Mobility: Promoting Health and Physical Activity in School Environments

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Abstract: Technology, although it has brought many advances in various social spheres, has contributed to the popularization of a sedentary lifestyle. The evolution of machines and the automation of daily processes have reduced the need for daily physical activities, contributing to a serious public health problem. Given this scenario, it is necessary to develop strategies that encourage adopting healthy practices in daily life. In this sense, this article investigates the implementation of the "Mobility" application in high schools, aiming to promote physical activity among adolescents. By integrating technology with health promotion, Mobility stands out as a creative tool to reduce cases of sedentary lifestyles and improve the quality of life of young people.

1 INTRODUCTION

Health, as one of the fundamental human rights, is equated with other essential rights such as freedom, food, education, and security as established in the Universal Declaration of Human Rights (UDHR), adopted by the United Nations (UN) in 1948. Recognized as one of the key pillars for social, economic, and personal development, health is considered a crucial dimension of quality of life (Organization, 1995).

According to the (Nation, 1948), quality of life is an individual's perception of their position in life within the context of the culture and value systems in which they live and concerning their goals, expectations, standards, and concerns. In this context, the WHO subdivides quality of life into four main domains: physical, social, psychological, and environmental. This study focuses on the physical domain, covering aspects related to the motor skills of high school students, their fitness for daily activities, and their degree of mobility.

The Physical Activity Guide for the Brazilian Population, published by the Ministry of Health, states that physical education can contribute significantly to students' health and personal development. During periods of intense study, such as in the weeks leading up to college exams, entrance exams, or the delivery of a course completion paper, it is common for the student to be anxious and overloaded and, also, the practice of physical activity may not be a priority during this period, but it should be. Proper physical exercise improves body health, which consequently benefits brain health, increasing mental well-being and reducing symptoms of anxiety and depression (da Saúde, 2022).

When we think of neurocognitive aspects, such as memory, it is through motor activities that new and meaningful neural connections are formed. The psychomotor approach already indicates that the components of motor skills (a set of neural and muscular functions that enable voluntary or automatic body movements) share common brain areas. This allows students to transfer knowledge and skills acquired through physical activity to academic tasks (Lisboa, 2022).

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Physical education is mandatory in the primary curriculum and optional in rare cases. Through culture and movement, in addition to its diversity of content, physical education seeks to sensitize and guide students to reflect on their body mobility practices and their impact on the environment in which they live. Despite this, schools still need to encourage physical exercise more, and little is said about its benefits for students' academic lives.

This study is necessary to help students become more physically active since good performance in school tasks is essential to achieving their goals. To this end, the effectiveness of the Mobility app in the school environment is investigated to promote better habits in academic life. This investigation is conducted by performing a usability test that evaluates the quality and functionality of the app.

2 RELATED WORKS

To survey related studies, we searched the literature using Google Scholar for approaches similar to the proposal presented in this article. We aimed to identify studies related to promoting physical activity and using technologies in the health area, resulting in selecting five studies for discussion. The objective is to provide a solid foundation for this article, highlighting the need for technological innovations in health and emphasizing the relevance of applications such as Mobility.

In the foreground, the study by (Becchi et al., 2021) discusses the practice of physical activities during the COVID-19 pandemic. This scenario made it challenging to maintain healthy habits due to social distancing and the closure of public places, limiting opportunities for physical activity and contributing to a sedentary lifestyle. The article highlights the need for digital tools to keep the population active amid the lockdown. Despite the end of the pandemic, a sedentary lifestyle continues to be a reality for many people, highlighting the need to encourage the population to adopt healthier habits.

Similarly, the article by (Verzani and de Souza Serapião, 2020) analyzes the impact of smartphone applications on promoting physical activity. The study highlights that these software programs have great potential to encourage physical activity and improve public health. Many applications incorporate gamification elements, such as challenges and rewards, which can motivate users to stay active and engaged. However, it is important to overcome limitations such as dependence on technology, variation in effectiveness between different users, and the possibility of disengagement over time. It is concluded that applications have the potential to encourage exercise. However, it is important to overcome the aforementioned limitations to maximize their impact.

Complementing the previous view, the (Silva et al., 2020) review states that health apps are essential in monitoring health conditions and promoting physical activities. They facilitate communication between the healthcare professional and the patient and allow health monitoring. However, challenges can be overcome, such as prolonged user adoption, the need for scientific validation, and ensuring data privacy. The study shows that this software offers many benefits; however, it is essential to emphasize the referential challenges. Mobile health has promising results and can help various public policies external to the promotion of well-being and health.

Mobile health (mHealth) has been gaining increasing attention in the health field. The study by (Oliveira et al., 2018) explores the opportunities mobile health offers in promoting physical activity and improving health outcomes for the population. The paper discusses how apps can monitor and encourage physical exercise, supporting active lifestyles. As in previous dissertations, it is found that there are obstacles, such as accessibility, that need to be addressed for the implementation of mobile health applications.

Contributing to the previous perspective, the text by (Organization et al., 2007) is part of the WHO information series on school health and highlights the importance of physical activities in the school context as a fundamental component for promoting health and well-being. The study states that implementing school physical activity programs improves students' physical, mental, and social development, improving their academic performance and general well-being. The document suggests that schools implement programs and policies that add physical activities to the curriculum, creating an environment that encourages healthy lifestyles.

Analyzing the approaches discussed, Mobility shares the goal of integrating users through digital tools. However, the app stands out among other applications for creating the practice of physical activities in a fun and interactive way, using tools such as challenges and rankings combined with health monitoring, such as BMI calculation. In addition, it seeks to overcome the challenges identified in the literature, such as user disengagement and digital inclusion.

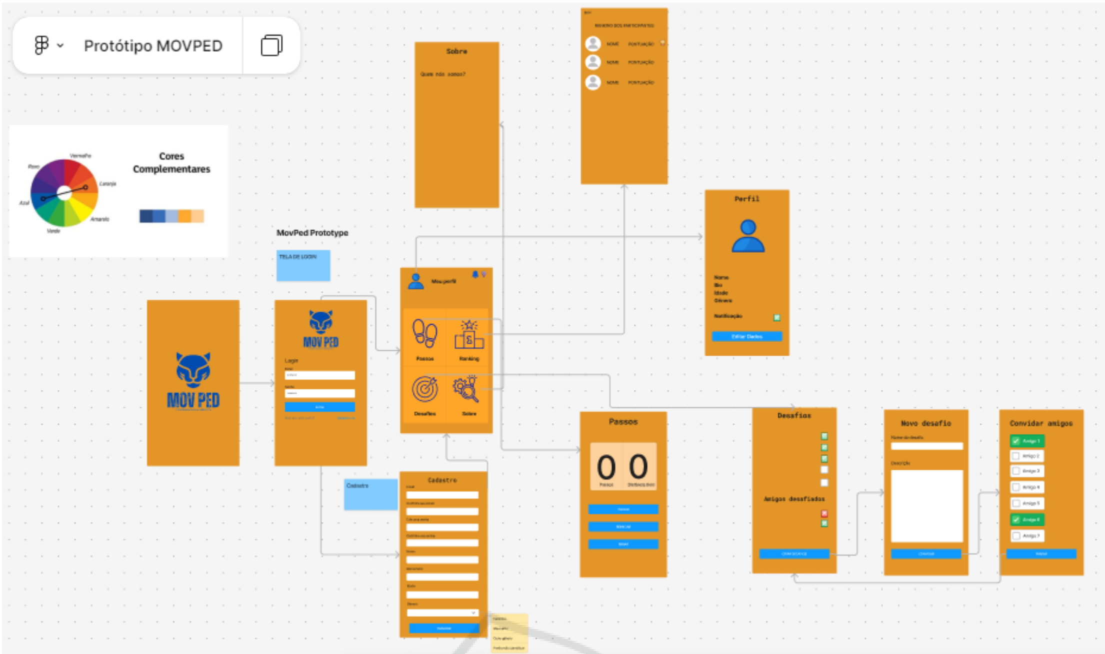

Figure 1: Mobility Prototype.

3 MOBILITY

The Mobility App aims to encourage mobility challenges that promote students' physical health. The project suggests mobility-related challenges integrated with the infrastructure of *"omitted for blind review"*. Initially, it was called MovPed and was being developed on the App Inventor platform [1], a web software from the American university Massachusetts Institute of Technology (MIT) for creating Android applications. Subsequently, the application was moved to the Kodular tool [2], inspired by App Inventor but with more functionalities and components. The prototype of the project's screens was built in FigJam [3] 1, an online whiteboard tool launched by the company Figma [4].

The application logo 2 features an image of a cheetah, symbolizing mobility, as it is the fastest land animal in the world. It also includes the slogan: 'You in motion.' The color scheme uses orange and its complementary blue on the screens because the orange hue symbolizes energy, vitality, movement, and creativity. All interface elements of the app 3 were sourced from the Flaticon website [5], which provides icons and stickers for download.

[1]https://appinventor.mit.edu/
[2]https://kodular.io/
[3]https://figma.com/figjam/
[4]https://figma.com/
[5]https://flaticon.com/

Figure 2: Mobility app logo.

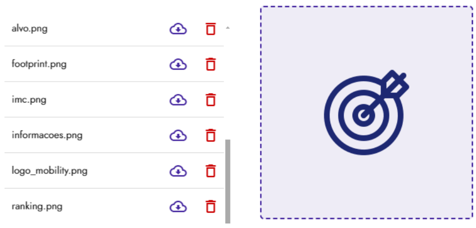

Figure 3: Icons from Flaticon.

The Mobility app includes the following screens: Login/Register 4, Menu 7, Profile, Challenges 5, Ranking 6, BMI Calculator 7, and Information.

- **Login/Registration:** The registration screen contains fields to enter the full name, email, password, password confirmation, age, and gender. All this data is sent and stored in Firebase 8 once the user fills out the fields and clicks the "Create account" button. After this step, when clicking "Login," the login screen will appear with fields to enter the username and the previously registered password in the database.

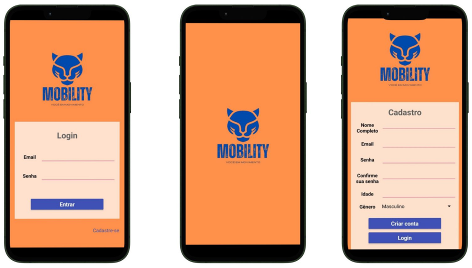

Figure 4: Splash screen, registration and login.

- **Menu:** This screen opens after the user has logged in and clicked the "Log In" button. It has four buttons: Challenges, Ranking, BMI Calculator, and Information. It also displays the user profile in the top section of the screen. Users are redirected to the respective screen when they click any button.
- **Profile:** This screen displays the user's name, age, and gender, retrieved from Firebase 8. The user can edit these details by clicking the "Edit data" button. After making changes, the user clicks "Save data," and the fields will reflect the updated information saved in the database.
- **Challenges:** This screen lists the proposed challenges in the app. Two challenges are listed: Maximum steps in 5 (five) minutes and Run from the entrance to the announcement TV. The first challenge tracks the maximum number of steps the user can achieve in five minutes. On this screen is a step counter sensor that records the number of steps and the distance covered in meters, along with a timer that stops when five minutes have passed, ending the challenge and saving the result in the list below.

  The second challenge is to run from the entrance to the campus announcement TV as soon as possible. This screen shows the user's current coordinates and the distance in meters from the start and end points of the challenge. Due to GPS accuracy, there is a tolerance of up to 6 meters from the reference points to start or finish the challenge. After completing the challenge by pressing the "Finish challenge" button, the time taken to complete the path is recorded. The results of the challenges are listed in descending and ascending order, respectively.

Figure 5: Mobility Screens: Challenges.

- **Ranking:** The following screen displays all the recorded results for each challenge, including the name, score achieved, and the date the user completed the challenge. This data is retrieved from Firebase, which is neatly saved for the sorting list.

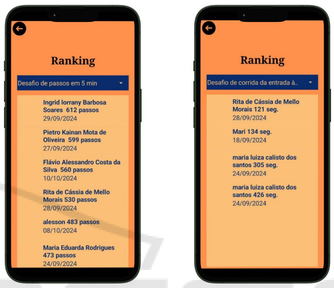

Figure 6: Mobility Screens: Ranking.

- **BMI Calculator:** This screen presents fields to enter height (cm) and weight (kg). When the "Calculate" button is clicked, the user's body mass index and a classification table for health status reference will appear. In the "Clear" option, the user can input new values and recalculate the BMI.

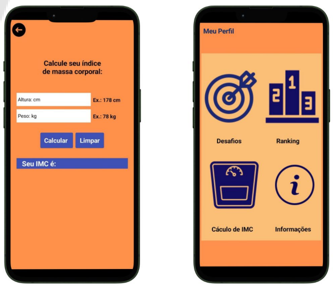

Figure 7: Mobility Screen: Homescreen and BMI.

- **Information:** This screen contains a description of the developers of the Mobility app and the purpose of the application.

The Firebase Realtime Database [6] is used 8, which is a cloud-hosted database that stores and syncs data

[6]https://firebase.google.com/

among its users in real-time. The app settings are stored on the platform (containing the latitudes and longitudes of the two points in the running challenge and the tolerance in meters, which can be modified), the profiles (with the user's name, age, and gender), the records of the completion of each challenge (containing the achieved value, the name of the person who completed it, and the date), and the users (which include the registered name, email, and password).

Figure 8: Mobility Database.

4 PRELIMINARY ASSESSMENT

It is important to note that the school did not officially implement Mobility. However, before the main study was implemented, a preliminary evaluation was conducted to test and identify possible challenges in using the developed application. For this phase, two exploratory questionnaires were applied through the Google Forms platform: the pre-experiment questionnaire, which aimed to analyze the students' physical activity habits, and the post-experiment questionnaire, which aimed to evaluate the app.

4.1 Methodology

To conduct the preliminary assessment, questionnaires created by the Mobility development team and made available through the Google Forms platform were used. Before the questionnaire was administered, the students had not tested the application, allowing a concrete analysis of the student's first impression of Mobility. No exclusion criteria were established for participants in the preliminary assessment.

The first form, a pre-experimental form, consisted of 11 questions and took an average of five minutes to complete. It sought to analyze participants' academic data, including age, course, shift attended, year in which they were enrolled, and study modality (integrated, subsequent, or undergraduate). After collecting this initial information, questions related to the participants' health were presented, such as "Do you have any chronic diseases or health problems?" and "How physically active do you consider yourself?", in order to assess the participants' general health status and level of physical activity.

After completing the first form, the evaluation itself began. Participants tested all the software's features, including the proposed challenges. During this phase, the tool's usability, ease of access, and clarity of the application's instructions were observed, and the effectiveness of the challenges in promoting adherence to physical activities was evaluated. At the end of the test, students were invited to answer a second questionnaire: the post-experiment.

The Likert scale was used for the post-experiment form, and an evaluation scale was used to measure the participants' opinions, motivations, and other aspects. It uses a series of response options ranging from an extremely positive opinion to a highly negative one, sometimes including moderate or neutral options. The questionnaire evaluated several aspects of the application and included questions such as:

- "How easy was it to use Mobility?", with answers ranging from 1 (very difficult) to 5 (very easy) 10;
- "How interesting/appropriate did you find the challenges?", with options ranging from 1 (not very interesting) to 5 (very interesting) 11;
- "What would you rate the application?" with answers ranging from 1 (poor) to 5 (excellent) 12.

In addition to these questions, the form contained a section dedicated to suggestions, allowing participants to provide feedback and proposals for improving the application,. The post-experiment form took, on average,, seven minutes to complete. Overall, considering the time spent on the questionnaires and the evaluation itself, the application protocol lasted about 30 minutes.

4.2 Data Collected

The data collected in the pre-experiment and post-experiment are shown in the following graphs 9, 10, 11, 12.

5 RESULTS AND DISCUSSION

Mobility aims to encourage students to practice physical exercise in a fun and accessible way within the school environment. To ensure the app's efficient use at school, an evaluation period was conducted to ensure its effectiveness.

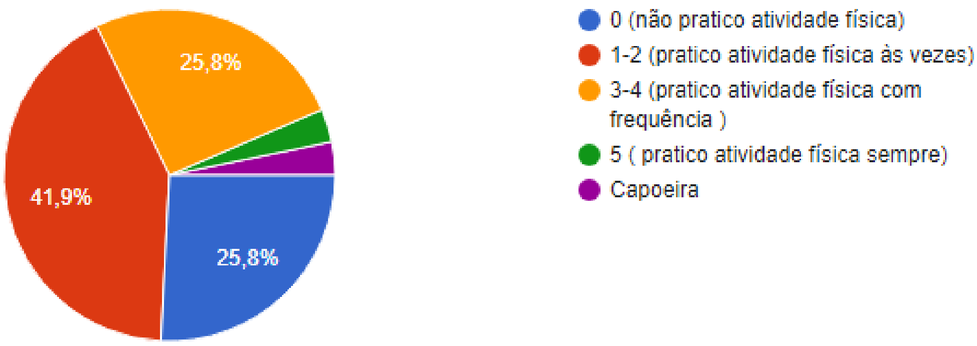

Figure 9: Percentage distribution of students about the practice of physical exercises.

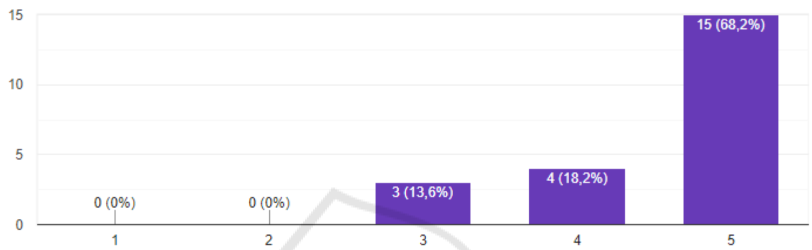

Figure 10: Level of ease of using Mobility.

Before introducing the application, a questionnaire was conducted using the Google Forms platform to analyze aspects related to the students' physical lives. The questionnaire was structured to collect information on the frequency of physical activity practices, mobility difficulties, and possible barriers to performing exercises.

Based on the results obtained 9, it was observed that 90.3% of the participants did not present mobility-related problems. Furthermore, the data indicate that 25.8% of the students do not perform any physical activity, while 41.9% reported practicing physical activities occasionally. On the other hand, 25.8% reported practicing physical activities frequently, and only 3.2% of the students reported practicing physical activities regularly.

Therefore, the data obtained on physical activity practice indicate a worrying situation. The number of students who do not perform physical activity (25.8%) is high. This inactivity indicates that the school has not encouraged or made students aware of the benefits of regular physical activity.

In addition, the majority of the students (41.9%) reported practicing physical activities only occasionally, which may be insufficient to guarantee their benefits. This occasional practice indicates that the students understand the importance of physical exercise but are not encouraged to do it.

Among the 31 participants in the experiment, only 3.2% practice physical activities regularly, indicating that only a small portion of those being evaluated understand the real need to maintain a healthy routine.

5.1 Post-Assessment Form

After the preliminary assessment, another form was proposed for the Mobility evaluation. This analysis included the quality of the challenges and scores from 1 to 5 for application and ease of use.

The responses obtained from this questionnaire indicated that the application is easy to use 10, with an intuitive interface that makes navigation more accessible for users. In addition, the feedback on the quality of the challenges was mostly favorable, indicating that the proposed activities are appropriate for the app's purpose 11.

On the other hand, some participants highlighted the need to add other functions to the software. These functionalities include creating more challenges and an area reserved for meal tips and nutritional guidelines for better physical conditioning when practicing mobility exercises. In addition, it was suggested that the app integrate the Physical Education discipline so that the challenges proposed in Mobility can also be used as practical classes for the subject.

In general, the rating given to the application was excellent, as shown in the graph 12. Considering the suggestions presented by the participants, it is possible to improve the tool further, adapting it to different lifestyles.

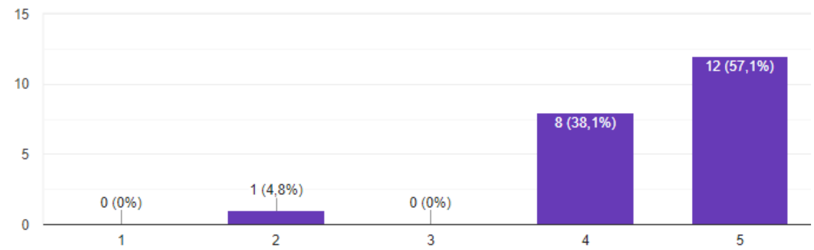

Figure 11: Level of suitability for Mobility challenges.

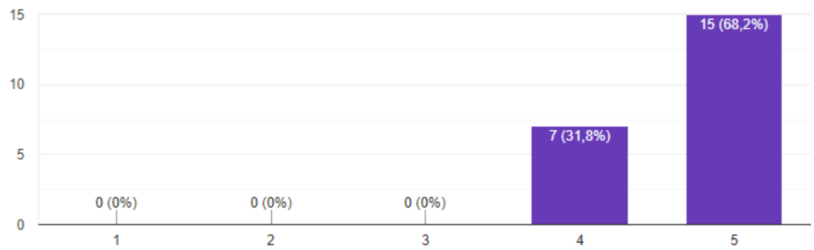

Figure 12: Mobility app general rating.

5.2 Study Limitations

One of the limitations of the study was the small number of people who participated in the test period, in addition to the fact that it was conducted in a specific school environment with a limited age range. In addition, several obstacles make it challenging to apply this software in schools, such as digital inclusion, since not all students have the same level of knowledge about using software, in addition to the suitability of the environment for carrying out the challenges proposed by Mobility. These factors restrict the generalization of the results, making it difficult to compare with other institutions with different structural conditions and socioeconomic contexts.

Another difficulty encountered is the lack of interest in practicing physical activities. This barrier may be related to individual issues (motivation, self-esteem), social issues (influence of friends and family), and environmental issues (access to suitable spaces) (Ceschini and Junior, 2007). In the context of the school in question, students feel overwhelmed by the choice of a technical course integrated into high school, which results in great academic demands. Therefore, they naturally prefer more passive lifestyles, which, in turn, generate a view of irrelevance regarding the application. For this reason, initially, the participants did not seem very interested in participating in the preliminary evaluation.

During the application testing in the preliminary evaluation phase, the software presented GPS-related difficulties, which initially did not work correctly on all cell phones. However, despite this obstacle, Mobility proved to be successful in the testing phase, proving to be easy to apply in practice.

5.3 Future Research

For future research, it is suggested that more comprehensive tests be conducted to obtain a broader view of physical activity patterns among students. The effects of programs that promote physical health in schools should be observed, relating them to students' academic performance and the associated psychological implications. In addition to promoting training on using this type of software in schools, strategies to overcome the aforementioned challenges must be created.

6 FINAL REMARKS

In summary, the study was based on the 17 UN Sustainable Development Goals (SDGs), emphasizing health and well-being. Thus, considering the global scenario regarding the increase in the number of young people facing problems related to a sedentary lifestyle and diseases resulting from this lifestyle, it is essential to adopt effective measures to solve this issue, leading to the creation of the Mobility application.

Although the software has not been implemented in schools, the results observed in the questionnaires carried out indicate promising potential. However, although the study presents excellent results, it is clear that there are several barriers related to implementing this software in schools, such as digital inclusion and the appropriate environment for carrying out the challenges, among others. In addition, a comprehensive evaluation of the application discussed in this article is still necessary.

The present study was based on the performance of a usability test to assess the impact of Mobility in schools. It is worth mentioning that before the preliminary evaluation was carried out, all students involved agreed to the consent terms present in the questionnaires.

To demonstrate the researchers' commitment to ensuring a viable project, it is emphasized that the current study is under analysis by the Ethics Committee and, if successful, will enter the process for more in-depth research at the institute itself. Therefore, among the main findings of this work is the need to integrate technologies into educational networks to promote a healthier environment that encourages the practice of physical activities.

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