Adapting Technology for Dementia Care: The Case of Emobook App in Reminiscence focused Music Therapy

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Abstract

INTRODUCTION: Life Story books are frequently employed to facilitate reminiscence interventions, but their use in Music Therapy remains limited in the scientific literature. There is a paucity of research detailing the design processes involved in this context.

OBJECTIVES: This paper aims to report on the adaptation of the Emobook Life Story Book App for a Reminiscence Music Therapy Program for people living with dementia.

METHODS: An interdisciplinary team comprising an interaction designer, a software engineer, a music therapist, and a research assistant engaged in a Participatory Design process. The study comprised two distinct phases: "Adaptation Phase," aimed to identify features requiring adjustment to integrate Emobook into MT effectively and the "Implementation Phase," focused on evaluating the adequacy of these changes for Emobook's use within the Music Therapy Program

RESULTS: By merging the requirements identified during each phase, additional improvements were generated, leading to the decision to evolve Emobook Post-Prototype towards a version tailored specifically for Music Therapy.

CONCLUSION: Collaborative, interdisciplinary efforts are essential in advancing the incorporation of technology into music therapy practice. This study demonstrates the value of a Participatory Design approach in this regard.

1. Introduction

Dementia is a pressing global concern, affecting approximately 50 million individuals worldwide, with projections estimating a substantial rise to 82 million cases by 2030 and 152 million by 2050 [1]. With such escalating prevalence, there is a critical need for cost-effective interventions to enhance the quality of life for both dementia patients and their caregivers. Reminiscence therapy, a non-pharmacological approach, has emerged as a promising intervention, demonstrating positive impacts on cognitive function, depressive symptoms reduction, and the promotion of positive self-esteem [2]. Music Therapy (MT), another non-pharmacological approach, has proved its efficacy in alleviating mood disorders among individuals living with dementia [2,3]. When working with people with dementia in

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MT, it is frequently to evoke reminiscence through familiar melodies, fostering meaningful conversations and the recollection of memories linked to personal and cultural identities. A recent study reported benefits of integrating music with reminiscence therapy, notably in mitigating depressive symptoms among those with dementia [4].

Within MT field, there are two techniques that systematize the reminiscence-focused process: Associative Mood and Memory Training (AMMT) and Reminiscence Focused Music Therapy (RFMT). AMMT is a cognitive rehabilitation technique that uses music to enhance memory processes in three ways: (1) by producing a mood-congruent state to facilitate memory recall, (2) by activating associative mood and memory networks to access long-term memories, and (3) by instilling a positive mood at both encodings and recall enhancing learning and memory function [5]. RFMT distinguished for combining the use of music with associative items, such as photographs, knitting patterns, smells, tastes, textures, and old objects, to encourage reality orientation, increase verbal interaction, and stimulate cognition [4]. The two techniques offer a systematization of the reminiscence-focused process, including guidelines for the selection of music, session planning, and associated protocols [4,5].

Multimedia technologies, such as life story book apps, have also proven to be beneficial for conducting reminiscence therapy in dementia care. They facilitate narrative construction by containing photos, images, videos, music, or audio that prompt life memories, thereby serving as a tool to impact well-being and quality of life. Among them Emobook stands out as an app developed to enhance reminiscence experience by providing therapists with multimedia control, interactive features (e.g., music, sounds, movie clips), and interaction record collection, facilitating disease progression monitoring [6]. It facilitates the organization of memories by arranging them into themes/chapters. Furthermore, multimedia contents can be tagged to facilitate searching and filtering content. Its adaptable features, including mood meters, offer flexibility and participants mood tracking (see Figure 1).

Despite the frequent use of life story book apps to facilitate reminiscence interventions in dementia care, there is currently a gap in the literature, as no studies have explored their implementation within MT. Consequently, there is also a lack of evidence regarding specific requirements and challenges encountered when integrating multimedia technologies into MT programs for people living with dementia. Participatory Design (PD) emerges as a methodology to address this gap, particularly prevalent in co-designing health-related applications [7,8].

This article explores PD process developed to adapt Emobook to be integrated into a Reminiscence Focused Music Therapy Program.
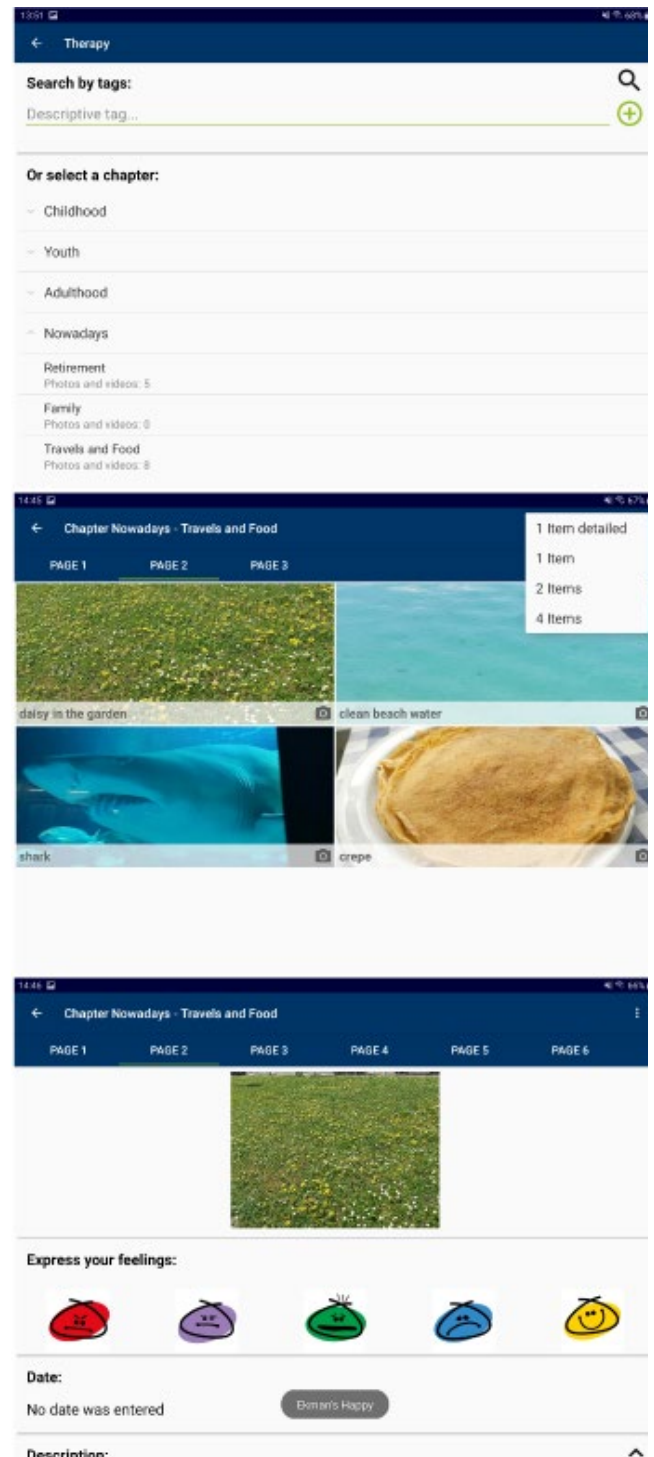

Figure 1. Snapshot of Emobook first prototype.

2. Objectives

The aim of this article is to report on the PD process involved in the adaptation of the Emobook App for a reminiscence focused MT program for people living with dementia. To address this objective, three specific aims were established:

- To identify the requirements of the interdisciplinary team involved in the Adaptation Phase.
- To report the technical challenges encountered during the Implementation Phase.
- To document the improvements devised as starting points for enhancing Emobook use in MT.

These objectives served as guiding principles throughout the study, facilitating a comprehensive assessment of the PD process and its implications for enhancing dementia care through technology adaptation.

3. Questions

In accordance with the study objectives, three questions were set to be answered in this article:

- What were the requirements identified by the interdisciplinary team during the Adaptation Phase?
- What were the primary technical challenges encountered during the Implementation Phase?
- What improvements were drawn to address the challenges and advance the app integration into MT?

4. Methods

PD iterative process promotes the participation of users in the design process of health-related applications [7,8]. Key activities include fieldwork, literature reviewing, development and testing. Based on published evidence [7] and in order to enhance user participation, the workflow was structured under three headings:

- **Telling:** Participants chance to share their knowledge.
- **Making:** Tools allow the ability to create, for example, through creative workshops conducted to generate ideas.
- **Acting:** Explore how new designs could affect practice, for example, by testing ideas in the field.

This study comprised two distinct phases within the PD process. The first phase, referred as the "Adaptation Phase" (P1), aimed to identify features requiring adjustment before implementing Emobook into MT. The second phase, termed the "Implementation Phase" (P2) focused on evaluating the adequacy of those changes for Emobook's use within the MT program. The program involved targeted groups of three older adults living with dementia, with each group participating in 8 sessions. Each session lasted 45 minutes and was conducted twice weekly, spanning a month-long duration.

4.1. Setting

P1 comprised five meetings. The first meeting was conducted online via Microsoft Teams platform, facilitated by the University of Santiago de Compostela. Starting from the second meeting, sessions took place onsite at CiTIUS

(Research Centre for Intelligent Technologies), an institution affiliated with the university. The meeting room was well-equipped to foster collaboration and productivity, featuring a spacious worktable, synchronized screens mirroring the designer's tablet, and individual tablets for therapists' use. Additionally, traditional tools such as paper and pens were available for sketching diagrams or notes. To ensure comprehensive documentation and continuity, diaries were maintained to record key discussion points and areas for further exploration after each meeting.

P2 comprised three meetings distributed throughout the pilot study conducted in December 2023, post protocol approval from the Ethics Committee of the University of Santiago de Compostela (USC53/2023, December). Thy were strategically scheduled at three key points of the pilot study: (1) following participant pre assessment, (2) midway through the program, and (3) upon program completion. These meetings were conducted onsite at CiTIUS.

4.2. Team

The team consisted of four professionals from two distinct domains: technology and social health. In the social health domain, there was a music therapist responsible for designing and implementing the intervention program as part of her doctoral studies, as well as a nurse specialized in gerontology serving as a research assistant with participant familiarity. The technology domain included the software developer and creator of the Emobook App, along with a computer engineer acting as a project collaborator. Additionally, the process received oversight from an experienced music therapist and the director of the doctoral program, a psychologist specialized in gerontology.

4.3. Tools

The co-design tools were selected to effectively amalgamate knowledge from diverse fields and foster collaborative problem-solving:

- **Brainstorming:** Within this tool, the "technology domain" encompasses emerging technologies that may stimulate innovative design concepts. Simultaneously, the "social health domain" focuses on health aspects open to potential adaptations.
- **Timeline:** These minute-by-minute diagrams outline the actions to be executed during the intervention.
- **Work Diaries:** These served as comprehensive records, documenting the subjects discussed, ideas generated, and future action plans emerging from meetings.

4.4. Procedure

Meetings were convened at biweekly intervals, lasting approximately one and a half hours each. These work meetings followed a structured format divided into three distinct phases:

- **Introduction (Telling).** The meeting began with an introduction to the topic at hand. This phase often involved the presentation of findings from literature reviews or research results, and it also included updates to the project timeline.
- **Idea Generation (Making).** The second phase involved a brainstorming meeting aimed at finding solutions to any issues or challenges that surfaced during the presentation. This creative process generated a pool of ideas and potential solutions.
- **Action Plan (Acting).** The final phase focused on defining concrete steps and action plans for upcoming meeting.

Table 1 provides a concise overview of the meeting objectives.

Table 1. Meeting objectives.

Meeting	Objective
Phase 1: Emobook Adaptation	
1	Present the Music Therapy Program.
2	Establish a timeline for the program.
3	Share findings from literature reviews.
4	Integrate Emobook into timeline.
5	Discussion regarding Emobook post-prototype.
Phase 2: Emobook Implementation	
6	Report on initial challenges encountered.
7	Report on coping mechanisms implemented.
8	Discussion on potential improvements.

Meeting specifics are outlined in section 5, as they are integral to the sequence of results.

4.5. Strategic Meeting Design and Evaluation

Each meeting was strategically designed to build upon the outcomes of the previous one. This deliberate sequencing aimed to facilitate the integration of the ideas generated (IG) into an action plan (AP), enabling well-informed decision-making for the successful Emobook integration within the MT program. To assess the effectiveness of our PD process, we considered several critical factors: the quantity and quality of ideas generated, their alignment with the action plan, and their overall influence on improving Emobook.

5. Results

5.1. Phase 1: Emobook Adaptation

Meeting 1
Introduction. The music therapist outlined the program's objectives and components. It was designed under the AMMT technique [5], chosen for its associated framework conducive to developing a precise timeline, a requirement highlighted by the technologists involved. Specifics regarding the implementation were provided: the program would be conducted in a group setting, involving three older adults living with dementia, with a specific emphasis on fostering social interaction outcomes, in line with the documented benefits observed in previous studies [3]. The research assistant offered insights into the institutional context, underscoring her prior experience within the institution and her familiarity with the participants.

Brainstorming. The technologists asked questions about the music therapist's presentation, the technique, and the processes involved. They also requested a copy of the protocol involved. They were interested in understanding the different stages of the session.

Action Plan. For the next working meeting, the music therapist should develop a minute-by-minute timeline of the intervention and state: what questions will be asked to the patients, when measures will be taken, and what instruments will be used (LA1).

Meeting 2
Introduction. The music therapist presented a minute-by-minute timeline in accordance with the clinical protocol, ensuring precise data correlation to meet the requirement for a comprehensive schedule. Subsequently, the technologists explained how to choose and preset the emotional assessment scales included in the app [6]. The data collection architecture of the app was elucidated, focusing on how Emobook facilitates the organization of memories by incorporating pictures or videos into themes/chapters, intended to construct the life story of each participant individually.

Idea Generation. Considering the group setting, the generated idea was to adapt Emobook from its individual profiles interface into groups of three (IG1). In this manner, chapters would encompass shared memories, featuring a combination of individual and group experiences. Labels would play a crucial role in relating multimedia files.

Action Plan. Since Emobook allows for the selection between different scales to assess emotions, the line of action derived from this meeting was to conduct a concise umbrella review of the emotional assessment scales included in the application to analyse which ones should be used and when (LA2). The search was initiated based on the technical team members providing pertinent literature relevant to the subject.

Meeting 3
Introduction. The umbrella literature review uncovered various mood meters, ranging from simple like/dislike models to more intricate frameworks such as Plutchik's 8 basic emotions and Desmet's Pick-a-Mood to the Dementia Mood Picture Test [9, 10, 11]. It is worth noting that a preceding study that utilized Emobook supported the use of simplified mood meters for the precise capture of responses from individuals with dementia through direct questioning [6]. Moreover, therapists engaged in that study suggested incorporating a secondary mood meter to encompass a broader spectrum of emotions, thereby enhancing the

emotional assessment process [6]. In response to this recommendation and the literature review, the music therapist proposed integrating a secondary mood meter for comprehensive emotion assessment.

Idea Generation. It was determined that the Ekman Scale would serve as the primary mood meter, employed each time a multimedia file was utilized to evoke a memory. This selection was based on its simplicity, as it offers fewer options compared to the other mood meters included in the app. Conversely, the Pick a Mood scale was suggested as the Secondary Mood Meter at the beginning of each session through the question "How are you feeling today?" to evaluate the mood before the intervention. The Pick a Mood User Manual advises that "given the relative stability of mood, it is advisable to inquire about it no more than twice around the event of interest" [9]. It also emphasizes that reporting moods immediately after an emotional event, such as a social interaction, may lead individuals to express their feelings about that anticipated event rather than their current mood [9]. Therefore, the idea generated in this meeting was to incorporate two emotional assessment scales into the music therapy program (IG2).

Action Plan. Consequently, for the next meeting, the action line involved creating a new timeline incorporating the use of Emobook, taking into consideration each of the moments of the meetings and the use of the assessment scales included in the app (LA3).

Meeting 4

Introduction. The music therapist presented the intervention timeline with Emobook integrated as a tool. In the second part of this meeting, the technologists showed how a smartwatch with a built-in scale would work to assess the emotional responses of people with dementia. Such a smartwatch interface suffers from touch overshooting and divided attention as the user must look down the wrist for longer and maintain the arm in an inconvenient position. Further, unlike the tablet, the smartwatch would not allow the multimedia material to be manipulated, it would only incorporate the emotional assessment scale.

Idea Generation. Following a constructive exchange of viewpoints and a thorough review of the intervention timeline, a consensus emerged. It was collectively decided that equipping both the music therapist and the assistant with tablets featuring the new Emobook prototype was the optimal choice. The primary rationale behind this decision was to ensure that the assistant also had access to the application and an updated data backup, enhancing the overall effectiveness of the intervention. There-fore, the idea generated was related

to the device selection: to use two tablets featuring the Emobook post-prototype for the music therapy pilot program (IG3).

Action Plan. One of the technologists commented that it would be convenient to have at least one additional measurement instrument or tool for more objectivity regarding the data collected. The music therapist recalled that the data could also be correlated with a music therapy assessment tool that would be used. The line of action derived from this proposal was to determine how the validated music therapy assessment tools complement the records obtained through Emobook (LA4).

Meeting 5

Introduction. Concerning the line of action that emerged in the previous meeting, the music therapist presented MiDAS [12], a validated music therapy tool developed to measure the observable musical engagement of persons with moderate or advanced dementia who may have limited verbal skills to directly communicate their musical experiences. "MiDAS focuses on capturing what people with dementia value in music (the "enjoyment")" [12] using a Visual Analogue Scale (VAS). It also allows qualitative data to be recorded.

Idea Generation. After the music therapist's presentation, it was decided that it would be positive to correlate the data obtained through the Emobook application with those obtained from the MiDAS assessment toolkit (IG4). Especially, considering that it allows qualitative data to be recorded, a relevant aspect facing the challenges and limitations of quantifying significant emotional experiences. In this sense, this as-assessment tool is adequately complemented by the scales incorporated in Emobook.

Action Plan. Finally, the technologists delivered the configured equipment with Emobook post-prototype. They explained that they configured the package to be updatable without deleting data, although previous tests must be carried out by creating three profiles. At the end of this meeting, the process was concluded with a post-prototype of Emobook ready to be tested by the music therapist before the start of the pilot program).

5.2. Phase 1 Evaluation

The results of P1 include the generation of four ideas and four lines of action. The iterative condition of the process was reflected in the concatenation of LA and IG, as shown the Figure 2.
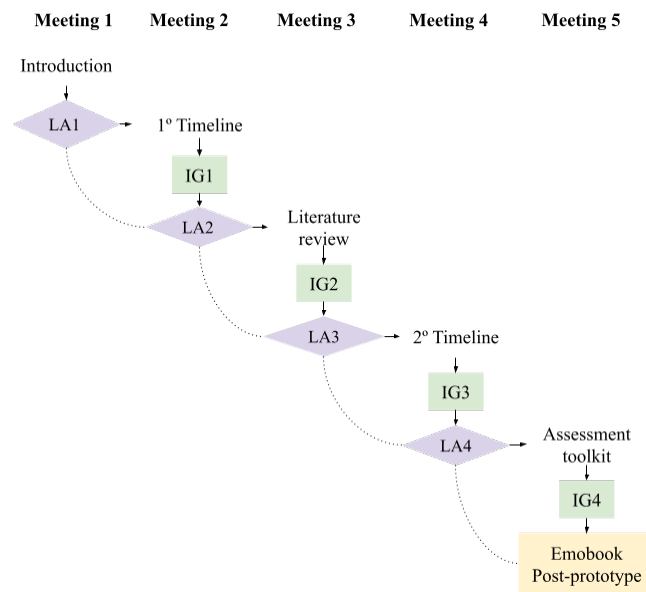
Figure 2. Participatory Design Flowchart: Lines of Action (LA) and Ideas Generated (IG) in Phase 1.

The requirements identified by the interdisciplinary team during the Adaptation Phase include: (1) the development of a detailed schedule to ensure precise correlation of intervention-related data, (2) the addition of a secondary mood meter to enhance emotion registration, (3) the decision to correlate data with MiDAS Assessment Toolkit, (4) the configuration of Emobook Post-Prototype for group testing.

5.3. Phase 2: Emobook Implementation

Upon installing Emobook's post-prototype on the devices, the implementation phase commenced. Throughout this phase, three meetings were convened at CiTIUS to report and discuss the outlined objectives in Table 1.

Meeting 6
Introduction. The pre-assessment stage not only involved collecting data before starting the MT program but also gathering information for contents personalization to be included in the app. Following the selection of multimedia content for each profile, both users reported a drawback. Due to the current app's lack of a cloud storage system, changes made on one tablet do not reflect on the other, thereby disrupting collaborative work. Additionally, uploading multimedia content requires exiting the app, which impedes workflow.
Idea Generation. The technologist explained that Emobook was initially designed to be used on a single device managed by one user. However, considering the current context and potential future usage scenarios, the team recognized the potential benefits of implementing **optional data storage and real-time data synchronization** (IG5). This enhancement would not only enable direct uploads from

platforms within the app but also facilitate synchronization among all social health professionals involved.
Action Plan. For subsequent sessions, the technologist suggested sharing materials by copying the backup folder on each device. They also requested the team to **note down all drawbacks** from now on, considering and reporting in detail the coping mechanisms implemented (LA5).

Meeting 7
Introduction. Midway through the program, users reported the need to track in a separate spreadsheet participant assistance. Additionally, difficulties were encountered in accurately registering active participation due to temporary absences related to factors such as napping or bathroom breaks.
Idea Generation. Technologists expressed interest in the coping mechanisms implemented. Users presented the type of list on paper they were using, based on which possible solutions were crafted. Thus, it was proposed to integrate **attendance tracking** directly within the app for ease of use and implement a system to record periods of inactivity, providing more accurate participation data (IG6).
Action Plan. Technologist request that users continue to note down any drawbacks they encountered. Additionally, a meeting was convened immediately after completing the program to evaluate adjustments aimed at enhancing Emobook (LA6).

Meeting 8
Introduction. The discussion on potential future improvements started with the notes taken by the therapist and assistant during the program. Apart from the previous ones reported, considerations included giving a central role to songs: although they are crucial for memory recall in music

therapy, audio files are not currently central to the app, which primarily focuses on image files. Furthermore, the possibility of changing emotional rating scales easier was commented, as changing scales require switching to the "Settings" section, slowing down the process.

Idea Generation. It was decided to include the option of promoting memories, including songs which could give them a central role in digital life history book (IG7). Additionally, the idea was put forward to offer the option to adjust the rating scale directly where memories are displayed, allowing for

faster recording of emotions linked to specific moments in the session (IG8).

Action Plan. Based on the discussions regarding adjustments to the App for use in MT, additional requirements were brainstormed to evolve it (LA7).

5.4. Phase 2 Evaluation

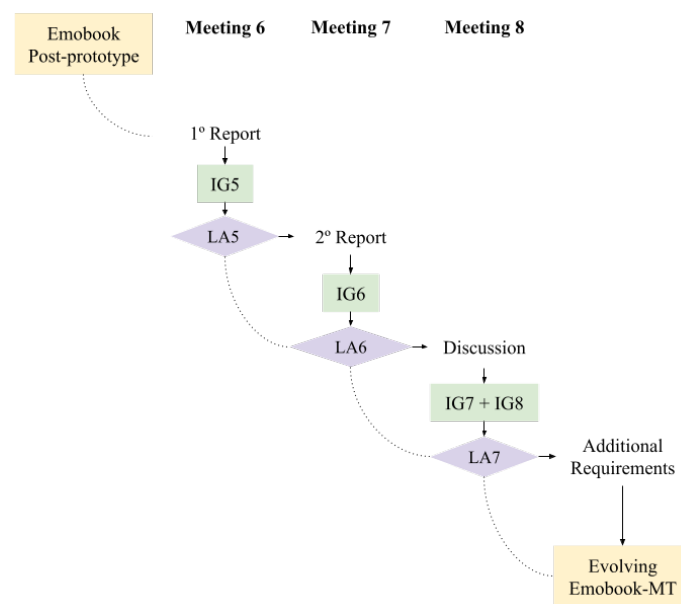The results of P2 include the generation of four ideas and three lines of action (Figure 3).

Figure 3. Participatory Design Flowchart: Lines of Action (LA) and Ideas Generated (IG) in Phase 2.

The primary technical challenges encountered during the Implementation Phase were as follows: (1) the lack of a cloud storage system, (2) absence of tracking participant assistance and accurately registering active participation within the app, (3) inadequate integration of audio files in relation with their significance for memory recall in MT, and (4) cumbersome process of changing emotional rating scales, which requires navigating to the "Settings" section and slows down the workflow. Based on these reports and on additional requirements brainstormed later, a decision was made to establish a list of initial improvements to evolve Emobook into a new version adapted for use in Music Therapy: Emobook-MT.

5.5. Evolving Emobook-MT: Initial Requirements

Throughout the PD process, and particularly during the final brainstorming sessions, a list of initial requirements was established for evolving the Emobook-MT version. This selection of improvements represents the core outcome of this PD double phase:

- **Attendance Track:** Include a toggle switch or checkbox for each participant to mark them as "Present" or "Absent." Offer an optional text field where users can input reasons for absence (appears when "Absent" is selected).
- **Status Icon:** Include a small icon next to each participant's name that changes colour to represent their activity level (e.g., green for active, red for inactive).
- **Seamless Multimedia Integration:** Implement in-app search functionalities for platforms like YouTube, Spotify, and Google Images. Allow users to directly search, select, and integrate multimedia content into their sessions. Integrate APIs provided by these platforms to enable in-app searching and potentially embedding content (with proper permission checks).
- **Promoting Memories:** This mechanism will aim to enhance the significance of certain memories. By "promoting" a memory, the app emphasizes its importance, such as highlighting the hierarchy of music in memory recall.

- **Dynamic Emotional Rating:** Include a customizable emotional rating scale directly within the memory display area. Users can quickly select a rating scale. Design an interface element for the rating scale that can be dynamically displayed next to memory entries.
- **Offline Functionality**: Visually indicate if content is stored locally or in the cloud. Consider caching mechanisms for limited offline access when an internet connection is unavailable. Implement chosen storage solution (cloud storage API or real-time database integration).

6. Conclusions

The interdisciplinary collaboration in the PD process proved fruitful, resulting in valuable adjustments to Emobook for its integration into MT. This collaborative effort accelerated the assimilation of technological competencies, promoting the integration of knowledge in adapting the tool for music therapy practice.

This comprehensive process led to the decision to evolve Emobook into Emobook-MT, tailored specifically for Music Therapy. Although this study relies on the PD process for adapting technology rather than the results of an MT intervention, it advances the potential benefits of technology-enhanced reminiscence for people living with dementia. Furthermore, considering that the use of digital technologies in MT shows promise in improving emotional engagement and social interaction.

While the study provides valuable insights into the intersection of music therapy and technology, it also highlights the need for further exploration, particularly to bridge the experience with existing evidence on technology in MT. The literature investigation encountered challenges due to gaps in knowledge, which influenced study decisions and highlighted the scarcity of scientific literature on relevant topics.

The next phase will address the technical implementation of the software features to give full coverage to the initial requirements identified for Emobook-MT. Then, a second pilot study of the evolved version will be carried out, to evaluate the effectiveness in monitoring mood effects during and after the intervention, assessing persistence, and determining ongoing treatment needs. The PD process will be repeated based on the results obtained during the second pilot study.

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