Design of an educational proposal in physical education to promote walking to school in adolescents

Diseño de una propuesta educativa en educación física para fomentar andar al colegio en adolescentes

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Abstract

Introduction: Promoting physical activity among adolescents requires innovative methodologies to make educational interventions more engaging and effective.
Objective: to implement and evaluate a school-based intervention integrated into physical education lessons, utilizing the Mystic School mobile application to promote physical activity among adolescents.
Methodology: A total of 62 students (aged 14-15) and 2 physical education teachers from Spain participated. Their perceptions were assessed through personal interviews, which were analysed qualitatively using NVivo software.
Results: The main results indicated that students enjoyed the physical education lessons, finding them more engaging than traditional lessons, and expressed a desire for more sessions over time. Despite the Mystic School application being viewed as a fun innovation, some concerns were raised; one teacher found the points and rewards system confusing, while the other noted increased student engagement but suggested improvements for the app's user-friendliness and appeal.
Discussion: The findings suggest that integrating innovative methodologies and technologies, such as the Mystic School application, can enhance student engagement in physical education lessons. However, the mixed feedback highlights the need for refining technological tools to improve usability and appeal. These results align with existing literature, emphasizing the importance of user-friendly designs and well-structured interventions for maximizing the potential of educational technologies.
Conclusions: Both students and teachers found the Mystic School mobile application and educational proposal enjoyable and innovative, suggesting such methodologies could enhance physical education lessons. Collaboration among researchers, teachers, and families, alongside extending interventions, integrating behaviour change frameworks, and optimizing tools, offers a comprehensive approach to effective programs.

Keywords

App; exercise; mobile phone; school; youth.

Resumen

Introducción: Promover la actividad física entre los adolescentes requiere metodologías innovadoras que hagan las intervenciones educativas más atractivas y efectivas.
Objetivo: Implementar y evaluar una intervención escolar integrada en las lecciones de educación física, utilizando la aplicación móvil Mystic School para promover la actividad física entre adolescentes.
Metodología: Participaron 62 estudiantes (de 14 a 15 años) y 2 profesores de educación física en España. Sus percepciones fueron evaluadas mediante entrevistas personales y analizadas cualitativamente con el software NVivo.
Resultados: Los estudiantes disfrutaron de las lecciones de educación física, considerándolas más atractivas que las tradicionales, y expresaron su deseo de más sesiones. Aunque la aplicación Mystic School fue vista como una innovación divertida, un profesor encontró confuso el sistema de puntos y recompensas, y otro sugirió mejoras en usabilidad y atractivo tras observar mayor compromiso estudiantil.
Discusión: Los hallazgos sugieren que integrar metodologías y tecnologías innovadoras, como la aplicación Mystic School, puede aumentar el compromiso de los estudiantes en las lecciones de educación física. Sin embargo, el feedback mixto resalta la necesidad de refinar las herramientas tecnológicas para mejorar su usabilidad y atractivo. Estos resultados coinciden con la literatura, que subraya la importancia de diseños intuitivos y bien estructurados para maximizar el potencial de las tecnologías educativas.
Conclusiones: Estudiantes y profesores percibieron la propuesta educativa y la aplicación Mystic School como innovadoras y capaces de mejorar las lecciones de educación física. La colaboración entre investigadores, docentes y familias, junto con intervenciones extendidas y herramientas optimizadas, ofrece un enfoque integral para programas educativos efectivos.

Palabras clave

Aplicación; ejercicio; teléfono móvil; escuela; jóvenes.

Introduction

Physical activity (PA) is related to health benefits, such as the decrease of cardiovascular risks (Andersen et al., 2006), mental health (Rodriguez-Ayllon et al., 2019), and social health (Janssen & LeBlanc, 2010). However, four out of five adolescents do not accumulate 60 min or more of daily PA (moderate-to-vigorous intensity) (Guthold et al., 2020). There are four active living domains where people may accumulate PA, being transport one of those (Sallis et al., 2006). In this sense, a potential opportunity for the young people to accumulate daily PA levels through active transport is active commuting to and from school (ACS) (Ikeda et al., 2022). On average, each school student makes approximately 360-400 trips to and from school every year (Craw, 2018). ACS is defined as the use of active modes of transport such as walking, cycling, skateboarding, or other non-motorized modes of transport that imply energy consumption for commuting to and/or from school (Ruiz-Hermosa et al., 2019). Additionally, when children actively commute to school, they improve their well-being and physical fitness (Larouche et al., 2018), especially cardiorespiratory fitness (Villa-González et al., 2015).

In addition, active and unaccompanied commuting is associated with improved health (Herrador-Colmenero et al., 2017) and environment (Huertas-Delgado et al., 2017), as it reduces exhaust emissions (Wilson et al., 2007) and consequently reduces noise pollution (Hong, 2018). Despite these individual and social benefits, a recent Spanish study indicated that approximately 40% of adolescents did not actively commute to school (Gálvez-Fernández et al., 2022). Nevertheless, it is crucial to promote appealing interventions that consistently encourage ACS among adolescents (Dinu et al., 2019; Henriques-Neto et al., 2020; Ruiz-Hermosa et al., 2019). In a recent systematic review, it was concluded that ACS could contribute to 48% of the recommended guidelines of PA (Campos-Garzón et al., 2023).

The school system in Spain is universal, compulsory, and free for every child and adolescent, making it an ideal environment to promote the adoption of healthy habits. Children and adolescents spend a significant portion of their lives within the school setting, presenting a unique opportunity to instil positive behaviours and attitudes towards health and well-being (Heelan et al., 2015). Moreover, the school incorporates a range of crucial developmental stages, particularly during key formative years.

This could potentially cultivate a physically active youth demographic that is more inclined to lead active and healthy lifestyles as adults (Telama et al., 2014). Also, the school could actively involve all agents of the educational and social community and implement strategies through curricular and non-curricular means (Abarca-Sos et al., 2022). In summary, the school setting offers an ideal "lab" for the development of interventions such as PA (Larouche et al., 2018; Pang et al., 2017; Villa-González et al., 2018). The International Society for Physical Activity and Health has proposed a total of eight investments to ensure the health of young people through the practice of PA (ISPAH, 2020). The "whole-of-school programmes" and "active transportation programmes" were two of the essential proposals in the need to carry out within the school setting. One more time, schools have also been recognised as the perfect environment to promote health-related behaviours such as ACS (Sevil et al., 2019).

Physical education (PE) lessons in the 1990s focused on a traditional teaching method (Pastor López & Gea Fernández, 2010). There has been an increasing number and variety of methodologies and, recently, innovative methodologies used in the PE lessons to develop different skills, being the focus that students are responsible for their own learning, exchanges new experiences in the classroom, are able to evaluate for oneself and solve problems through autonomy (Crisol-Moya et al., 2020). Moreover, innovative methodology has some advantages such as increasing creative thinking (Bezanilla et al., 2019), cooperation (Sein-Echaluce et al., 2019), and opportunities to connect with the technological society (Nikolopoulou et al., 2019). On the other hand, a prior systematic review (Yuksel et al., 2020) concluded that the main characteristics to reach success-efficiency in interventions are the content, quality, and duration of those.

Previously, innovation interventions have been carried out in school contexts (González et al., 2018; Shin et al., 2019) both in Europe (Coombes & Jones, 2016; Escola, 2018) and in Spain (Carballeira et al., 2023; Moreno-Guerrero et al., 2022). A systematic review (Mulato et al., 2024) concluded that the integration of digital technologies in PE represented a significant shift that necessitated a revaluation of pedagogical strategies. It was essential to adopt a proactive approach to strategic management to balance policy, curriculum, and student engagement. Secondly, the priority is to focus on comprehensive school programs and teacher capacity to promote PA from childhood to adolescence. For this reason,

the PE role is relevant for improving PA during the school hours. Teachers could use technological tools to boost PA attitudes and participation among youth. It is an opportunity for PE teachers to lead designs of effective PA interventions based on games and applications to be applied from the early stage (Goodyear et al., 2023). School-based interventions had increased due to children and adolescents spend many waking hours in schools (Dodd et al., 2022; Medeiros et al., 2022).

Recently, a mobile application called Mystic school was developed as a tool for PE teachers (Saucedo-Araujo et al., 2022). The main purpose was to encourage walking as a mode of commuting to increase the levels of daily PA in young people. The functionality and feasibility of Mystic School mobile application has been previously tested in adolescents considering their opinions through a focus group.

At this moment, an update of the application was developed to incorporate it into a real educational proposal. The intervention is not only crucial for the well-being of adolescents, but it also has the potential to create a lasting positive effect on public health, the community, and the environment.

Implementing active commuting strategies and promoting PA in schools is, therefore, an investment in a healthier and more sustainable future. Thus, it is necessary to delve more deeply into the implementation of this proposal based on an innovative methodology for the promotion of active commuting (by walking) in PE lessons. Nevertheless, in the current study, a school-based intervention was implemented based on the use of innovative methodology and integrating a Mystic School mobile application in the PE lessons. The primary objective of this study was to develop an educational proposal tailored at PE lessons for Spanish adolescents. The second objective involved the implementation and evaluation of this proposal, which included the integration of a mobile application Mystic School. The third objective aimed to explore the perceptions of both adolescents and teachers regarding the educational proposal and the mobile application Mystic School.

Method

Study design

The current study adopted a qualitative research method through personal interviews. Qualitative studies often focus on a particular context, as was the case in this study. This means that the findings may reflect more the experiences or perceptions of that sample rather than being representative of a broader population. Previously, the application was tested and analysed with adolescent students and their considerations as users were carried out in a previous study (Saucedo-Araujo et al., 2022). In the present study, an educational proposal focusses on PE lessons using a mobile application called Mystic School.

Participants and recruitment

The participants of this study are part of "The PACO (Pedalea y Anda al Cole; Cycle and Walk to School) study", which has been designed to promote ACS, and consequently PA in adolescents (Chillón et al., 2021). The PACO study has been approved according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the University of Granada (Reference: 162/CEIH/2016) on 6 June 2016.

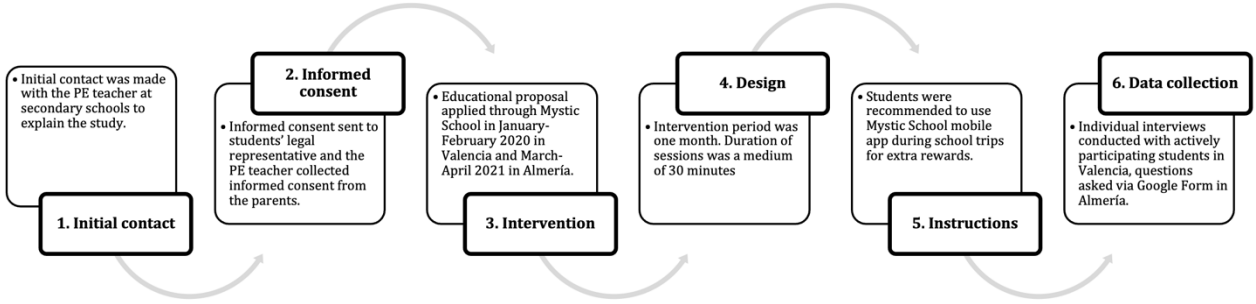
In this study, two groups of students per secondary school were invited to participate in the cities of Valencia (n= 34) and Almería (n= 58). Inclusion criteria for participation were as follows: 1) be in the 3rd grade of Spanish secondary education and 2) have a mobile phone with an Android operation system. A total of 16 adolescents from Valencia and 14 adolescents from Almería did not meet the inclusion criteria. Finally, a total of 62 adolescents agreed to participate in the study from two public secondary schools in Valencia (n =18) and Almería (n =44).

Procedure

Initial contact was made with the PE teacher and school staff at secondary schools to explain the study. Informed consent was sent to the students' legal representative (parents/legal guardians) and the PE teacher collected the signed informed consent from them. The intervention period was one month in both schools (4 sessions). In Valencia, one session per week was carried out in each group. In Almería, on the other hand, due to COVID-19 health recommendations, each class was reduced to smaller groups.

The duration of the sessions was a medium of 30 minutes. The educational proposal and Mystic School mobile application were applied during January-February 2020 in Valencia and March-April 2021 in Almería. In addition, in each session, students were recommended to use the Mystic School mobile application during their school trips as an option to obtain extra rewards in the educational proposal. After the intervention, an individual interview was conducted with those students who had actively participated in the sessions in Valencia. However, due to COVID-19, the questions were asked individually by google form in Almería (see Figure 1).

Figure 1. Summary of the study protocol



Description of the educational proposal

An educational proposal was developed based on PE lessons (four sessions) and regarding the specific content that correspond to the PE content. The Mystic School mobile application was added as an optional resource during after-school hours to get advantages in PE lessons. The PE lessons were designed based on the contents of PE for adolescents in the 3rd grade of secondary education (13–14 years old). The main objective of the educational proposal was to increase the PA level through active commuting domain by carrying out more active sessions and improving the organization of the students, as well as better managing their time. Secondly, to enhance orientation skills by gaining a better understanding of the immediate environs. Thirdly, to become proficient in reading and utilizing maps effectively. Fourthly, to cultivate teamwork skills for collaborative problem-solving.

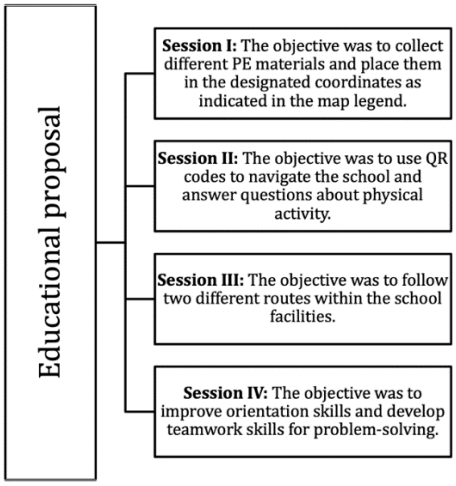
The Spanish Education Law, approved in 2006, establishes the general framework for education in the country. During a time of transition and modification of the law, an educational proposal was made in Valencia within the Organic Law of Education (LOE). The following year, the LOMLOE, Organic Law Amending the Organic Law of Education, is a law that modifies the LOE to adapt it to the changes that have occurred in society and in the educational field. The educational proposal was implemented in Almería, within the framework of the LOE modified by the LOMLOE, which was approved in December 2021.

The educational proposal was presented based on four sessions with the contents established in the Spanish curriculum of Compulsory and Upper Secondary Education (Real Decreto 1105/2014, 26th December, BOE no. 3, 3rd January 2015). The curriculum established five modules for PE. This proposal focused on module five - Physical activities in the natural environment - which includes: a) carrying out PAs in the natural environment to improve health and quality of life and active leisure and free time occupation; b) the techniques for progression in unstable environments; c) basic orientation techniques, route selection, continuous map reading, relocation, and finally, d) the study of available activities and the use of the possibilities offered by the immediate environment for PAs.

The study employed innovative methodologies, including collaborative learning, as well as elements such as badges, narratives, and roles within the gamification dynamics. To capture the students' attention and promote their participation in the educational proposal, a specific theme (as a story tale) was introduced. The educational proposal was called "The resistance Ultimatum to Humanity", revolved round the concept of an alien invasion. The premise was that the intruders would seize control of everything unless the students banded together to complete various missions to repel the aliens. Each session involved the students, functioning as part of the "resistance" team, engaging in activities

designed to enhance a range of skills. Teams were formed randomly, with a maximum of 4 to 6 members depending on the class size, and each team selected a leader and a name. Each session featured specific rules that needed to be adhered to, with points awarded based on compliance. Points were deducted for any rule violations. The group that successfully achieved the mission objective and accumulated the most points, while following the rules, was deemed to have passed the mission. Additionally, teams that utilized the Mystic School mobile application were given bonus points during sessions to gain advantages and conquer challenges. The points of each session are presented in more detail below and a summary is shown in Figure 2.

Figure 2. Sessions of the educational proposal



In the session I, the objective was to collect different PE materials and place them in the designated coordinates as indicated in the map legend. Each group received a map of the school's outdoor tracks and had to read the map to correctly place all the materials according to the instructions. In addition, the leader of each group carried a mobile phone with an app that recorded the total steps and distance covered (using health or fitness mobile phone apps was suggested). To carry out the activity, the teacher had a record sheet with the requirements that each team had to meet (sheet and map with coordinates in supplementary file 1).

In the session II, the objective was to recognize the environment through clues (images with different descriptions). An orientation race was carried out using QR codes based on specific images of the school (i.e., landmarks). Each team used the mobile phone of a group member to display the clue presented in the QR code. The students gradually discovered a question about PA and commuting that they had to answer to continue with the game clue. Once answered correctly, the students moved on to the next QR clue (different QR in supplementary file 2).

In the session III, the objective was to follow two different routes within the school facilities. Each group had to find a clue and, to do so, they had to complete an activity. Sometimes they had to use a map to continue the route (map given in advance). Once the activity was completed, they could move on to the next clue. Some examples of activities included a tour of the school facilities, solving equations, drawing, or solving riddles located in or around the school (map and some clues in supplementary file 3).

In the session IV, the objective was to improve orientation skills and develop teamwork skills for problem-solving. Stations with different tests were set up in the park closest to the school. The teacher provided a map to each team before leaving the school to guide them to the park outside the school with instructions. In this case, all teams moved together as a group to the nearest park. Each map of the park contained 4 locations (stations) called alpha, beta, gamma, and delta, each with a test to pass. When each team managed to locate the area, the teacher presented them with a situation, a problem, or a physical test that they had to solve as a team. At each station, each team was given a fragment of Morse code that they had to decipher. At the end of all the test, with all the Morse code clues, they had to access a platform

to prevent the extermination of aliens and avoid their invasion (map and instruction in supplementary file 4).

In Table 1, a brief explanation is provided of the main activities, duration, facilities, and material resources for each PE lesson (4 sessions) of the current educational proposal.

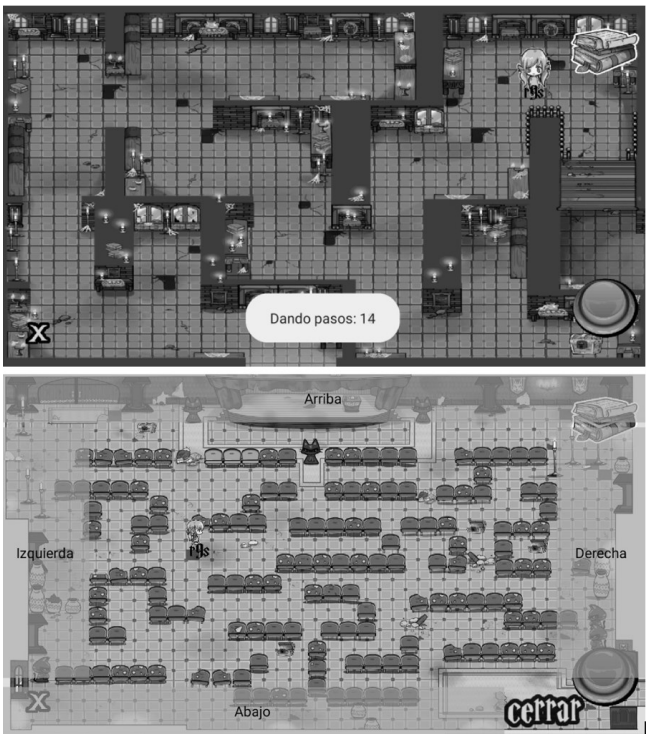
Table 1. Timetable in PE lessons

Intervention			
Session/Main activities	Duration	Facilities	Material resources
I. Move different elements according to a school map to know the nearby environment	25 minutes	Outdoor tracks	Group registration form, mats, balls, and hoops. Map of the outside tracks and one student per group must have their own phone and Internet connection.
II. Through QR codes to recognise different facilities	25 minutes	School gym / Outdoor tracks	Group registration form, mobile phone with Internet access and QR.
III. Different requirements to use map	25 minutes	School gym / Outdoor courts. Surroundings of the educational secondary school	Group registration form, mobile phone with Internet Access.
IV. Overcome different games related to orientation and location	45 minutes	Space outside the educational secondary school (e.g., park, plaza, etc.)	Group registration form, cones (10) and Internet Access.

The Mystic School mobile app

The software Mystic School (figure 3) is a mobile application whose purpose is to promote ACS by walking in adolescents. The Mystic School was designed only for the Android mobile phone operating system (minimum version 4.0). The Mystic School transforms the steps of the real route into virtual steps to play with. It counts the real steps, accumulating them virtually and allowing the user to move his avatar through a maze and obtain certain objects to complete missions and scape from it, overcoming the different levels (Saucedo-Araujo et al., 2022).

Figure 3. Different levels of the Mystic School mobile application (Spanish version).



Interviews with adolescents and teachers

A structured interview was conducted at the school in Valencia with adolescents about their PE sessions. Four questions were asked to gather their thoughts and feedback:

- What did you think about the sessions?
- Which session did you like the most?

- Which session did you like the least?
- How could the sessions be improved or what would you modify to have more fun?

Regarding the Mystic School mobile application, three questions were asked:

- What did you think about Mystic school?
- What would you improve to play more?
- If you were a teacher, would you see the app applicable in PE lessons?

Experts in qualitative analysis outside of the research team reviewed the questions. Only participants who attended PE lessons and played during the four weeks were invited to be part of the interview group. Afterwards, the same researcher who conducted the meetings with the students and oversaw the entire process acted as the moderator to guide the group. The topics discussed in the group were kept anonymous and confidential. Both individual and group opinions on the intervention were collected and analysed together.

In addition, there was a structured interview to the two PE teachers. At the end of the intervention, the teacher responsible for the PE subject in each city was asked about the educational proposal and the Mystic School mobile application. In the city of Valencia, the teacher assigned to the subject was female, and she was referred to as “F". In the case of the city of Almería, the teacher in charge was male and was assigned the letter "M". The questions that were asked were:

- What did you think about the sessions?
- How would you apply Mystic School with your students?
- Do you think it could be useful?
- What aspects did you think should be worked on more?

Data analysis

The information obtained from the individual/group interviews with adolescents and teachers was analysed using qualitative methods with NVivo 11 plus software. To protect the participants' privacy and ensure a comfortable and quiet environment for the interviews, the author conducted them in a room at the school. The opinions gathered were analysed in different phases. Firstly, the transcripts were read multiple times to grasp an overall understanding of the data. Then, the text was broken down into meaningful units. Finally, themes were identified, compared, contrasted, and classified while maintaining fidelity to the original text. Ultimately, the contributions made by the participants were discussed by the entire research team.

Results

A total of 62 adolescents (aged 14□0.45, 54.8% girls) were part of the intervention. The main perceptions of the adolescent about the intervention and Mystic School mobile application extracted from the interview (n=9, Valencia; and n=12, Almería) are presented in Table 2.

In the PE sessions, and regarding the first question, "What did you think of the sessions?", the adolescents provided positive feedback such as "they were fun and original" AND "enjoyable and different". They expressed a desire for the sessions to be longer and emphasized that they enjoyed them. When asked about their favourite session, the majority cited the last session as the most enjoyable due to the unique context in which the activities took place. On the other hand, when questioned about their least favourite session, some adolescents mentioned that the first session was the least enjoyable because of the cumbersome PE material they had to transport through the playground. Another question asked the adolescents was “How can you improve the sessions?”. Overall, the perception was positive as most stated that they wouldn't change anything. However, some suggested making the sessions longer and incorporating additional activities, such as sports. In addition, individual interviews were conducted with both teachers. The PE teacher referred to as "F”, enjoyed the sessions, as they allowed her to utilize different parts of the school facilities and engage in activities that she typically does not do with common materials. She found the idea of the points and rewards system to be

innovative but challenging to implement without a pre-established plan. Furthermore, she mentioned that implementing this strategy would require ample time in advance and someone to help her. She expressed doubts about its feasibility in the short term due to the need for training. While she appreciated the sessions, she believed that more time was necessary as PE lessons are typically brief. On the other hand, teacher "M" reported that the adolescents were more engaged and enthusiastic during the sessions because of the novelty of the activities. He noted that he could incorporate the sessions into his lessons, but only at specific times as adolescents easily become disinterested.

About the Mystic School mobile application, the adolescents found it to be "enjoyable and interesting." Nevertheless, there were a few students who were unable to access the app or experienced technical issues on their mobile devices. In relation to the following question, "What would you improve about the video game to play more?", the adolescents mentioned that the steps count numbers earned by walking were quickly spent. It would be beneficial if the app didn't crash as frequently, and it would be even better if there was a version available for the iPhone operating system (IOS). Another question was "If you were a teacher, would you see the Mystic school mobile application applicable in PE lessons?" The majority answered positively this question. They recalled that some students own IOS mobile phones, prompting the need to ensure participation and offer increased rewards for each accomplishment or final prize to make the extracurricular activity inclusive for all. Teacher "F" expressed that she found it to be enjoyable and believes that it could be effectively utilised for PA promotion, although she tried to use it and found it necessary to improve the app. She believes that, although the initial concept is promising, the current design may not be focused on today's adolescents because perhaps the context of the app did not appeal so much to students. She suggested that testing the app with elementary school students could be more positive results, although she acknowledged the challenges in obtaining consent from both schools and parents for younger participants. Similarly, teacher "M" also highlighted the need for further improvements to the app, citing various usability issues. He emphasized that today's adolescents have limited patience and tend to swiftly abandon apps that do not perform as expected, opting for alternatives without attempting to troubleshoot the problems.

Table 2. Characteristics of perceptions about the intervention by personal interview

Questions	Point of view – perception of adolescents
Questions about PE sessions	
What did you think about the sessions?	"I liked all the sessions". "The sessions were fun and original". "They were very enjoyable and different".
Which session did you like the most?	"The orientation session outside the school (last session)". "When we had to look for the QR codes and take pictures where the instructions indicated".
Which session did you like the least?	"None, all have been fun". "All the sessions have been good". "When we had to move the objects around the school playground".
How can the sessions be improved or what would you modify to have more fun?	"I would have liked to do a gymkhana around the playground, looking for objects and clues". "I would have liked to have played more sports". "The truth is that I had a great time, I wouldn't improve anything".
Questions about Mystic School mobile application	
What did you think about Mystic school app?	"The app has been good, but it had a lot of problems". "Very interesting". "Good but needs a little more development". "The application is enjoyable".
What would you improve to play more?	"That it does not waste so much battery power when you are walking". "That it would not give so many failures when entering the application". "That the steps were not spent so fast when you play. "I would change having to have the application in the background and the messages of speed and steps".
If you were a teacher, do you see the app in PE lessons?	"Yes, it would be a voluntary activity outside of school". "I would make teams with my students and see who would win". "Rewarding those who accumulate the most steps".

Discussion

This study was focused on the creation of an educational proposal for PE lessons. Additionally, the implementation of this program and the evaluation of it is efficacy among Spanish adolescents utilizing the Mystic School mobile application were also covered. Subsequently, the students' perception was

evaluated, followed by that of the teachers, regarding both educational proposal and the Mystic School mobile application.

The adolescents appreciated the educational proposal, finding it enjoyable and distinct, particularly the final session. Despite their enjoyment of the Mystic School mobile application, they faced technical difficulties, including incorrect user registration and slow loading times. PE teachers observed that the proposal titled "The Resistance Ultimatum to Humanity" was intriguing and could be integrated into PE lessons due to its novel approach. Nonetheless, they recommended enhancements to the mobile application.

There is evidence about the different barriers in the school settings that hinder the promotion of PA, one of which is the level of experience of the teacher (Jenkinson & Benson, 2010). The teacher “F” commented that although the proposal appeared very appealing, it would necessitate more experience to proficiently manage every situation and adequately prepare for the sessions in advance. It is also important to take into consideration that the duration of the sessions were relatively short in order to effectively cover the contents of the proposal. Currently, innovative methodologies are having an increasingly significant impact (González & Dueñas, 2009). Implementing an intervention in schools presents challenges such as limited resources, the need to train teachers, and the diversity of learning styles. Involving families can also be complex, and ensuring the long-term sustainability of the intervention is another concern. Our results confirm it, since teacher “M” confirm that adolescents were more actively involved in the sessions and showed a higher level of enthusiasm within the PE sessions using innovative methodologies. It agrees with Freeman et. al. (2014) who indicated that “active methodologies involve students” in the learning process through activities and/or discussions in the classroom, and where students are the protagonists of learning, through the teacher guiding them. Although learning is focused on the student, this study needs to plan the characteristics of the expected feedback in the intervention to achieve more feedback and thus, promote the success of the objectives.

Another methodological aspect in the PE sessions is the feedback and motivation. In this sense, previous study showed (Torregrosa & Murcia, 2015) that a positive feedback and intrinsic motivation in PE, reduce the fear of making mistakes in young people, and they may achieve new physical challenges that may increase PA during the school time. Furthermore, it has been evidenced that a comprehensive programme is required to ensure that children increase PA and meet PA guidelines. Moreover, these studies (Check, 2013; Hills et al., 2015) suggested that to achieve the benefits of PA promotion there must be coordination among the following five components: 1) quality PE; 2) PA during the school day; 3) PA before and after school; 4) staff involvement; and 5) family and community engagement. In Spain, PE lessons have a maximum duration of 1 hour. With respect to points 1 and 2, it must be noted that in this study, the provision of a full hour of PE lesson was initially requested. However, it was not implemented since the school allowed time in each session for the students to change clothes and go to the facilities. Therefore, we had less time than planned. A prior study has shown that this is one of the barriers in the school settings, since the time is fixed and there is no flexibility to change or extend the schedule (Lounsbery et al., 2011). Concerning point 4, it is possible to design the educational proposal together with the teacher, but in this case, only the researcher applied the sessions, and the teacher observed without participating. Active learning including, simulations and role playing, requires going beyond focusing on the student (Crisol-Moya et al., 2020) . This methodology requires not only changes in the teacher, but also organisational changes, in terms of infrastructure, resources, and cooperative environment among teachers (de la Sablonnière et al., 2009) , as well as motivation of both students and teachers (Maclellan, 2008) . Including a greater data collection could have provided us with more detailed information about the participants' characteristics, as well as the outcomes, also incorporating quantitative indicators. Additionally, harmonizing digital and in-person components proved crucial for creating a blended learning environment that accommodated diverse learning preferences and enhanced educational outcomes. Emphasizing cooperative learning also democratized access to sports and physical activities, fostering equitable development of motor skills and physical abilities among all students (Mulato et al., 2024).

The major challenge was that the use of mobile phones is prohibited in most schools, and it is difficult to convince to participate. However, several authors endorse the advantages of mobile devices in schools, due to the attractiveness and wide educational offer they provide to the teacher (Crompton & Burke, 2018). Earlier investigations have shown that in order to establish the effectiveness of behaviour

change techniques in PA and diet apps, interventions should be targeted for implementation in the school curriculum (Brannon & Cushing, 2014). Additionally, it appears that most the mobile health apps have positive effects on individual health variables (Milne-Ives et al., 2020). Therefore, while the results indicate that further research is needed, the perceptions of both students and PE teachers are essential for the development of student-centred methodologies, as also highlighted in previous studies (Crisol-Moya et al., 2020). The Mystic School mobile application has encountered technical issues that have adversely affected the outcomes of the intervention. The application's inconsistent availability hampers access to its content and features, thereby limiting user participation. Technical failures, such as crashes or sluggishness, can frustrate users, leading to decreased motivation and reduced usage of the application. Furthermore, challenges in the interactive functionalities may disengage users, negatively impacting their involvement in activities that are crucial for the success of the intervention. Discrepancies in user experience arising from technical malfunctions may result in varied outcomes among participants. Ultimately, a high incidence of failures could lead to a significant dropout rate, affecting the sample size and, subsequently, the intervention's results. Addressing these technical issues should be a priority to ensure that users have a smooth and positive experience, to maximize participation in the intervention, and to achieve more accurate and meaningful results. To address the poor perception of mobile phones, strategies are recommended to regulate the use of mobile phones at school for a proper use and enjoyment (Kopecký et al., 2021).

Future directions and research implications

It would be particularly beneficial for the proposed educational initiative to be developed in collaboration with both the research team and the PE teacher. This collaborative approach could leverage the research team's expertise in innovative pedagogical strategies and the PE teacher's extensive experience in fostering adolescent development and navigating the complexities of the school environment. By working together, these stakeholders can co-create a program that is not only evidence-based but also tailored to the unique needs and dynamics of the student population. The involvement of the PE teacher during the implementation phase is crucial, as their familiarity with the students can facilitate a smoother integration of the proposal into the existing curriculum. This real-world experience enables them to anticipate potential challenges and adapt the program to enhance student engagement and learning outcomes. Furthermore, the PE teacher can play a vital role in creating an environment of trust and safety, which is essential for encouraging students to adopt the proposed behavioural changes. Looking ahead, it would be wise for future studies to extend the duration of such interventions. Long-term commitment can provide richer data on the sustainability of behavioural changes and help determine whether the positive effects of the program endure beyond the initial implementation phase.

Some recommendations to improve the situation described regarding The Mystic School could include enhancing the app's performance optimization to reduce loading times and minimize failure rates. It may also be worth considering allowing users to interact with the app even when they do not have an internet connection, as this could increase usage and engagement. Another recommendation could be to establish an efficient technical support system that enables users to report issues easily and quickly. It should provide quick responses to inquiries and prioritize solving problems. By addressing these points, the user experience can be improved, engagement in the intervention can increase, and more accurate and meaningful results can be achieved.

Collaboration with families and schools will also be key to creating a comprehensive support system that reinforces desired behaviours both in school and at home. When families are involved, students may feel more motivated to adopt new behaviours, knowing that their efforts are supported both academically and at home. Incorporating behavioural frameworks more systematically into this study could be of great value. Frameworks such as Social Cognitive Theory or the Transtheoretical Model (Hashemzadeh et al., 2019) offer structured perspectives on how behaviour change occurs and the factors that influence it. By utilizing these frameworks, researchers can gain a deeper understanding of the underlying mechanisms that facilitate or hinder positive behavioural changes. This could lead to the identification of specific intervention strategies that are particularly effective in different contexts or with various student populations, allowing for a more targeted approach.

In summary, a joint effort between the research team and PE teachers in the design and implementation of the educational proposal can create a more enriching learning experience for adolescents. Future

research should prioritize long-term interventions and collaboration among multiple stakeholders, as well as the systematic integration of behaviour change frameworks, to enhance the effectiveness of educational initiatives.

Study strengths and limitations

The strengths in this study include a novel and attractive proposal and strategy to motivate participation in the sessions based on innovative methodology in two schools. In addition, the intervention was implemented as part of the subject curriculum. The educational proposal (4 sessions) was focused on the curricular contents of PE lessons. However, some limitations were observed. Include a diverse and broader sample that represents different perspectives to enrich the findings and minimize biases. Conduct data or source triangulation (documents, records) to enhance validity. The qualitative analysis provided in the methodology is presented as a simple collection of phrases deemed relevant, rather than through a more in-depth analysis organized by thematic groups or response categories. In addition, the sessions were brief, and the implementation of new strategies requires extensive experience and long-term follow-up. Another crucial aspect was the prohibition of mobile phone use in both schools. The research group obtained prior authorization for their use, some students did not bring the device and could not carry out the planned activity. The Mystic School mobile application presented some inconveniences and, the circumstances were different between the two periods due to the COVID-19. Thus, behavioural science and technology should be more aligned between academia and industry to ensure that technologies are effective for adolescents (Brannon & Cushing, 2014). In addition, the application was developed by different designers in different phases, which could have influenced the results (some problems with the application system in the initial phase were not resolved). Considering this situation, the various mobile phone models used by the students involved in the study were documented. However, it was not feasible to make enhancements for all models due to the significantly higher costs and time requirements than initially anticipated. While it is certainly beneficial to create a proposal that incorporates relevant content and utilizes technology, it is essential for future researchers to delve deeper into aspects such as motivational strategies to better cater to the needs of adolescents. Addressing these limitations rigorously could strengthen the applicability of the results and facilitate a better understanding of the interaction between behavioural science and technology in the educational field. Ultimately, the recommendations proposed can serve as a guide for future research, significantly contributing to advancements in this area.

Conclusions

The educational proposal, along with the integration of the Mystic School mobile application, received positive feedback from both adolescents and teachers, who praised its engaging and innovative features. However, it is essential to implement behaviour change strategies to enhance user engagement and extend the duration of the intervention within this educational context, as well as to explore other online alternatives that are accessible to all adolescents and do not present usability issues. Leveraging innovative methodologies and new technologies could provide a compelling alternative to traditional PE lessons.

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