



Development of a Game-Based Mobile Application to Improve the Psychosocial Well-Being of Children with Cancer and Their Caregivers

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ABSTRACT

Pediatric cancer not only impacts children physically but also significantly affects their psychosocial well-being and that of their caregivers. Traditional play therapy has been widely used to address psychological distress in young patients, but digital transformation opens new avenues to enhance its accessibility and effectiveness. This study aims to develop and evaluate a mobile application-based game to support the psychosocial health of children with cancer and their caregivers. The research adopted a design-based approach involving need analysis, app development, and usability testing. The application includes interactive education about cancer, relaxation exercises, and caregiver support communities. Effectiveness was assessed through a pre-and post-use evaluation involving children undergoing cancer treatment and their caregivers in selected hospitals. Significant improvements were found post-intervention: children experienced a 50% decrease in anxiety and a 47.3% improvement in mood; caregivers reported reduced stress (33.7%) and a 53.9% increase in perceived social support. Both children and caregivers expressed high satisfaction and willingness to continue using the app. The developed mobile application positively impacts the emotional resilience and psychosocial conditions of pediatric cancer patients and their caregivers. Integrating play therapy into a digital format provides an accessible, engaging, and effective tool to enhance quality of life during treatment.

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1. INTRODUCTION

Cancer in children is one of the diseases that have a significant impact, both in physical and psychosocial aspects [1]. Every year, more than 400,000 children around the world are diagnosed with cancer, which causes them to face various severe challenges, such as anxiety [2], stress, and depression [3] during treatment [4]. Children and caregivers who accompany them also feel considerable emotional pressure, affecting their ability to provide maximum support [5], [6]. This phenomenon demands innovative approaches to improve psychosocial conditions for patients and their caregivers.

The study adopted the theory of play therapy as a foundation [7], [8], which is effective in reducing anxiety and improving the quality of life of children undergoing cancer treatment [9], [10]. In addition, the study leverages the theory of the influence of technology in psychosocial therapy, which integrates game-based applications to support the therapy process [11], [12]. This technology offers advantages in terms of greater accessibility and flexibility compared to conventional therapeutic approaches.

Given the increasing number of childhood cancer patients and the enormous challenges faced by their caregivers [13]. With the development of technology-based game applications, it is hoped that it can be an effective alternative in improving the psychosocial condition of patients and caregivers [14]. The urgency of this research is to reduce anxiety, improve mood, and improve their quality of life during the challenging treatment process [15].

This research offers a novelty by developing a technology-based game app designed specifically for children with cancer. In contrast to conventional play therapy, this app can be accessed anytime and anywhere, providing

ongoing emotional support [16], [17]. In addition, the app also provides space to strengthen social interactions between children and caregivers and improve their control over the treatment process, which has not been explored much in previous studies.

This research aims to develop technology-based game applications that can improve the psychosocial condition of children with cancer and their caregivers. The main objectives of this study are to reduce the anxiety and stress of children and caregivers, improve their quality of life, and strengthen the emotional connection between children and caregivers through interactive features in-game apps. The application is expected to be an innovative solution that can be widely used to support psychosocial therapy for pediatric cancer patients.

2. RESEARCH METHOD

This study adopts qualitative and quantitative research methods to develop technology-based game applications that aim to improve the psychosocial condition of children with cancer and their caregivers. The method consists of three main stages: application design and development, testing and validation, and implementation and evaluation.

In the design and development stage of the application, a needs analysis was carried out to understand the psychosocial challenges faced by children with cancer and their caregivers. This analysis involved interviews with medical personnel, psychologists, and caregivers of children with cancer, as well as observations of children undergoing cancer treatment. Based on the results of the needs analysis, the development team designed an application with relevant features that support improving the psychosocial condition of patients and caregivers through educational games, relaxation, and social interaction. The design of this app uses a storyboard, wireframe, and mockup-based approach.

These game apps are developed using programming languages appropriate to the target platform (e.g., Swift for iOS or Kotlin for Android). Application development is done iteratively, with periodic testing to ensure the application performs according to the desired specifications. Key features in the app include cancer education, breathing exercises, meditation to reduce anxiety, and facilities for social interaction between caregivers and children through sharing experiences and stories.

Once the app is fully developed, the next stage is testing and validation to ensure that the app can function properly and effectively in improving the child's and caregiver's psychosocial condition. Testing is conducted in two stages: Internal Testing: The first test is conducted by the development team to identify and fix bugs or technical issues in the application. A limited trial was then carried out: testing was carried out on a small group of children with cancer and their caregivers in a hospital that collaborated with the study. The data obtained from this limited trial was used to measure the app's effectiveness in improving psychosocial conditions and obtain user feedback for app improvements at the data collection and analysis stage.

During the limited trial, data was collected through questionnaires, interviews, and direct observation of children and their caregivers. The questionnaire measured anxiety, stress, mood, a sense of control over treatment, and the quality of communication between the child and the caregiver. The data obtained from this limited trial were analyzed using appropriate statistical methods, such as mean comparison analysis (t-test), to measure changes in psychosocial conditions before and after using the app.

Based on the test results, the app is improved by fixing bugs and adding the necessary features to improve the user experience. Improvements were made based on feedback from limited testing, focusing on ease of use and effectiveness in supporting psychosocial conditions. In the last stage, the app was implemented in some hospitals that treat children with cancer. Medical personnel and caregivers are trained to ensure the app is used effectively. The app's performance was evaluated through surveys and interviews with the children, caregivers, and medical personnel involved. This evaluation aims to measure the impact of the application on the psychosocial conditions of children and caregivers and determine potential improvements in the future.



3. RESULTS AND DISCUSSION

3.1. Results

Table 1. Changes in Psychosocial Conditions of Children and Caregivers Before and After Using the App

Aspects Tested	Before Using the App (Scale 1-10)	After Using the App (Scale 1-10)	Change (%)
Children's Anxiety Level	8.2	4.1	-50%
Children's Stress Levels	7.9	4.3	-45.57%
Children's Mood	5.5	8.1	+47.27%
A Child's Sense of Control over Medication	3.8	7.2	+89.47%
Quality of Communication with Caregivers	6.3	8.5	+34.92%
Caregiver Anxiety Level	7.6	5.0	-34.21%
Caregiver Stress Level	8.0	5.3	-33.75%
Caregiver Social Support Sense	5.2	8.0	+53.85%

Table 2. Impact on the Psychosocial Conditions of Children and Caregivers

Aspects Tested	Impact on Children	Impact on Caregivers
Anxiety Level	Significant reduction in children's anxiety (50% lower)	Decreased caregiver anxiety (34% lower)
Stress Level	Reduced child stress (45% lower)	Reduced caregiver stress (33% lower)
Mood	Improved child's mood (47% higher)	Increased feeling of calmness and stability
A Sense of Control Over Treatment	Children feel more empowered and in control (89% higher)	Caregivers feel better able to manage situations (58% higher)
Quality of Communication with Caregivers	Improved the quality of communication between children and caregivers (33% better)	Caregivers find it easier to communicate with children (34% better)
A Sense of Social Support	Children feel more supported in dealing with treatment	Caregivers feel more supported by communities and apps (53% higher)
Children's Involvement in Treatment Activities	Increased interest and engagement in medicine thanks to the app's educational features	Caregivers feel more involved in the treatment process thanks to the app
Ability to Manage Emotions	Children are better able to manage feelings of anxiety and fear using the relaxation feature in the app.	Thanks to the app's support features, caregivers can better manage emotions and stress.
Improved Quality of Life	Children show an overall improvement in quality of life during the treatment process.	Caregivers feel an improvement in their overall quality of life
Motivation to Continue Use	Children show high motivation to continue using the app	The caregiver reported the intention to continue using the app for the child

Table 3. User Satisfaction with the Application

Aspects Tested	Score (Scale 1-10)
Application Satisfaction	8.3
Level of Desire to Continue Using the App	9.1

3.2. Discussion

This research aims to develop and test technology-based game applications that can improve the psychosocial condition of children with cancer and their caregivers. Based on the results obtained from the application trial, there is a significant positive impact on the psychosocial condition of both children and their caregivers, which can be further understood in the following aspects.

One of the study's key findings was a significant reduction in anxiety and stress levels in both children and caregivers after using the app. In children, anxiety levels dropped by 50%, and their stress was reduced by 45.57%. This shows that the game app is successful in distracting children from the anxious feelings that often arise during

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cancer treatment, such as fear of medical procedures and an uncertain future. Previous research showed that the use of applications is very beneficial for cancer patients undergoing chemotherapy to reduce anxiety [18], [19].

Caregivers also reported a 34.21% reduction in anxiety and 33.75% in stress. This indicates that caregivers feel more supported and have tools that help them manage the stress of caring for a sick child. These apps give caregivers the opportunity to feel calmer, which is crucial to ensuring they can provide optimal emotional support for the child [20].

In addition to reducing anxiety and stress, the study also showed that children's moods improved significantly after using the app, with an increase of 47.27%. The app's fun and interactive gameplay elements can explain this mood boost. These elements help children feel more positive and more excited in the face of treatment. The process of cancer treatment is often exhausting and painful, and these apps provide an opportunity for children to get entertainment that also has a good emotional impact.

This study also emphasizes the importance of a sense of control for children undergoing cancer treatment. Children who used the app showed an increase in their sense of control over their treatment process by 89.47%. The app allows children to learn more about their treatment through educational games, which helps them feel more empowered in treatment. This high sense of control is essential, as it can reduce the sense of helplessness that child patients often experience and help them be more active in the healing process [21].

Another noteworthy result was the improvement in the quality of communication between children and caregivers, which increased by 34.92%. The game's playable features that can be shared between the child and the caregiver strengthen their emotional bond. These games provide entertainment and allow the caregiver to understand the child's feelings better and interact more positively with them. This is important because good communication between the child and the caregiver can improve the quality of emotional support provided during the treatment process [22], [23].

Caregivers who care for children with cancer often feel isolated and emotionally burdened [5], [24], [25], [26], [27]. Gotze et al (2018) research shows that caregivers of cancer patients have symptoms of severe anxiety (32%) and depression (29%) [28]. Several factors cause caregivers to be anxious and depressed, namely, treatment for more than 24 months, outpatient care, pension, health insurance, illiteracy, surgery, economic [29], and patient age [30]. However, the app provided a greater sense of social support, with an increase of 53.85%. Through community features and interactions with other caregivers facing similar situations, caregivers feel more connected and not alone in their journey. This strong sense of social support helps caregivers to be more resilient to the challenges of caring for their children.

Lastly, the user satisfaction rate with this app is very high. With a satisfaction score of 8.3 on a scale of 1-10 and a very high desire to continue using the app with a score of 9.1, this study shows that the app is not only effective in improving the psychosocial condition of children and caregivers but is also well received by its users. This reflects that the app has a significant impact on their daily lives, providing entertainment and helping to manage stress and anxiety during cancer treatment.

Although the results positively impacted the study, they identified some challenges, one of which is the limited access to technology faced by some children and caregivers, especially those from lower economic backgrounds. Some caregivers also reported difficulties using the app due to a lack of familiarity with technology. Therefore, it is important to continue simplifying the app's interface and providing clear guidance for caregivers who are less familiar with technology.

Additionally, the app's content may need to be further tailored for different age groups, given that children of different ages have different preferences and developmental levels. Improving the app to ensure that content remains relevant and engaging for different age groups will help increase its effectiveness in supporting cancer treatment in children.

4. CONCLUSION

Overall, the results of this study show that technology-based game applications have great potential to improve the psychosocial condition of children with cancer and their caregivers. The app has successfully reduced anxiety and stress, improved mood, improved communication quality, and provided a much-needed sense of social support for caregivers. While some challenges need to be overcome, especially related to technology access and difficulty of use, the app offers innovative solutions that can improve the quality of life of children and caregivers during cancer treatment.



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