


DEVELOPMENT OF AN MHEALTH TECHNOLOGY FOR PREVENTION AND MENTAL HEALTH LITERACY AMONG YOUNG COLLEGE STUDENTS

DESENVOLVIMENTO DE UMA TECNOLOGIA MHEALTH PARA PREVENÇÃO E LITERACIA EM SAÚDE MENTAL ENTRE JOVENS UNIVERSITÁRIOS
DESARROLLO DE UNA TECNOLOGÍA MHEALTH PARA LA PREVENCIÓN Y ALFABETIZACIÓN EN SALUD MENTAL ENTRE JÓVENES UNIVERSITÁRIOS

Alice Agnes Spindola Mota

Universidade Federal do Tocantins.
aliceagnes@uft.edu.br

 0000-0003-2634-8374


Hareli Fernanda Garcia Cecchin

Universidade Federal do Tocantins hareli@uft.edu.br

 0000-0003-4875-7638


Sidiany Mendes Pimentel

Universidade Federal do Tocantins.
sidiany.pimentel@iftto.edu.br

 0000-0003-2460-8443


Marta Romilda Spíndola

Universidade Federal do Tocantins.
martaromilda@gmail.com

 0000-0003-4593-8791


Humberto Martins

Universidade Federal do Tocantins.
hbertoduarte@gmail.com

 0000-0001-5459-2759

Felipe Leite

Universidade Federal do Tocantins.
felipeleite@uft.edu.br

 0000-0002-8267-2198

Mailing address: Universidade Federal do Tocantins, Reitoria, DIRETORIA DE COMUNICAÇÃO. Quadra 109

Norte Avenida NS 15, Plano Diretor Norte, 77001090 - Palmas, TO – Brasil.

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ABSTRACT:

The topic of this paper is the development of a mobile technology application for health promotion in the context of the public university. This is an applied research that presents the steps of building and designing an mHealth technology. The work is guided by interdisciplinary theoretical reflection, covering fundamentals of communication, psychology, and computer science. Through the analysis of interviews and suggestions from students of the institution, a software project was developed for illness prevention and promotion of mental health. The proposal is of fundamental importance and can contribute to the development of practices that alleviate psychological suffering in the context of public higher education.

KEYWORDS: Primary Prevention; Mental Health; Science Management; Technology and Innovation in Health; mHealth; Health Literacy.

Introduction

Entering higher education brings radical changes in routines and experiences, especially during youth. Such transformations can affect the identity, personality, emotions, and mental health of individuals. The university constitutes a space for constructing social life that allows for the expansion of experiences lived in the individual's family. During adaptation to university life, a new culture comes into play, with new relationships of power, meaning, and belonging (Sahão & Kienen, 2021). The set of transformations and efforts required by insertion into university life can result in discomfort and even psychological suffering for students (Andrade et al., 2016).

In addition to adapting to university life, other factors can cause psychological distress for undergraduate students during their academic experiences in their most complex perspectives. Academic experience is a term that defines the "overall set of aspects of university experiences, which reflect in the performance and success of students" (Association of College & Research Libraries, 2018).

When discussing mental health, it is important to discuss integrated skills that include the discovery, reflection, and perception of information for its qualified use in new knowledge, a concept associated with information literacy or competence (Association of College & Research Libraries, 2018). In Brazilian Portuguese, the concept of literacy presents a wide and complex definition. The entry frequently translated as "literacy" in Portugal, in the scientific literature of Brazil, is commonly presented under the terms "competence" for information sciences, and "literacy" or "alphabetization" in education, linguistics, and health (Souza, 2020). The term "literacy" has been included in the Houaiss Dictionary of the Portuguese Language since 2009 and, although there is no consensus regarding its translation in Brazil, it will be used here to promote alignment among research in the Portuguese language, following the sense adequacy proposed by Souza (2020). Health literacy is the ability to access, understand, and use health information for self-care. In mental health, literacy studies how information about mental disorders can aid in prevention and recognition (Watts, 2006).

Within universities, there is the Student Assistance Center (SAC), also called Pedagogical or Psychopedagogical Support Center, which aims to provide students access to Pedagogy, Psychology, and Social services. Watts (2006) argues that such services should be organized into three flows: remedial (aimed at recognizing students with significant adjustment problems in the academic environment), preventive (focused on controlling risk factors to prevent potential problems), and developmental (intervening in the psychological development of the student). Brown (2016) supports this, stating that universities need to increase investments to identify mental health needs and help-seeking behaviors within their institutional policies.

Student assistance professionals have been discussing the importance of using technology in the prevention and screening of mental health problems since 2005 (Tavares et al., 2008). However, the literature shows that this need has not yet been met. In this context, promoting mental health literacy among university students is an important strategy for action in preventive and developmental flows. The university must offer means that allow students to develop at cognitive, social, cultural, and psychological levels. For this purpose, it is necessary to create spaces for the development of mental health competencies and spaces for listening, expression, and reflection so that the

process of formation and identity of the student can be redefined in this process (Gomes et al., 2018).

The use of new communication technologies has facilitated access to information, especially among young people, and transformed the communication scenario in the health area. The increasing number of accesses to health information via the internet signals the problem of information quality. According to the TIC Domiciles 2018 survey (Regional Center for Studies on the Development of the Information Society, 2019), about 45% of Brazilians use the internet to search for health-related information or health services. For Gray et al. (2005), current data point to a preference among young people for seeking health information on the internet, since access through this medium is easy, timely, and confidential, especially regarding sensitive topics.

The concept of mobile health (mHealth) falls within the area of Digital Information and Communication Technologies (ICTs) and is defined as the use of mobile communication technologies to assist in promoting health care (Galeno et al., 2020). The use of mental health care apps and online tools can help university students understand determinants of health promotion, boost skills for habit and attitude changes, and adoption of healthier lifestyles. A scoping review of 46 articles on the development of apps for self-management of mental health, published between 2015 and 2020, concluded that building such apps should be based on scientific evidence, identifying gaps, and involving the target audience in the development process (Nóbrega et al., 2021).

Fassnacht et al. (2022) demonstrated the effectiveness of an internet-based group intervention for promoting mental health and well-being in a vulnerable population of university students. They concluded that students engaged with the psychoeducational intervention showed significant improvements in all primary outcomes, including mental well-being, resilience, depression, and anxiety, as well as secondary outcomes such as self-efficacy, sense of control, and cognitive flexibility.

Mobile communication technologies and digital health literacy in mental health offer the possibility of expanding access to important information, primary prevention, health surveillance, and obtaining data and indicators for the development of public policies. In this context, the development of mHealth technologies emerges as a psychoeducational intervention strategy among young people in a university setting.

The use of communication technologies as support for health services began in the 20th century and underwent extensive development. In 1905, Einthoven, a Dutch physician and inventor, used the prefix "tele" in a medical context to refer to a successful telephone transmission of electrocardiographic images as a "telecardiogram."

Subsequently, Arthur Bennet and his associates developed the concept of telehealth in 1978, referring to an idea that extended beyond telemedicine, being defined as a broad set of activities that include patient education and provision, a care support system through information with an emphasis on efficiency and effectiveness (Duque, 2017). Since then, the development of an interdisciplinary area began, in which health professionals, communication, and informatics work together to build solutions, giving rise to the concepts of Teleconsultation, Telecare, Telediagnosis, and Telesurgery (Boogerd et al., 2015).

The neologism eHealth emerged in 1999 to demarcate a new form of networked work through information and communication technologies (Carvalho, 2018). This term can also be used to encompass the concepts of Medicine 2.0 and Health 3.0 (Istepanian et al., 2006). In this context, the definition of mHealth appeared in 2003 to refer to mobile technology communications, which began to be perceived as potential tools for accessing mental health care (Jorm, 2012).

In parallel to this, mental health literacy, or "*letramento em saúde mental*" (LSM) in Portuguese, emerged in the late 1990s when psychologist and researcher Anthony Jorm and colleagues were struck by the lack of research on the general population's knowledge and beliefs about mental disorders. They understood that it was important not to neglect the public receiving mental health interventions, offering actions that helped people recognize mental illness (Jorm et al., 1997). At that time, they coined the term literacy or *literacia*, defined as "knowledge and beliefs about mental disorders that aid in their recognition, management, or prevention" (Watts, 2006). LSM does not refer only to the transmission of information, but to knowledge that promotes action for the benefit of mental health. This proposal gained widespread acceptance in the field of public health over time, which, combined with technological developments, initiated the use of technologies for disseminating information about mental health.

In the university context, the National Student Assistance Program (PNAES), a legal framework that drove the creation of Student Assistance Centers (NAE) throughout the country, encouraged initiatives aimed at both early identification and treatment of students in mental distress and psychoeducation and health promotion (Brazil, 2010; Bernardes & Rosa, 2021), and mHealth is an alternative to expanding access (Tavares et al., 2008). However, budgetary constraints, a lack of qualified professionals, and the growing demand for services stand out as challenges to using technologies in preventing and promoting health for young people in higher education. In this context, digital tools prove to be a low-cost and highly effective vehicle, contributing to up to a 20% improvement in services (Boogerd et al., 2015). The development of mental health apps

for adolescents and young people presents itself as an initiative of great originality and relevance for Preventive Medicine, Communication, and Psychology, as it allows going beyond traditional clinical practice, adopting public health guidelines, and providing information to a broad audience that uses technology daily.

The aim of this study is to describe the process of developing a mobile application with a focus on digital health literacy in mental health, primary care, and symptom tracking of stress, depression, and anxiety among students at a public university in the northern region of Brazil.

Methodology

For the development of the Mobile Health (mHealth) tool "*Aplicativo Mais Um Dia*", a technical study was conducted with an emphasis on health promotion, prevention, and digital health literacy on mental health among university students. Through a specific methodology, the construction followed the steps: a) Definition of the theoretical framework, functions, and features, b) Definition of the design and construction of the prototype, c) Evaluation of the design by student judges in the health field, d) Adaptation and final publication.

In the first stage, which established the construction of an application function model, the emphasis was placed on digital health literacy in mental health based on the conceptual references, concepts, and categories proposed by the Mental Health Literacy Questionnaire (MHLq) by Campos and collaborators (2016) in its adaptation for the Portuguese language and the mental health literacy assessment questionnaire - LSMq - (Dias et al., 2018).

The LSMq establishes four factors for analyzing mental health literacy, which were included in the application: Knowledge about mental health problems; Misconceptions and stereotypes; First aid skills and help-seeking behaviors, and Self-help strategies. Thus, the tool aims to reduce the rates of young people's illness in the academic context through psychoeducation.

In the second stage, which aimed to develop a prototype, evaluate design proposals, and validate the technical content by judges from the areas of digital communication and mental health, the theoretical and conceptual references used were the translation and adaptation of the Suitability Assessment of Materials (SAM) instrument (Sousa et al., 2015), the System Usability Scale (SUS) by John Brooke from 1986, validated in Brazil by Tenório and collaborators (Tenório et al., 2010), and the experience of developing and validating an mHealth technology in Brazil (Alves et al., 2021).

For the prototype construction and design definition, concepts of color use in psychology (Diane, 2019) were used, and evaluation with students was conducted through open-ended questions, with assessment based on content analysis (Bardin, 2011).

In the judge validation stage, a questionnaire was created based on the literature about User Experience (Tenório et al., 2010; Sousa et al., 2015; Alves et al., 2021). The instrument consisted of 21 items divided into six categories: Content; Literacy Demands; Illustrations; Layout and Presentation; Learning Stimulation, and Cultural Appropriateness. The judges were invited to download the application and, after the user experience, evaluate the items according to the options: excellent, adequate, not adequate, or not applicable.

Finally, the final version of the application was made freely available to students. The participation of the judges and students followed all ethical principles of confidentiality and anonymity for research with human subjects.

Results

During the application conception study, with theoretical support, six brainstorming meetings were held with the development team over a year to establish the main functions for an mHealth application for psychoeducational intervention through digital health literacy in mental health among university students. The following features were set as priorities: 1) support from qualified professionals; 2) tips for mental health care; 3) simplicity and easy navigation; 4) a list of useful phone numbers; 5) human interaction.

Based on these definitions, the structural support for the development team was established, which jointly defined six functions for the application:

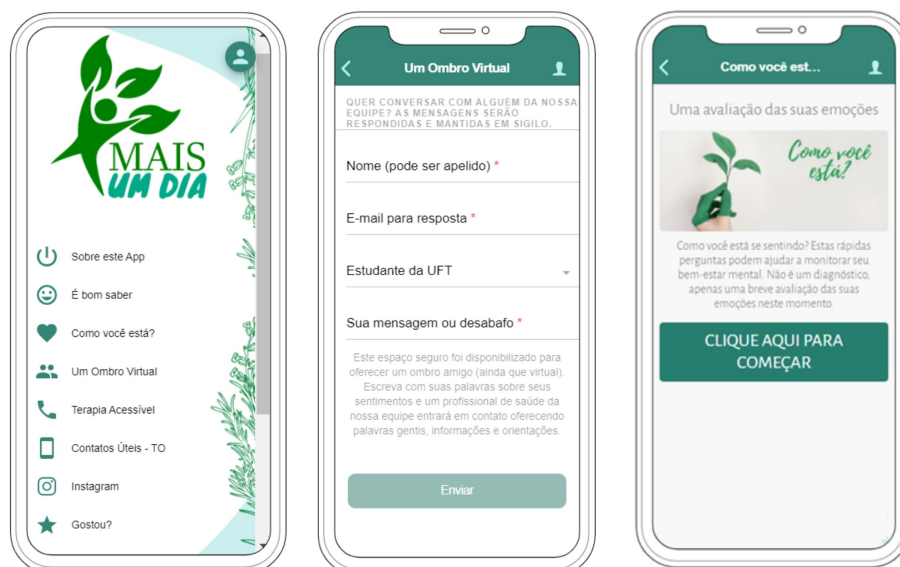
- 1. Channel for qualified listening:** a welcoming and guidance service through an exclusive chat feature in the application. Through this service, the user can send messages to a health professional who provides qualified listening, guidance, and offers health care information. Contacts are answered within a maximum of 24 hours. This is not a channel for psychotherapy, but for listening and guidance.
- 2. Mental health content:** dynamic materials and infographics with scientific mental health content in informal language, adapted to communication trends among young people.
- 3. Psychologists' Contacts:** a list of psychologists who offer psychotherapy at an affordable price for students and provide in-person and/or online services.

Registration is done only with professionals in good standing with their respective councils.

4. **Daily tips:** A space for clear health communication in the language of students through 'tips' for promoting health care and preventing suffering. Push notifications are available.
5. **Information on services offered at the university and in the territory:** through this function, the user can identify all support services and mental health promotion activities offered within the university context and local public services.
6. **Online test on levels of depression, anxiety, and stress:** offering the Depression, Anxiety and Stress Scale - DASS-21 (Vignola & Tucci, 2014) in a digitally adapted and validated format for Brazil (Kieling & Belfer, 2012). This function aims to measure symptoms of anxiety, stress, and depression. The feature comes with a warning alert explaining that it does not have diagnostic purposes but will allow the user to identify relevant signs of anxiety, stress, and depression, with the intention of encouraging help-seeking behaviors.

In the first version of the app, completed in November 2021, it was decided to work with a visual identity focused on green, which is associated with health, nature, and vitality (Diane, 2019), and with a vertical and list-based button menu (Figure 1).

Figure 1 First app version screenshots



Source: Mais Um Dia App (2022).

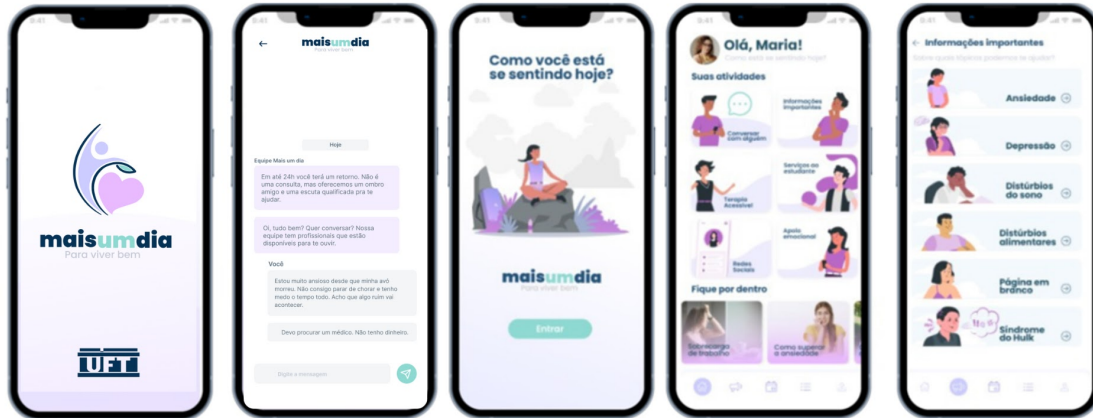
The application was evaluated in two phases of work: 1) evaluation of color, menu organization, and iconography in design and adaptations; and 2) validation of content, usability, and user experience.

During the first phase, the prototype of the application was disseminated among university students via email and WhatsApp groups. Within a 30-day period, there were 110 downloads of the prototype. Users of this first version were offered the possibility to evaluate the tool through a Google Docs form with an open question about the main impressions, suggestions, doubts, or criticisms that could exist regarding the developed prototype. In total, 30 users of the application participated in this evaluation, voluntarily and anonymously. Content Analysis (Bardin, 2011) was used to analyze the material, where three limiting factors were identified in the app test version:

1. Resistance/disapproval of the green color and complementary palette.
2. Little identification with the app visual identity.
3. Difficulties with the usability of the menu in list and without iconography.

Based on these observations, a new conceptual design of the tool was carried out. To implement improvements, a design and User Experience specialist joined the team. With the support of some studies (Santos et al., 2017; Galeno et al., 2020; Alves et al., 2021), the team developed the new prototype. Based on the issues raised by students, a new layout and usability project was developed. With a more illustrative approach and using cool colors (Diane, 2019), the project was redesigned from November 15, 2021, to February 15, 2022, resulting in the version presented in Figure 2.

Figure 2 Second version of the app Mais Um Dia screenshots



Source: Mais Um Dia App (2022).

During the second phase, six judges participated, including four researchers and healthcare professionals and two technicians from the design and application development area. The judges' participation in this phase was also voluntary and anonymous. Invitations were sent by e-mail to fourteen psychologists and social workers working in the student assistance centers at the university, and six professionals from the technology field linked to institution projects. Later, those who expressed interest in participating in the evaluation were directed to a form with the link to the new version of the application, which was made available for 30 days (starting from June 1st, 2022).

Through the link, which was executable only on Android mobile devices, the six evaluators had access to all the features of the latest version of the application and, by using it, they responded to the questionnaire on the Google Forms platform, with their evaluations on the content and design of the accessed tool.

The application was considered suitable, with a percentage of scores equal to or greater than 83.4% in all categories. The application was published on Play Store on September 12, 2022.

Application Technical Description

The "Mais Um Dia" application was developed with a simple architecture consisting of a single mobile application as the front-end, and a RESTful API back-end server. The application was developed in Javascript using the React Native library in conjunction with

the Expo tool, which allows us to use the React framework without losing access to the native capabilities of Android and iOS platforms. Through the Expo tool, we also have access to a cloud compilation service, which reduces the complexity of the application development and publishing process.

The API server was built on a Node.js runtime environment, responsible for the validation and authorization of all API access, and uses a MariaDB database, which provides reliable storage and management of project data.

Additionally, to provide a secure login experience for application users, as well as to ensure the integrity of server access, the Firebase Authentication service provided by Google was used at no cost.

Main Features

The project's architecture establishes that all system administration and monitoring functions are done through the mobile application, which avoids the need to develop and maintain a separate administration platform. The contents available on the platform can be dynamically changed without the need for re-publishing the application.

Similarly, all support related to the "Talk to Someone" function is done through the application by authorized and evaluated volunteer members of the health team, which includes a family doctor and a nurse, both qualified in mental health care.

All data collected by the "Talk to Someone" feature is handled with special care due to its confidential nature. Once a conversation is initiated between a user and an authorized member of the healthcare team, the messages exchanged can only be accessed by the involved parties. The transmission and storage of this data is done securely using widely-used security protocols (TLS/AES).

The database of the project has also implemented automated cleaning and monitoring procedures to eliminate the need for active management, apart from regular backup and restoration tasks, as recommended. Additionally, the app was designed so that static content, such as the professional agenda and daily health promotion tips, can be accessed without an internet connection. Any additional content added after the app's launch will also be available for offline access once the user is online.

Discussion

After two years of work, the Mais Um Dia application was built through research, knowledge translation, alignment, and technical production. The construction of the tool was based on literature on mental health care and literacy (Henderson et al., 2013; Kutcher et al., 2016; World Health Organization, 2021; Santos et al., 2017), which were gathered

and translated into an attractive visual language that spoke to university students. The development of the application is of remarkable relevance in the context of misinformation in which the country finds itself. By emphasizing preventive care with mental health, the application reduces barriers to access to information, encourages help-seeking behaviors, and reduces psychological distress among university students.

Studies have shown that lower levels of Mental Health Literacy (MHL) are related to worse clinical health outcomes and promoting MHL in adolescents and young adults positively impacts the adoption of health-protective behaviors that persist into adulthood (Henderson et al., 2013; Rickwood et al., 2015; World Health Organization, 2021). Adolescents and young adults should be a priority in MHL interventions as they are in a period of psychological and social development (World Health Organization, 2021) with an epidemiological profile of high prevalence of mental disorders. Without adequate MHL skills, mental disorders are more likely to become established and chronic.

Research supports that mental health interventions that make use of digital resources have a great impact on young people, as there is a high use of mobile devices among this group (Henderson et al., 2013). In addition to the growing interest and search for websites and apps focused on mental health (Kutcher et al., 2016), young people with some mental or emotional illness are often reported as the main users (Nobre et al., 2021). Promoting mental health through apps allows reaching the young audience and adapting the content to the language used among the group, with evidence already reported of an increase in seeking health care (Chandrashekar, 2018; Ridout & Campbell, 2018).

The Mais Um Dia app was built through research, translation, alignment, and technical production. Scientific evidence on mental health literacy was collected and translated into an attractive visual language that resonated with the target audience, university students.

Since the app was recently released, its effects are still being evaluated. However, the app has been well-received and is being used by students. In the first seven days available on the Android app store, the app received almost 200 downloads, according to the Play Store report. On average, five chat support requests were made per day, and 12 self-tests for identifying and tracking depression, anxiety, and stress with DASS-21 were performed. An average of three users per minute were online between 8 am to 10 pm.

Research on the acceptability and effectiveness of support in reducing emotional distress and suffering can be conducted in studies with control groups.

Final Considerations

The proposal described here is original and innovative as no evidence-based mental health applications for university students were found in the Brazilian context. The Mais Um Dia app brings the differential of a mobile technology with the possibility of qualified professional guidance, interactivity, and partnerships focused on promoting collective mental health. The application enables the widespread dissemination of mental health services provided by the university, as well as those available in the surrounding area where the young person is located. In addition, the extensive accessibility of mobile phones among youth enables a broader outreach to this particular group of the population, which typically does not utilize in-person public health services due to several reasons, such as time constraints and lack of interest.

The application represents an innovative tool for care, as it differs from traditional/preventive medicine and psychology practices by enabling the use of communication technology to adapt knowledge about mental health in a comprehensive and attractive way for society. This is aligned with the fundamental principles of health professionals' practice, regarding the promotion of mental health and quality of life for individuals and communities.

In addition, this tool materializes public health concepts such as accessibility and health education and is based on the three doctrinal principles of the Brazilian Unified Health System (SUS): universality, equity, and integrality. In future stages, the project aims to build a partnership to extend the use of the application to the entire Brazilian young population, contributing to the effective implementation of health as a right for all and territorialization through primary health care.

Despite the scope of the tool, social inequalities are pointed out as a limitation that a part of the university population faces, such as the lack of access to devices with mobile internet connection and the lack of adaptation of the app for users with visual impairments.

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RESUMO:

A temática deste trabalho é o desenvolvimento de um aplicativo de tecnologia móvel para a promoção à saúde no contexto da Universidade Pública. Trata-se de uma pesquisa aplicada que apresenta as etapas de construção e designer de uma tecnologia de mhealth. O trabalho é pautado pela reflexão teórica interdisciplinar, abrangendo fundamentos da comunicação, psicologia e computação. Mediante a análise de entrevistas e sugestões de discentes da instituição construiu-se um projeto de software para a prevenção ao adoecimento e promoção da saúde mental. A proposta é de fundamental importância e pode contribuir com o desenvolvimento de práticas que amenizem o sofrimento psíquico no contexto do Ensino Superior público.

PALAVRAS-CHAVE: Prevenção primária, Saúde Mental; Gestão de Ciência; Tecnologia e Inovação em Saúde; Msaúde; Letramento em Saúde.

RESUMEN:

El tema de este trabajo es el desarrollo de una aplicación tecnológica móvil para la promoción de la salud en el contexto de la Universidad Pública. Se trata de una investigación aplicada que presenta las etapas de construcción y diseño de una tecnología mhealth. El trabajo se guía por una reflexión teórica interdisciplinar, que abarca fundamentos de la comunicación, la psicología y la informática. Mediante el análisis de las entrevistas y las sugerencias de los alumnos de la institución, se construyó un proyecto de software para la prevención de enfermedades y la promoción de la salud mental. La propuesta es de fundamental importancia y puede contribuir al desarrollo de prácticas que mitiguen el sufrimiento psicológico en el contexto de la Educación Superior pública.

PALABRAS CLAVE: Prevención primaria; Salud mental; Gestión de la ciencia; la tecnología y la innovación en salud; Alfabetización sanitaria.