadata":"intelligent assistant" OR "All Metadata":"personal assistant" OR "All Metadata":"Personal Digital Assistant" OR "All Metadata":"smart assistant" OR "All Metadata":"smart speaker" OR "All Metadata":"virtual agent" OR "All Metadata":"virtual assistant" OR "All Metadata":"voice assistant" OR "All Metadata":"voice interface" OR "All Metadata":"voice user interface") AND ("All Metadata":"ageing" OR "All Metadata":"aging" OR "All Metadata":"old" OR "All Metadata":"elder*" OR "All Metadata":"senior" OR "All Metadata":"geriatr*")**<br>**"Automated chat agent" OR "Chatbot" OR "conversation agent" OR "Conversational agent" "Conversational AI" OR "Conversational assistant" OR "Conversational interface" OR "Conversational User Interface" OR "digital personal assistant" OR "embodied agent" OR"Intelligent agent" OR "intelligent assistant" OR "personal assistant" OR "Personal Digital Assistant" OR "smart assistant" OR "smart speaker" OR "virtual agent" OR "virtual assistant" OR "voice assistant" OR "voice interface" OR "voice user interface") AND ("ageing" OR :"aging" OR "old" OR "elder*" OR "senior" OR "geriatr*")** |

| | |
|---|---|
| **WoS** | **"Automated chat agent" OR "Chatbot" OR "conversation agent" OR "Conversational agent" OR "Conversational AI" OR "Conversational assistant" OR "Conversational interface" OR "Conversational User Interface" OR "digital personal assistant" OR "embodied agent" OR "Intelligent agent" OR "intelligent assistant" OR "personal assistant" OR "Personal Digital Assistant" OR "smart assistant" OR "smart speaker" OR "virtual agent" OR "virtual assistant" OR "voice assistant" OR "voice interface" OR "voice user interface" (Title) and "ageing" OR "aging" OR "old" OR "elder*" OR "senior" OR "geriatr*" (Abstract) or "ageing" OR "aging" OR "old" OR "elder*" OR "senior" OR "geriatr*" (Title) and "Automated chat agent" OR "Chatbot" OR "conversation agent" OR "Conversational agent" OR "Conversational AI" OR "Conversational assistant" OR "Conversational interface" OR "Conversational User Interface" OR "digital personal assistant" OR "embodied agent" OR "Intelligent agent" OR "intelligent assistant" OR "personal assistant" OR "Personal Digital Assistant" OR "smart assistant" OR "smart speaker" OR "virtual agent" OR "virtual assistant" OR "voice assistant" OR "voice interface" OR "voice user interface" (Abstract)** |
| **EBSCO HOST** | **[[Title: "ageing"] OR [Title: "aging"] OR [Title: "old"] OR [Title: "older"] OR [Title: "older adult"] OR [Title: "older adults"] OR [Title: "elder"] OR [Title: "elders"] OR [Title: "elderly"] OR [Title: "senior"] OR [Title: "seniors"] OR [Title: "geriatric"] OR [Title: "geriatry"] OR [Title: "geriatrics"]] AND [[Abstract: "automated chat agent"] OR [Abstract: "chatbot"] OR [Abstract: "conversation agent"] OR [Abstract: "conversational agent"] OR [Abstract: "conversational ai"] OR [Abstract: "conversational assistant"] OR [Abstract: "conversational interface"] OR [Abstract: "conversational user interface"] OR [Abstract: "digital personal assistant"] OR [Abstract: "embodied agent"] OR [Abstract: "intelligent agent"] OR [Abstract: "intelligent assistant"] OR [Abstract: "personal assistant"] OR [Abstract: "personal digital assistant"] OR [Abstract: "smart assistant"] OR [Abstract: "smart speaker"] OR [Abstract: "virtual agent"] OR [Abstract: "virtual assistant"] OR [Abstract: "voice assistant"] OR [Abstract: "voice interface"] OR [Abstract: "voice user interface"]] OR [[Title: "automated chat agent"] OR [Title: "chatbot"] OR [Title: "conversation agent"] OR [Title: "conversational agent"] OR [Title: "conversational ai"] OR [Title: "conversational assistant"] OR [Title: "conversational interface"] OR [Title: "conversational user interface"] OR [Title: "digital personal assistant"] OR [Title: "embodied agent"] OR [Title: "intelligent agent"] OR [Title: "intelligent assistant"] OR [Title: "personal** |

| | |
|---|---|
| | **assistant"] OR [Title: "personal digital assistant"] OR [Title: "smart assistant"] OR [Title: "smart speaker"] OR [Title: "virtual agent"] OR [Title: "virtual assistant"] OR [Title: "voice assistant"] OR [Title: "voice interface"] OR [Title: "voice user interface"]] AND [[Abstract: "ageing"] OR [Abstract: "aging"] OR [Abstract: "old"] OR [Abstract: "older"] OR [Abstract: "older adult"] OR [Abstract: "older adults"] OR [Abstract: "elder"] OR [Abstract: "elders"] OR [Abstract: "elderly"] OR [Abstract: "senior"] OR [Abstract: "seniors"] OR [Abstract: "geriatric"] OR [Abstract: "geriatry"] OR [Abstract: "geriatrics"]]** |
| **ScienceDirect** | **("ageing" OR "aging" OR "old" OR "older" OR "older adult" OR "older adults" OR "elder" OR "elders" OR "elderly" OR "senior" OR "seniors" OR "geriatric" OR "geriatry" OR "geriatrics") AND ("Automated chat agent" OR "Chatbot" OR "conversation agent" OR "Conversational agent" OR "Conversational AI" OR "Conversational assistant" OR "Conversational interface" OR "Conversational User Interface" OR "digital personal assistant" OR "embodied agent" OR "Intelligent agent" OR "intelligent assistant" OR "personal assistant" OR "Personal Digital Assistant" OR "smart assistant" OR "smart speaker" OR "virtual agent" OR "virtual assistant" OR "voice assistant" OR "voice interface" OR "voice user interface")** |

## A.2 Descriptive Information Matrix

***Table A. 2: Descriptive information about the studies included***

| | User Profile | | | | | | | | | | | Topic | | | | Method | | | | | | | | | | | | | | | | | Length | | | | | | Context | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Older Adults** | | | | | | | Other | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ARTICLE CODE | 50+ | 55+ | 60+ | 65+ | 70+ | 75+ | 85+ | Relatives | Professional Caregiver | Number of older participants | Health | General/Daily Life | E-Commerce | Psychological/Well-being | Interview | Focus Group | Usability Test | Workshop | Co-design | Usage Log Analysis | Content Analysis | Wizard of Oz | Participant Observation | Scale/Survey/ Questionnaire | Diary | Home Tour | Think Aloud | ≤ 1 day | 1-15 Days | 15 - 30 days | 1-3 months | 3-6 months | 6-9 months | ≥ 1 year | Home | Hospital | Facility | Lab | Other Setting | Preferred VCA Terms*** | VCA Platform*** |
| 2 | | | | | | | ■ | | | 5 | | | | ■ | ■ | | | | | | | | | | | | | | ■ | | | | | | | | ■ | | | Smart Speaker | Google Assistant |
| 3* | | | ■ | | | | | | | 105 | ■ | | | | | | | | | | | | | ■ | | | | ■ | | | | | | | | | | | | Conversational Agent | In house - developed |
| 4 | | | | ■ | | | | | ■ | 11 | ■ | | | | ■ | | ■ | | | ■ | | | | ■ | ■ | | | | | ■ | | | | | ■ | | | | | Intelligent Virtual Agent | In house - developed |
| 7 | | | | ■ | | | | | | 95 | ■ | | | | | | | | | | | | | ■ | | | | ■ | | | | | | | | ■ | | | | Embodied Conversational Agent | In house - developed |
| 10 | ■ | | | | | | | | | 13 | ■ | | | | ■ | | | | | | | | | | | | | | | | ■ | | | ■ | | | | | Digital Personal Assistant | Anne4Care |
| 11 | | | ■ | | | | | | | 19 | | ■ | | | ■ | | | | | | | | | ■ | | | | ■ | | | | | | | | | | | ■ | Voice Assistant | Tmall Genie Cube Sugar |
| 12 | | ■ | | | | | | | | 21 | | ■ | | | ■ | | | | | | | | | ■ | | | | ■ | | | | | | | | | ■ | | | Voice Assistant | Amazon Alexa |
| 13 | | ■ | | | | | | | | 28 | | | | ■ | ■ | | | | | | | | | | | | | ■ | ■ | | | | | | | | ■ | ■ | | Conversational Agent | In house - developed |
| 14 | | | | ■ | | | | | | 25 | | | ■ | | | ■ | | | | | ■ | | | | | | | ■ | | | | | | | | | ■ | | | Virtual Agent | In house - developed |
| 17 | | | | ■ | | | | | | 10 | | | | ■ | | | | | | | | | | | | | | | | | ■ | | | ■ | | | | | Embodied Conversational Agent | In house - developed |
| 19 | | | | ■ | | | | | | 47 | | ■ | | | | | | | | | | | | ■ | | | | | | | ■ | | | | | ■ | | | Voice Opareated Smart Speaker | Amazon Alexa |
| 21 | | | | ■ | | | | | | 34 | ■ | | | | ■ | | | | | | | | ■ | | ■ | | | | | | | | ■ | ■ | | | | | Voice Assistant | In house - developed |
| 22 | | | | | ■ | | | | ■ | 10 | ■ | | | | ■ | | | | | ■ | | | | ■ | | | | | | | ■ | | | ■ | | | | | Virtual Home Assistant | Amazon Alexa |
| 23 | | | ■ | | | | | | | 6 | ■ | | | | | | | | | | | | | ■ | | | | ■ | | | | | | | | | ■ | | | Voice Assistant | In house - developed |
| 24 | | | ■ | | | | | | | 5 | | ■ | | | ■ | | | | | | | | | ■ | | | | | ■ | | | | | | ■ | | | | | Voice Assistant | Amazon Alexa |
| 26 | | | | | | ■ | | | | 20 | | ■ | | | | | | | | | | | | ■ | | | | ■ | | | | | | | | | ■ | | | Chatbot | In house - developed |
| 28 | | | ■ | | | | | | | 10 | ■ | | | | ■ | | | | ■ | | | | | ■ | | | | ■ | | | | | | | | | ■ | | | Voice User Interface | In house - developed |
| 29 | | | ■ | | | | | | | 10 | ■ | | | | ■ | | | | ■ | | | | | ■ | | | | ■ | | | | | | | | | ■ | | | Voice User Interface | In house - developed |
| 31 | | | | | | ■ | | | | 33 | | | | ■ | ■ | | | | | ■ | | | | | | ■ | | | | | ■ | | | ■ | | | | | Digital Voice Assistant | In house - developed |
| 34 | | | | | | ■ | | | | 35 | | ■ | | | | | | | | | | | | ■ | | | | ■ | | | | | | | | | ■ | | | Chatbot | In house - developed |
| 36 | ■ | | | | | | | | ■ | 25 | ■ | | | | | | | | | | | | | ■ | | | | ■ | | | | | | | | | ■ | | | Multimodal Conversational Agents | In house - developed |
| 37 | | | ■ | | | | | | | 30 | ■ | | | | ■ | | | | ■ | | | | | | ■ | | | | ■ | | | | | | | | ■ | ■ | | Voice Assistant | Google Assistant |
| 40 | | | | ■ | | | | | | 19 | | ■ | | | ■ | | | | | | | ■ | | | | | | ■ | | | | | | | ■ | | ■ | | ■ | Intelligent Voice Assistants | In house - developed |
| 43 | | | ■ | | | | | | | 15 | | ■ | | | ■ | | | | | | | | | | | | | | | | ■ | | | ■ | | | | | Voice-controlled Intelligent Personal Assistant | Amazon Alexa |
| 46 | | | | ■ | | | | | | 78 | ■ | | | | | | | | | | | ■ | | | | | | ■ | | | | | | | ■ | | | ■ | ■ | Virtual Coach | In house - developed |
| 47 | | | | ■ | | | | | | 18 | | ■ | | | ■ | | | | | | | | | | | | | | | | | | ■ | ■ | | | | | AI Conversational Agent | SK Telecom's NUGU (Arya) |

*Since the one marked article examined all age groups, including the elderly, the table doesn't show a specific age range for this.

**Age categories reflect the definitions adopted by the included studies. Studies were included when they referred to their participants as older adults/elderly, regardless of the specific age threshold used by the author

***Only categories occurring in ≥2 studies are shown. Single-occurrence terms and platforms were excluded.

***Table A. 3: Descriptive information about the studies included (continued)***

| ARTICLE CODE | User Profile: Older Adults** 50+ | 55+ | 60+ | 65+ | 70+ | 75+ | 85+ | Other: Relatives | Professional | Caregiver | Number of older participants | Topic: Health | General/Daily Life | E-Commerce | Psychological/Well-being | Method: Interview | Focus Group | Usability Test | Workshop | Co-design | Usage Log Analysis | Content Analysis | Wizard of Oz | Participant Observation | Scale/Survey/ Questionnaire | Diary | Home Tour | Think Aloud | Length: ≤ 1 day | 1-15 Days | 15 - 30 days | 1-3 months | 3-6 months | 6-9 months | ≥ 1 year | Context: Home | Hospital | Facility | Lab | Other Setting | Preferred VCA Terms*** | VCA Platform*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 48 | | | | | | ■ | | | | | 18 | | ■ | | | ■ | | | | | | | | | | | | | ■ | | | | | | | | ■ | | | ■ | Smart Speaker Based Voice Assistant | Amazon Alexa |
| 49 | | | | ■ | | | | | | | 12 | | ■ | | | ■ | | | | | ■ | | | | | | | | | | | ■ | | | | ■ | | | | | Smart Speaker Based Voice Assistant | Google Assistant |
| 50 | | | | | ■ | | | | | | 20 | ■ | | | | | | ■ | | | | | ■ | | | | | | ■ | | | | | | | | | | | | Smart Voice Technology | In house - developed |
| 52 | | | ■ | | | | | | | | 40 | ■ | | | | | | | | | | | | | ■ | | | | ■ | | | | | | | | | | ■ | Voice Assistant | Amazon Alexa |
| 55 | | | ■ | | | | | | | | 18 | ■ | | | | | | | ■ | | | | | | | | | | | ■ | | | | | | | ■ | | | | Intelligent Assistant | In house - developed |
| 57 | | | ■ | | | | | | | ■ | 7 | ■ | | | | ■ | ■ | | | | ■ | | | | ■ | | | | | | | ■ | | | ■ | | | | | | Conversational Assistant | In house - developed |
| 59 | | | ■ | | | | | | | | 10 | ■ | | | | | | | | | | | ■ | | | | | | ■ | | | | | | | | | | | | Intelligent Virtual Agent | In house - developed |
| 60 | ■ | | | | | | | | | | 12 | ■ | | | | ■ | | | | | ■ | | | | | | | | | ■ | | | | | ■ | | | | | | Conversational Agent | In house - developed |
| 63 | | | ■ | | | | | | | | 24 | ■ | | | | | | | | | | | | | ■ | | | ■ | ■ | | | | | | | | | ■ | | | Virtual Conversational Agent | In house - developed |
| 64 | | | | | ■ | | | ■ | | ■ | 8 | | ■ | | | ■ | | | | | | | ■ | | | | | | | | ■ | | | | | | | | ■ | | | Smart Home Voice Interface | In house - developed |
| 65 | | | | ■ | | | | | | | 7 | | | | ■ | ■ | | | | | ■ | | | | | ■ | | | | | ■ | | | | | ■ | | | | | | Smart Speaker Based Voice Assistant | Amazon Alexa |
| 66 | | | | ■ | | | | | | | 7 | | ■ | | | ■ | | | | | ■ | | | | | ■ | | | | | ■ | | | | | ■ | | | | | | Intelligent Virtual Agent | Amazon Alexa |
| 67 | | | | ■ | | | | | | | 8 | | ■ | | | | | | | | ■ | | | | | | | | | | | | | ■ | ■ | | | | | | | Smart Home Speakers | Amazon Alexa |
| 68 | | | | ■ | | | | ■ | | | 12 | | ■ | | | ■ | | | | | | | | ■ | | | | | ■ | | | | | | | | | | | ■ | Voice Assistant | Huawei Celia |
| 69 | | | ■ | | | | | | | | 9 | ■ | | | | | | | | | | | ■ | | ■ | | | | | ■ | | | | | | | | ■ | | | Conversational Agent | Amazon Alexa |
| 70 | | | | ■ | | | | | ■ | | 25 | | | | ■ | ■ | ■ | | | | | | | | | | | | ■ | | | | | | | | ■ | | | | Chatbot | In house - developed |
| 72 | | ■ | | | | | | | | | 5 | ■ | | | | | | | | | ■ | | | | ■ | | | | | ■ | | | | | ■ | | | | | | Voice Assistant | Google Assistant |
| 74 | | ■ | | | | | | | | | 44 | | | | ■ | ■ | | | | | | | | | ■ | ■ | | | | ■ | | | | | ■ | | | | | | Robot and Virtual Agent | In house - developed |
| 75 | | | ■ | | | | | | | | 5 | ■ | | | | | | | | | | | ■ | | | | | | ■ | | | | | | | | | ■ | | | Intelligent Virtual Agent | In house - developed |
| 76 | | | ■ | | | | | | | | 55 | ■ | | | | ■ | | | | | | | | | ■ | | | | | | ■ | | | | | ■ | | | | | | Embodied Conversational Agent | In house - developed |
| 77 | | | | ■ | | | | | | ■ | 20 | ■ | | | | ■ | | | | | ■ | | | | ■ | | | | | | ■ | | | | | ■ | | | | | | Embodied Conversational Agent | In house - developed |
| 79 | | | | | ■ | | | | | | 33 | | ■ | | | ■ | | | | | | | | | | | ■ | | | | | | ■ | | | ■ | | | | | | Voice Assistant | Google Assistant |
| 82 | | | | | ■ | | | | | | 10 | | ■ | | | ■ | | | | | | | | | | | | | ■ | | | | | | | | ■ | | | | Voice Assistant | Amazon Alexa |
| 84 | | | | ■ | | | | | | | 14 | ■ | | | | ■ | | | | | | | | | ■ | | | | ■ | | | | | | | | ■ | | | | Embodied Conversational Agent | In house - developed |
| 86 | | | | | | | | | | ■ | 10 | ■ | | | | | ■ | | | | | | | | | | | | ■ | | | | | | | | | | ■ | Intelligent Cognitive Assistant | In house - developed |
| 88 | | ■ | | | | | | | | | 8 | ■ | | | | ■ | | | | | | | | | ■ | | | | | | ■ | | | | | ■ | | | | | | Conversational Agent | In house - developed |

*Since the one marked article examined all age groups, including the elderly, the table doesn´t show a specific age range for this.

**Age categories reflect the definitions adopted by the included studies. Studies were included when they referred to their participants as older adults/elderly, regardless of the specific age threshold used by the author

***Only categories occurring in ≥2 studies are shown. Single-occurrence terms and platforms were excluded.