USE OF ICT (APPS AND WEARABLES) AND LKT

AS AN EDUCATIONAL RESOURCE IN THE FIELD OF PHYSICAL EDUCATION

Editors:

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Project: Promotion of daily physical activity recommended for health in adolescents through mobile apps, wearables and a gamified LKT
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Advances in Information and Communication Technologies (ICT) and the development of Learning and Knowledge Technologies (LKT) have revolutionised the field of education, including Physical Education. This book explores how these technologies can enhance the teaching and practice of physical activity in school and extracurricular contexts.

Throughout its chapters, the book addresses the role of mobile applications and wearables in promoting physical activity, and the use of gamification and play as motivational strategies in the classroom. It also analyses the influence of the integration of ICT and LKT in Physical Education and their role in motivation, physical fitness assessment and autonomous learning. In addition, the TPACK model is presented as a benchmark model for teacher training in digital competence, providing practical recommendations for the effective implementation of technologies in the classroom. Finally, the book examines both the advantages and risks associated with the use of new technologies in Physical Education teaching, highlighting strategies to optimise their use and minimise their drawbacks. Finally, the reader is given tools to enhance self-assessment of knowledge related to Physical Education through LKTs.

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Use of ICT (Apps and Wearables) and LKT as an Educational Resource in Physical Education

This book has been evaluated by our Editorial Board

ÍNDICE

Chapter 1

Mobile applications (ICT and LKT) for promoting physical activity

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Abstract

Childhood and adolescence are crucial stages for developing healthy habits, with regular physical activity being essential for preventing chronic diseases. Although the WHO recommends 60 minutes of moderate or vigorous exercise per day, 80% of young people do not meet this target, especially adolescents and females. Physical Education classes are essential but insufficient in terms of time and intensity. Therefore, extracurricular physical activity should be promoted, and mobile applications are effective tools for this purpose. These apps allow users to record steps, calories and heart rate, and offer personalised routines. Applications such as ActivaApp stand out for their educational approach, use of gamification, and adaptation to students. However, their use faces challenges such as lack of access to devices, privacy risks, loss of interest, and a lack of design for students. Therefore, their safe, supervised, and educational use is essential.

Keywords: Physical Education; Physical exercise; Gamification; New technologies; Health; Educational technology.

1. Introduction

Childhood and adolescence are crucial stages for the development of healthy habits, which can have a lasting impact on present and future health. In this regard, regular physical activity stands out as a key protective factor in preventing the onset of chronic conditions such as obesity, type 2 diabetes, and cardiovascular disease, among others. According to the World Health Organisation (WHO), children and adolescents should engage in at least 60 minutes of moderate to vigorous physical activity every day, supplemented by muscle-strengthening exercises at least three times a week, to maximise their physical and mental well-being.

However, despite the benefits associated with physical activity, participation rates among children and adolescents are worryingly low. Recent research indicates that 80% of children and adolescents do not meet the minimum levels recommended by the WHO, which represents a significant public health problem for the present and the future. The problem is even greater among adolescents than among children, and among females compared to males, as there is a decline in physical activity with age, especially among females. Among the most common barriers to physical activity identified among adolescents, we find a lack of time, support, energy, or preferences for other more passive leisure activities, such as the use of electronic devices in their free time. In addition to the above, it is important to note that around 15% of males and 20% of females in the age of growth group say that they never exercise outside of compulsory Physical Education classes at school, which reflects the problem at hand.

In this regard, Physical Education in schools is a key tool for promoting healthy habits during adolescence and achieving physical activity recommendations. However, in Spain, the time allocated to this subject in the school curriculum ranges from two to three hours per week, which is insufficient to meet the recommendations established by the WHO. In addition, the effective time devoted to moderate or vigorous physical activity in these classes is limited due to various factors, such as the need to cover multiple topics, logistical constraints in schools and, in some cases, teaching methodology, class organisation

or the teachers' use of time. Along these lines, several studies indicate that even in perfectly planned sessions that promote moderate or vigorous physical activity, the actual time that students achieve these intensities rarely exceeds 20 minutes per session.

As a result, it is essential for children and adolescents to engage in physical activity outside school hours, and recent research has explored strategies to encourage this through Physical Education, considering that it is key to promoting an active and healthy lifestyle among students. Among the most notable measures, the following has been observed: the organisation of sports activities in schools; the promotion of student participation in school sports programmes; collaboration with local sports institutions to facilitate access to extracurricular activities; the development of projects that include sports challenges, which encourage students to engage in physical activity outside school hours, even involving their families; implementing recognition systems such as diplomas, trophies, or special mentions for the most active students; and using technological resources to monitor their extracurricular physical activity, motivating them with rewards. These actions seek not only to increase physical activity levels, but also to promote healthy habits and strengthen the connection among the student community.

Delving deeper into this, it is important to note that the use of new technologies with children and adolescents has a significant impact on their social, cognitive, physical, and emotional development. More specifically, new technologies offer this population access to information and learning, allowing students to explore alternative educational resources, develop digital skills, and foster their creativity, expression and socialisation, among others. However, although technologies offer educational and entertainment benefits, they also present significant challenges that must be managed appropriately. In this regard, some of the main concerns in this population include the addiction they generate and the consequences that their excessive use could have; health problems associated with their use, such as visual fatigue, poor posture, or the promotion of a sedentary lifestyle; exposure to content that is inappropriate for their age; or vulnerability

to cyberbullying, as well as the loss of privacy that results from the exposure of personal information online.

Given all of the above, in recent years, various studies have analysed the usefulness of Information and Communication Technologies (ICT) and Learning and Knowledge Technologies (LKT), as key tools for promoting active lifestyles in a growing population. Delving deeper into these concepts, ICTs encompass a wide range of technological tools used to manage information and communication. This group includes email, social networks, messaging applications, videoconferencing tools, search engines, digital encyclopaedias, digital databases, virtual learning platforms, augmented and virtual reality tools, video editors, streaming platforms, graphic design tools, word processors or spreadsheets, collaboration tools, video games, video or music content applications, and mobile applications, among others, which enable the transmission and exchange of data. LKTs are a type of technology whose purpose is to improve teaching and learning processes. In the context of physical activity for health, these LKTs serve to educate and motivate people to adopt healthy habits and, more specifically, to engage in physical activity.

Of the above, mobile applications have emerged as some of the most widely used ICTs and LKTs for promoting physical activity in growing populations, given that mobile phones are the most widely used electronic devices in this group. These applications allow data on users' physical fitness to be collected, and personalised feedback to be provided, and the physical activity carried out by students is quantified as well. This facilitates progress monitoring for both students and teachers. Numerous studies have shown that the use of apps that record data such as daily steps, calories burned, or heart rate, promoted by Physical Education teachers, helps students visualise their progress and allows teachers to objectively monitor activities, integrating this information into the assessment of the subject. Similarly, various studies have suggested complementing Physical Education classes with structured programmes outside school hours. These interventions have proven effective in increasing physical activity levels, improving body composition, promoting healthy habits, and reducing the risks associated with a sedentary lifestyle.

2. Benefits of mobile applications for promoting physical activity

Mobile applications, as part of ICT and LKT, offer a number of significant benefits for promoting physical activity in growing populations. Their accessibility, interactivity and customisation capabilities make them effective tools for promoting healthy habits. Among the advantages of this type of application, it has been found that they could increase motivation and commitment to physical activity as a result of the inclusion of rewards, reminders and challenges. In addition, gamified applications are becoming increasingly relevant in this population. These types of applications are based on the use of game mechanics and dynamics in non-playful contexts to motivate, engage and improve the user experience. In mobile applications, gamification has proven to be an effective strategy for increasing participation and promoting healthy habits. The elements that should be included are a points system, whereby students earn points by completing tasks or challenges, which encourages consistency and progress; a system of levels or features that are unlocked as the application is used, thereby encouraging its use; a reward system, such as badges, trophies or additional virtual content; the presence of rankings that allow users to compare their performance with that of others, encouraging competition; the presence of specific challenges, setting a time limit for achieving them, thus encouraging adherence to this type of application; or the presence of immediate feedback on the user's progress, with notifications or congratulatory messages, for example.

Another advantage of these apps is the possibility of accessing personalised training routines tailored to the student's level, personal goals, and interests, which could improve adherence to this type of exercise. In this regard, there are many apps for planning and monitoring cardio-respiratory exercise, strength training, high-intensity training, rhythmic activities, and routes, among others, offering a wide range of resources tailored to the user's interests and needs, encouraging their involvement, and helping them achieve a tailored, individualised training programme, which is more difficult when working in a group.

They also have the advantage of allowing users to track their progress towards their goals by recording and analysing data such as steps taken, calories burned, average and maximum heart rate, time spent in each heart rate zone during training, and distance covered, among other things. In addition, most of these apps allow users to view statistics and the evolution of these parameters during different training sessions, which could be an important motivational factor for students, as they can see their progress and evaluate the improvements achieved through physical activity. They also allow real-time monitoring of physiological parameters, making it possible to know whether the student is performing physical activity at a sufficient intensity to improve their health.

Another major advantage of these apps is the flexibility and autonomy they offer, as they allow students to access their physical exercise routine from anywhere and at any time, facilitating independent physical activity tailored to the student's needs.

Furthermore, a notable feature of most apps that encourage physical activity is the promotion of socialisation. Many apps have social features, such as support groups, shared challenges, and connections with friends, to encourage group activity and motivation, thereby helping to improve overall health.

3. Most popular apps for promoting physical activity in the growing population

Among the apps currently on the market for promoting physical activity in growing populations, there are several main categories: mobile apps for counting steps or distance; for strength training; and for flexibility training.

Mobile apps for measuring steps or distance are tools designed to record and analyse the number of steps or the distance travelled by a student in a specific training session or throughout the day. These apps use sensors built into smartphones (such as accelerometers and GPS), or connect to wearables, such as smartwatches or activity trackers. Some of the key features of these tools are that they record the

number of steps the user takes while walking or running, or the distance travelled while walking, running, cycling, swimming, or rowing. With this data, most of these apps estimate the calories burned based on the activity recorded; they allow users to quantify the time they have been exercising; and they allow users to set personalised goals and send reminders to users. In addition, many of these apps include gamification and allow users to share their progress with others or join virtual communities, which could encourage student motivation and commitment. However, most of these apps do not allow users to quantify the intensity of the exercise performed, which is a limitation when it comes to achieving sufficient physical activity to improve student health.

Most mobile strength training apps provide structured programmes with detailed instructions on the exercises to be performed, which could help students train independently. Another major advantage of this type of app is that they offer personalised routines to users, which could improve their experience and help them achieve their goals. Some of the common features of these apps are the inclusion of videos or tutorials showing how to perform each exercise correctly; the establishment of personalised training plans, which allow generating routines tailored to the user's goals; the inclusion of voice or text instructions on the pace, duration or repetitions to be performed; the possibility of monitoring progress through the automatic recording of workouts, which allow analysing the user's progress; and the inclusion of exercises or variations adapted to different levels of user proficiency. Many of these apps also incorporate gamification elements and offer the possibility of sharing progress with other users or joining virtual communities, which can boost student motivation and commitment. However, it should be borne in mind that the exercises and specifications given to users in this type of app are sometimes not in line with the principles of effectiveness and safety, so it is necessary to teach and raise awareness among students about these issues so that they are able to discern which exercises comply with these principles and which do not, and avoid doing the latter.

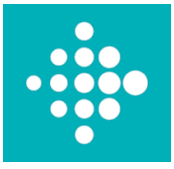
The availability of apps that allow flexibility training is somewhat limited, although there are some mobile apps that encourage stretching and mobility exercises. All of these apps offer appropriate content to improve flexibility progressively, with options for both beginners and people with previous experience in this area.

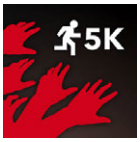
3.1. Most popular mobile apps

The following are among the most popular apps for cardiovascular, strength, and flexibility training:

Table 1. Most popular apps for monitoring physical and sports training.

App name and logo	Features	Operating system and QR code
ActivaApp	This is an educational tool designed to promote physical activity in school settings. It allows users to record steps, time, intensity and calories burned during training sessions, and includes gamification with daily, weekly, and monthly challenges that award points and unlock avatars. It also provides advice on healthy habits and a global and class ranking. It is accessible without a mobile data connection and allows students to register, linked to their school and class. Teachers can view detailed statistics from an associated website and export data to Excel, all free of charge.	Android and iOS

App name and logo	Features	Operating system and QR code
Strava 	This is a popular app for recording and analysing outdoor sports activities such as running, cycling, swimming, hiking and more. It uses GPS and wearables to track metrics such as distance, pace, elevation, calories and heart rate. It stands out for its segments, which allow users to compete on specific stretches and access global rankings, encouraging competitiveness. It also combines exercise tracking with a social network, allowing users to share workouts, routes and achievements, as well as interact with other users. Strava lets you create, save and discover custom routes based on other users' activity, makes it easy to join groups or clubs, and organises monthly and annual challenges with virtual rewards. The premium version, Strava Summit, offers personalised training plans and advanced analytics. The app is compatible with other health and fitness tools.	Android and iOS
Fitbit 	This app can be used with or without smart devices. It allows you to monitor daily physical activity, record exercises, set goals, and offers guided workouts. It also includes social challenges, comprehensive health tracking (such as heart rate, sleep and stress) and synchronisation with other healthy habit apps. Most features are free, but there is a premium subscription with advanced analytics, personalised programmes and more wellness tools.	Android and iOS

App name and logo	Features	Operating system and QR code
Zombies, Run! 	This is a gamified app that transforms running or walking into an immersive zombie survival experience. Users take on the role of "Runner 5," completing post-apocalyptic missions while listening to an intriguing narrative. It includes a "Zombie Chase" mode, introducing intervals when you are being chased by zombies, increasing the intensity and motivation. Missions allow users to collect supplies to improve their base, adding strategy to the game. The app integrates with music and, in its premium version, offers multiplayer challenges and global events.	Android and iOS
Pokémon Go 	It is an augmented reality game that combines physical activity with an immersive experience. Players explore the real world to capture Pokémon, visit PokéStops, battle in gyms, participate in raids, hatch eggs, and complete tasks. The game uses the camera and GPS to superimpose Pokémon onto the real environment, with variability depending on location, weather, and time of day. It also includes themed events, global challenges, Pokémon trading, and social mechanics such as gifts and friendship levels.	Android and iOS
Wikiloc 	This app allows users to explore and share outdoor routes for activities such as hiking, cycling, running and kayaking. Users can search for, download and record personal routes with details such as maps, distance, difficulty, and duration. It also allows you to add photos and descriptions, search for routes based on specific criteria and join communities and organised challenges. It offers downloadable maps for offline use and compatibility with smartwatches. Its premium version includes guided navigation to follow selected routes with greater precision.	Android and iOS

App name and logo	Features	Operating system and QR code
Pacer 2 	This is a physical activity tracking app that monitors steps, distance, time, calories burned and walking, running and cycling routes, displaying maps and detailed statistics. It offers personalised plans for different fitness levels, comprehensive activity history statistics, and exercise patterns. It also includes social features, such as global challenges and private groups, to encourage motivation. It stands out for its simple interface.	Android and iOS
MapMyWalk 	This is a fitness app designed to record walks, but it also allows users to track activities such as running, cycling, and gym workouts. It uses the mobile device's GPS to monitor routes, distance, time, pace, speed, calories burned, and other data. It offers detailed statistics and real-time audio feedback on progress. Users can save routes, share them, follow personalised training plans, and join challenges and a global fitness community. It is also compatible with wearables, smartwatches, and other nutritional tracking apps.	Android and iOS
Adidas Training 	This is a fitness app that offers personalised routines to improve strength, endurance, flexibility, and overall health. Exercises include bodyweight or equipment such as weights and resistance bands, adapting to the user's level and progress. It provides visual instructions and videos to perform the exercises correctly and avoid injury. It also allows you to participate in challenges, set goals, and sync with other fitness devices and apps. The free version includes basic exercises, while the premium subscription offers personalised plans, exclusive content, and advanced features.	Android and iOS

App name and logo	Features	Operating system and QR code
Sworkit	This is a fitness app that offers personalised training plans and guided exercises for users of all levels. It allows you to work out anywhere without equipment, with strength, cardio, yoga and stretching routines. Users can customise the duration and intensity of sessions, which range from 5 to 60 minutes. It includes videos with clear instructions and options for family training. Some advanced features are only available with a premium subscription.	Android and iOS
Nike Training Club	This is a fitness app accessible to all levels, offering a wide variety of strength and endurance workouts, both free and premium, tailored to individual goals. Its sessions, lasting from 15 to 45 minutes, can be performed with self-loading or basic equipment such as weights and bands, allowing users to train at home or at the gym. It includes visual instructions and videos to ensure safe and effective execution, minimising the risk of injury, as well as a community feature where users can share achievements and motivate each other.	Android and iOS
Seven	This fitness app is designed for those with limited time, offering effective routines of just 7 minutes a day, based on HIIT training and self-loading, with no equipment required. It allows users to adjust the duration of sessions, customise plans according to their goals, and adapt exercises to different levels. It includes visual instructions, animations, and a countdown to guide the pace of the workout. It also motivates users with challenges, progress tracking, achievements, and reminders. It offers free resources and a premium version with advanced content to enhance the experience.	Android and iOS

App name and logo	Features	Operating system and QR code
7 Minute Workout	This is a HIIT-based app that offers 7-minute workouts consisting of 12 exercises lasting 30 seconds with 10 seconds of rest. It allows users to customise exercises and rest times and offers strength, cardio, and flexibility routines, mostly with self-loading. It includes visual instructions and, in some cases, audio to make it easier to follow, indicating start and rest times to maintain the pace. It also allows users to record workouts, monitor goals, and set reminders. The app is mostly free, with advanced features available via a subscription.	Android and iOS
FitOn	This is a popular free fitness app that offers a wide variety of workouts for all levels, from strength and HIIT to yoga, Pilates and meditation. It allows users to create personalised plans based on their goals, time and level, with options that require no equipment or incorporate materials such as weights and bands. It includes detailed instructions for safe technique, integration with devices to track activity, and social features to train with friends, share achievements, and compete in group challenges. Although most of the content is free, the premium version, FitOn PRO, adds nutrition plans, advanced synchronisation, and personalised music.	Android and iOS

App name and logo	Features	Operating system and QR code
Freeletics	This is a fitness app focused on HIIT-based functional strength and endurance workouts that are adaptable to any level and can be done without much equipment, although some routines include some equipment such as weights or bars. It offers personalised plans that gradually increase in difficulty, allows users to record detailed progress metrics, and has an active community for sharing progress, tips and participating in challenges. Although it has a free version with limited access, its premium subscription unlocks personalised plans and exclusive content.	Android and iOS
JEFIT	This is a fitness app focused on strength training, ideal for those looking to improve their performance and monitor their progress. It allows users to create personalised plans or choose from a library of over 1,300 exercises, complete with descriptions, images and animations. Users can record repetitions, sets, weight and rest times, schedule workouts and analyse their progress using graphs and statistics on strength and body composition. It also includes a social network for sharing routines, tips and achievements. The app is free, but certain advanced features require a subscription.	Android and iOS

App name and logo	Features	Operating system and QR code
Gymbook 	This is a workout tracking and planning app focused on strength training. It allows users to create personalised routines from a library of pre-designed exercises or by adding their own exercises, organised by muscle group to balance the workout. Users can record repetitions, sets, weight and rest periods, keeping a detailed history of each session. The app generates progress reports and allows users to record body measurements such as weight and BMI to assess physical progress. Although it is functional in its free version, some advanced features require the premium version.	iOS
Dumbbells 	This app focuses on strength training and fitness routines using only dumbbells. It offers effective plans to build muscle, improve strength, and tone the body, with exercises that can be adapted to different skill levels. It includes specific routines for the chest, arms, legs, back, core, and full body, accompanied by images, videos, and descriptions to ensure proper execution. Sessions can last at least 10 minutes and can be customised according to the user's goals and the time they have available. Some advanced features require a subscription.	Android and iOS

App name and logo	Features	Operating system and QR code
Profit: Training 	This is a fitness app designed to offer customisable, guided routines tailored to different levels of experience and goals, such as strength, endurance, mobility, or general health. It includes a database of exercises classified by muscle group, with detailed instructions and video tutorials to ensure proper technique, as well as options for training at home or at the gym, using body weight or additional equipment. The app allows users to record weight, repetitions and other data to track progress, although some advanced features, such as personalised plans and detailed statistics, require a subscription.	Android and iOS
Stretching and flexibility 	This app offers personalised stretching routines to improve flexibility and mobility in different areas of the body, adapted to all fitness levels. It includes detailed guides with images or videos to perform the exercises correctly, focusing on specific areas such as the back, shoulders, legs or neck, as well as options for the whole body. Designed to be integrated into a daily routine, it offers quick stretches to energise the day or relax before bed. It also allows users to set personalised goals, record sessions and monitor progress. Although it has a free version, some advanced features require a subscription.	Android and iOS

App name and logo	Features	Operating system and QR code
Yoga for Beginners - Fit 	This app is designed to introduce beginners to yoga in an accessible and guided way. It offers short sessions, lasting 5 to 20 minutes, with simple poses and detailed explanations, ideal for establishing a routine for physical and mental well-being. It includes step-by-step visual guides and specific routines to energise the day or relax before bed. The app allows users to record the frequency of their sessions and offers reminders to encourage consistency, helping users to gradually increase their flexibility in a safe way.	Android and iOS
Daily Yoga 	This app offers yoga routines for beginners and advanced practitioners, with weekly programmes tailored to personal goals, including explanatory videos and audio, an integrated community for interaction, challenges, and the option to track progress by connecting with other apps. Although it offers free content, personalised plans and advanced classes require a premium subscription.	Android and iOS

4. Challenges and limitations in the use of mobile apps to promote physical activity in growing populations

The use of mobile apps to promote physical activity in growing populations presents several challenges and limitations. One of the main challenges is the lack of universal access to mobile devices or a constant internet connection, which limits the ability to use many of these tools effectively. This factor can lead to inequalities in the implementation of these technologies, hindering their reach and impact on certain groups of students.

Another difficulty with this type of intervention is maintaining adherence to physical activity promotion programmes, especially when

the initial novelty wears off. Loss of interest and consistent participation can become a significant obstacle, as previous research indicates that after the fourth week, there is a decline in the use of these apps, particularly when students' motivation is based exclusively on external rewards. For this reason, it is crucial to take advantage of the first few weeks, when the novelty of the apps generates a greater commitment, especially those that integrate gamification elements, symbolic rewards, and progressive levels, to increase intrinsic motivation, as this could increase the opportunities for using these apps in the medium and long term. It would therefore be advisable to set realistic and personal goals that help students set specific, achievable objectives related to their personal progress; give students autonomy in choosing activities, allowing them to increase their control and autonomy; set progressive challenges appropriate to the participant's ability, gradually increasing the difficulty to maintain interest and avoid frustration; incorporate games to promote enjoyment; encourage recognition of personal achievements and the enjoyment of the feeling of well-being after physical activity; create activity groups where students motivate each other and celebrate collective achievements; relate physical activity to goals and values that are meaningful to the student; provide individualised feedback that reinforces effort and suggests areas for improvement; focus on the pleasure of moving, playing, and exploring new activities, instead of the obligation to exercise; and allow students to record their progress to visualise their achievements.

Another major problem with using mobile apps to promote physical activity in growing populations is the collection of personal data, such as health-related information. This can pose significant privacy risks if not managed properly, especially in a population of minors. It is therefore essential to carefully consider the privacy and security conditions of the selected apps, especially in a school setting.

Several studies have pointed out that the use of mobile apps could increase the time spent using mobile phones, which poses a significant challenge. In this context, previous research has highlighted that excessive mobile phone use can lead to dependence, with negative effects such as deteriorating personal relationships, increased se-

dentary behaviour, physical inactivity, low self-esteem, anxiety, decreased academic performance and emotional well-being, and concentration problems. In addition, it has been observed that the use of mobile devices before bedtime can interfere with sleep duration and quality. Another worrying aspect is that these types of devices tend to promote impersonal interactions, reducing face-to-face interactions. They can also facilitate cyberbullying, perpetuating harassment through digital media. They also expose students to inappropriate content, whether violent, sexual or unsuitable for their age. Finally, these devices encourage a dependence on immediate reinforcement, as they promote instant rewards and a constant search for feedback. However, recent studies indicate that the use of mobile applications that promote healthy habits does not seem to increase addiction to new technologies or the inappropriate and excessive use of mobile devices.

Another problem is that students may use the apps inappropriately or manipulate the data recorded. In this regard, it is difficult to monitor whether it is the student who is actually completing the training sessions or whether they are using a shortcut to complete the challenges set, although it is true that most apps, especially those that focus on counting steps or tracking the route taken by GPS, have settings to prevent this type of manipulation as much as possible. In the case of applications that do not have these specifications, it would be necessary to include activity verification functions, especially when physical activity outside school hours is rewarded in the Physical Education assessment.

Without a doubt, one of the major limitations is that most of these physical activity quantification apps have not been designed for use by growing populations, nor are they adapted to the specific needs of this population or aligned with educational objectives. This means that students themselves say they prefer not to use them because they have a complex interface, require a lot of battery power, have features that are too demanding for the devices that students usually have, need data to work, or are not designed for them, among other reasons.

Finally, these types of applications also present difficulties for teachers; as they are not designed for use in an educational context, it is not usually easy to monitor the activity carried out by students. Previous studies have suggested that if the use of this type of application, after its integration into the educational system, generates a greater workload for teachers, it is unlikely that they will be used on a continuous basis. It is therefore essential that the applications used allow teachers to monitor student activity as easily as possible. However, as most applications are not designed with this objective in mind, there are not many applications that meet teachers' needs in this regard.

5. Practical recommendations

Given the limited number of hours of Physical Education in the educational context, promoting physical activity among students outside school hours has become a necessity in order to achieve the minimum levels of physical activity required to develop healthy habits, as established by international organisations. This is especially true when considering the need for physical activity to be of moderate or vigorous intensity in order to improve the health of those who practise it, and that most Physical Education sessions do not achieve this level of motor involvement. In this context, new technologies, and more specifically mobile applications, have been proposed as tools that allow for a reliable and personalised monitoring of physical activity carried out by students outside school, as they encourage them to maintain an active lifestyle, minimising sedentary time.

Thus, the use of applications that quantify data such as steps, calories burned, or heart rate is recommended to encourage students to improve their performance and visualise their progress. Another fundamental element in this population is gamification and the inclusion of reward and recognition systems, elements that seek to increase motivation and encourage participation. In this context, there are numerous apps that could be used to promote and record cardiorespiratory, strength, or flexibility work in a growing population, with high user ratings. However, perhaps the most interesting in this context could be the ActivaApp application, which has been specifically designed for use in education and with growing populations. As a result, its

design considers most of the limitations of other applications when used with children or adolescents. This app combines educational resources with gamification elements, allowing users to record steps, time, calories burned, and perceived effort, after each training session, making it one of the only LKTs available on the market. Its distinctive feature is its link to educational centres, allowing teachers to access detailed statistics for each student and export them to Excel from a web platform, all free of charge.

6. Conclusions

Mobile apps are a valuable complementary tool for promoting physical activity outside school hours, but their effectiveness depends on whether they are designed for the growing population and can be easily integrated into the educational environment. In addition, when implementing this type of application, consideration should be given to establishing strategies to maximise adherence, such as setting realistic goals, personalising the activities proposed and giving positive feedback to students, to prioritise their effort. Furthermore, ensuring data security and privacy is crucial when dealing with minors. In this context, effective integration requires apps designed for educational contexts, facilitating the monitoring of students' activity without increasing the workload for teachers. Meeting these requirements, apps such as ActivaApp stand out for their educational approach, gamification and readiness for integration into schools.

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Chapter 2

Promotion of physical activity at schools and after school using wearable devices

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Abstract

The use of wearable devices has emerged as an innovative strategy to promote physical activity among schoolchildren and adolescents, both at school and in extracurricular settings. These devices allow for real-time monitoring of health and performance parameters, encouraging adherence to exercise through immediate feedback and gamification. In schools, they enrich Physical Education with individualised assessments and greater participation. However, they present challenges such as a lack of teacher training, technological compatibility, and economic cost. Outside school, they allow personalised goals to be set and progress to be monitored anywhere, improving body composition and reducing sedentary lifestyles. However, these devices present challenges such as loss of interest, technological obsolescence, and concerns about data privacy. Therefore, their impact depends not only on access but also on educational and motivational strategies. Integrating technology, pedagogy, and psychology is key for achieving an active and healthy lifestyle.

Keywords: Adolescents; School setting; Extracurricular setting; Physical activity; Wearables

1. Use of wearables to promote physical activity among schoolchildren and adolescents

For decades, physical activity was recorded independently or with the help of an expert who was responsible for recording the parameters they considered relevant. These strategies were not objective enough to record the physical activity performed by the user, as they had significant limitations. As a result, the process of monitoring and recording physical activity has been digitised and automated, leading to the emergence of various technological devices designed specifically for this purpose, including wearable devices.

There are now a large number of wearables available on the market with different functions depending on the device, but they first appeared at the beginning of the 21st century with the launch of the first device. In 2007, there was exponential growth in these devices thanks to the appearance of the Fitbit device, which was considered the first highly accessible portable health device. The design of this device was very similar to that of current smartwatches, but it included fewer features and was not as accurate or reliable in its estimates of physical activity.

The evolution of these devices in recent years has led to them becoming one of the main ways of promoting physical activity among schoolchildren and adolescents. These electronic devices include different sensors that provide real-time feedback on the sporting performance, physical activity, and health status of the population. They are usually worn on the wrist as bracelets or smartwatches, but can also be found in T-shirts, socks and shoes, as well as in rings, headphones and earrings, or in different areas of the body such as skin patches. They are usually accompanied by a monitor or online control panel, but they can also feature a mobile app that synchronises the data recorded with the wearable device, providing greater functionality and offering a wider range of techniques for behavioural change.

Among the main features and characteristics of wearables, the following are found: a) the recording of certain biological and physiological parameters that help to monitor and track the progression of certain diseases; b) they are small, lightweight devices that transmit

data to mobile devices and have considerable battery life, making them attractive to adolescents and increasing their adherence; c) they allow parameters such as the number of steps taken, daily physical activity, heart rate, blood pressure, amount of sleep, and even diet to be recorded; d) they allow health goals to be set and personalised according to the user's needs; and e) they are water-resistant, which expands their possible uses.

Given these characteristics, wearables are considered a useful strategy for promoting physical activity among schoolchildren and adolescents, leading to up to 1,800 more steps per day, 40 minutes of additional walking per day and a 6-minute increase in moderate to vigorous physical activity per day, thereby reducing levels of physical inactivity. However, their use is conditioned by the scope of application, as recent research has attempted to use them at school and extracurricular settings, finding benefits and limitations in both cases. This means that, on occasions, the benefits they can bring are overlooked and they are not used, as they require more work by teachers.

This chapter presents the benefits and limitations of the use of wearables by schoolchildren and adolescents at school and in extracurricular settings, as well as the practical applications that should be taken into consideration for their implementation in each of these settings.

2. Applications of wearables at schools

The integration of these devices into Physical Education classes has developed over the last two decades thanks to advances in technology and concern about physical activity among schoolchildren and adolescents. Initially, devices such as pedometers and heart rate monitors were used during Physical Education classes to assess individual performance. However, with the evolution of technology, more sophisticated devices have been developed that offer more possibilities, not solely for assessing athletic performance.

The potential benefits of using wearables have been observed in primary and secondary education, suggesting that they could be used to keep an accurate record of physical activity and to increase student

involvement in class. However, the lack of adherence to learning theories when using wearables, as well as the barriers to the use of this technology in education (connectivity, device compatibility, economic cost), hinder its implementation as an educational tool.

The application of wearables at schools offers teachers numerous innovative alternatives that enrich the teaching-learning process. These electronic devices, in addition to promoting athletic performance among adolescents, provide multiple benefits regarding the quality of Physical Education classes and are considered significant tools that increase student motivation and involvement. Furthermore, given their characteristics and ease of use, they are considered suitable devices for use in Physical Education classes.

In this context, the use of wearables provides adolescents with the opportunity to increase their knowledge about healthy physical activity, as well as daily physical activity recommendations, thanks to the monitoring of steps taken and distance travelled. Furthermore, this information can be complemented with theoretical knowledge about the physiological variables involved in physical activity; concepts related to motor skills; the postural hygiene necessary to perform certain physical activities; or information that increases students' attitudes and self-efficacy towards physical activity and exercise. It also gives students the opportunity to create their own games or participate in activities and sports of varying intensity. However, the benefits are not exclusively for students, as teachers can find wearables to be an alternative method for evaluating academic results. In addition, they can use wearables as a complement to explain theoretical concepts during class, for example, by projecting the students' heart rate response to physical activities of different intensities on a screen.

Wearable devices that can be used in education include smartwatches, fitness trackers, virtual reality headsets, and augmented reality glasses. The main features of each of these devices include:

- **Smartwatches**: these are the most widely used devices in Physical Education classes. They offer features that exceed simple step counting, providing an overview of students' health and fitness. The data obtained allows students to set and manage their fitness goals, while teachers can use this information to

tailor the teaching process to individual needs and provide immediate feedback on achievements.

- **Activity trackers focus** mainly on metrics related to physical activity, such as step counting or calories burned. These devices facilitate a personalised approach to Physical Education, allowing teachers to create fitness programmes tailored to each student' physical level. The immediate feedback serves as a motivator for participation, which translates into improved health and performance.
- **Virtual reality headsets:** these are one of the most innovative devices. They offer an immersive experience that transforms Physical Education classes, improving learning through exercises and simulations.
- **Augmented reality glasses:** these expand the functionality of wearables by superimposing digital information onto the real world. These devices have great applicability in the field of Physical Education to demonstrate exercises and provide instructions, allowing teachers to offer real-time information while students are actively practising.

In addition to the educational and physical activity benefits, the use of wearables in Physical Education classes has reported benefits in motivation and commitment to the class. Active participation, the possibility of becoming involved, and cognitive concentration, are crucial aspects that foster student engagement in Physical Education classes. By providing immediate feedback, wearable devices allow students to stay motivated by checking their progress and participating in their own development. This falls within the theory of self-determination, as the use of wearables has shown a positive impact on basic psychological needs, particularly affecting autonomous motivation and commitment to physical activity. Furthermore, when the use of wearables is accompanied by gamified elements, even greater benefits are produced, improving the learning experience.

It should also be noted that these devices offer unique opportunities for interdisciplinary learning, integrating content from different

subjects into Physical Education. The data collected with wearables during Physical Education can be used and analysed in other subjects, such as science or mathematics, promoting a better understanding of the impact of physical activity on health. This improves the educational experience, not only in Physical Education, but in all subjects, as well as interpersonal relationships between teachers and students, encouraging continuous feedback, stimulating proactive participation and facilitating the learning process and understanding of content.

Table 1 presents some of the wearable devices that have been used in previous scientific literature to promote physical activity in schools.

Table 1. Wearable devices used in schools to promote physical activity among schoolchildren and adolescents.

Device	Positive aspects	Negative aspects
Fitbit Charge	- Real-time feedback. - Motivates with challenges and personal goals. - Measures steps, heart rate and minutes of physical activity.	- High price for an educational institution. - Requires a mobile app for full analysis, which may be a barrier for students.
Garmin vivosmart	- Compact and lightweight design. - Monitors physical activity and stress, providing an overview of well-being. - Real-time activity measurement.	- May be difficult to use for students with no previous experience of wearables. - Short battery life.
Polar	- Provides information on physical activity, sleep and recovery. - Personalised training function with immediate feedback.	- Some models lack GPS, limiting their use outdoors. - Requires basic knowledge of how to use the app it syncs with to maximise effectiveness.
Xiaomi Mi Band	- Affordable and accessible. - Monitors steps, sleep, heart rate, and physical activity. - Highly visual feedback for students.	- Does not offer detailed analysis compared to other wearables. - Loses accuracy during high-intensity activities.

Device	Positive aspects	Negative aspects
Omron HJ	- Simple and accessible. - Economical. - Easy to use with no additional setup required. - Useful for measuring moderate activity.	- Lacks advanced metrics. - Does not provide real-time feedback. - Does not offer customised settings.
Yamax SW	- Simple and easy to use. - Encourages physical activity through step goals. - Affordable. - Accessible for large groups.	- No advanced features. - Lacks real-time feedback.
Apple Watch	- Immediate feedback during activities. - Advanced heart rate and calorie tracking features. - Encourages exercise through rewards.	- High cost. - Requires an iPhone for synchronisation.
Samsung Galaxy Watch	- Measures physical activity, sleep and stress. - Real-time feedback. - Customisable goals. - Built-in GPS.	- High cost. - Limited functionality if not synchronised with a smartphone.

Each device has features that may make it useful for certain contexts or class groups. It is important to assess the group with whom the device will be implemented in order to choose the best device.

Despite the benefits and limitations presented, it should be noted that the use of these devices in Physical Education has a major handicap, which is the number of hours of Physical Education per week. Only two or three hours of Physical Education are available per week, which makes it difficult to work on the content planned in the teaching units. In addition, if the device used requires a minimum amount of time to understand how to use it and to ensure that it works optimally for all students, the chances of success are further reduced. For this reason, while the use of wearables in education continues to evolve and provide opportunities for permanent integration, their extracurricular use as a complement to Physical Education classes is becoming increasingly important.

3. Use of wearables to promote physical activity outside school

Wearables have become a very useful tool for promoting physical activity outside school hours, mainly due to the limitations found in the use of these devices at schools, as is the case with other forms of physical activity promotion. Their potential lies mainly in the fact that they provide real-time monitoring of physical activity levels, heart rate, and other metrics, as well as parameters that are relevant to the person exercising. This real-time information has proven to be a great promoter of physical activity, with a greater motivation to exercise among users of these devices. In addition, they allow users to set personalised physical activity goals, include gamified elements, and enable progress to be tracked, creating an environment conducive to behavioural change, which, unlike the school setting, can be fully exploited without any restrictions.

The most widely used wearable devices outside school are activity trackers, smart watches, smart clothing and fabrics, health monitors and wearable accessories. Their main features include:

- Activity trackers are mainly used to monitor physical activity, although they can also record heart rate, sleep patterns and energy expenditure. They usually come in the form of wristbands and have gained particular relevance and popularity among adolescents thanks to their usefulness in improving physical fitness.
- Smartwatches go one step further than activity trackers, as they include their own functionalities along with those of a smartphone, allowing users to receive notifications, manage phone calls and control other connected devices from the watch. Smartwatches have evolved exponentially in recent years, becoming increasingly better at monitoring health parameters, heart rate and sleep analysis. The strength of this device lies in the fact that, in addition to promoting health and physical activity, it encourages social interaction between users.

- Smart clothing and fabrics that incorporate electronic sensors directly into the manufacturing process enable the continuous monitoring of physiological parameters such as heart and respiratory rate and body temperature. These types of devices are very useful for adolescents who play sports where it is not possible to wear an activity tracker or smartwatch while training or competing. Depending on the device chosen, different parameters are measured, including a wide variety of possibilities in the areas of health and performance. The potential of these devices lies in the fact that adolescents get into the habit of using the sensor in their daily lives, using the data obtained to improve their physical activity and overall health.
- Health monitors are the least common and least used wearable devices among adolescents. This group includes patches and sensors that collect information on health-related parameters. The data recorded by these devices include blood pressure, oxygen levels, and symptoms related to mental health, such as anxiety and depression. These sensors are highly useful as they enable real-time diagnosis and management of physiological changes caused by training.
- The wearable accessories group includes all devices that are not activity trackers or smartwatches, such as heart rate rings and clip-on devices. These devices do not have all the functionalities of fitness trackers or smartwatches, but they do provide data on physical activity levels and some health parameters. However, their main problem is related to a lack of accuracy and data loss. Despite this, they are a good option for adolescents who do not feel comfortable wearing a wristband or smartwatch, as their design is minimalist.

In addition to the benefits obtained in terms of physical activity levels, the use of these devices outside school can lead to significant reductions in body mass index, body weight, and fat mass among children and adolescents, mainly those classified as overweight or obese. This highlights the importance of using this type of device, not only because they increase physical activity, but also because they promote changes in body composition.

Another strength of these devices is that they increase motivation and promote behavioural change. The continuous monitoring of activity, as well as the feedback mechanisms they provide, allows users always know how their physical activity level compares to their own goals or general physical activity recommendations. Thus, when adolescents realise that they need to do more physical activity that day to reach their goal, they are motivated to achieve it. This is essential, as it breaks the long periods of sedentary behaviour that schoolchildren and adolescents engage in, and of which they are unaware.

Furthermore, these devices facilitate access to physical activity. This aspect is not as important in the school environment, as it is limited to the number of hours of physical activity per week. However, in the extracurricular setting, it is one of the main points to consider, because unlike traditional physical activity interventions that require effort by adolescents to travel to a specific location, and time and ability to do so, wearable devices allow physical activity to be practised virtually anywhere, making it much more accessible to all users.

It should also be noted that wearables allow for the continuous monitoring of activity outside a structured programme, which provides a greater versatility when it comes to physical activity, as adolescents do not have to stick to a specific schedule or pre-established conditions. In addition, the fun elements included in wearables (rewards for achieving certain goals, customisation options, rankings) increase the commitment of schoolchildren and adolescents, also increasing their adherence to physical activity.

Table 2 shows some of the wearable devices that have been used in the scientific field and reported benefits in promoting physical activity among schoolchildren and adolescents.

Table 2. Wearable devices used in the extracurricular setting to promote physical activity in schoolchildren and adolescents.

Device	Positive aspects	Negative aspects
Xiaomi Smart Band	- Records physical activity. - Monitors heart rate and sleep quality, among other health parameters. - Water resistant. - Battery life of up to 20 days.	- Lacks some advanced features found in high-end models. - Measurement accuracy varies depending on the physical activity performed.

Device	Positive aspects	Negative aspects
Garmin Vivofit jr.	- Designed for children and adolescents. - Records daily steps and other physical activities. - Water resistant. - Long battery life.	- Small screen without backlight. - Limited functionality compared to other models.
Amazfit Band	- Monitoring of various sports activities. - Low cost. - Numerous features.	- Limited accuracy in recording physical activities.
Fitbit Charge	- Integrates GPS and NFC. - Extensive health and physical activity monitoring features. - Intuitive user interface.	- High price compared to other wristbands. - Poor battery life.
Apple Watch	- Aesthetic and attractive design. - Wide variety of apps available. - Seamless integration with other Apple devices.	- Poor battery life. - High cost.
Huawei Watch	- Sleek and robust design. - Measures multiple health indicators. - Long battery life.	- Less compatibility and functionality when used with iOS devices. - User interface not very intuitive.
Amazfit GTR	- Long battery life. - Extensive sports tracking options. - Price appropriate for the features offered.	- Measurement accuracy varies depending on the activity. - Less support for third-party apps compared to other devices.
Fitbit Versa	- Includes fast charging. - Good balance between price and functionality. - Very intuitive interface.	- Short battery life. - Fewer apps available compared to other smartwatches.
Oura ring	- Discreet and elegant design. - Accurate monitoring of parameters such as heart rate and sleep quality. - Long battery life.	- High cost. - No display, so it needs to be synced with a smartphone. - Limited functionality compared to wristbands and watches.

The accuracy of these devices varies depending on the brand, model and type of activity performed, which are aspects to consider when choosing one for use with adolescents. Compatibility is also essential, as not all students will have the same mobile device, and there will

even be differences between Android and iOS. Water resistance is also an interesting aspect to consider, as all students who participate in water activities will be able to record them. Battery life is another crucial aspect, because if it runs out too quickly, schoolchildren and adolescents are likely to stop using it. Therefore, when selecting a wearable device for use by adolescents outside school hours, it is important to strike a balance between the features offered and the needs and preferences of the students, as well as to consider aspects of accuracy and validity.

4. Challenges and limitations of using wearables with schoolchildren and adolescents

The challenges and limitations of using wearables in school and outside school include:

- **Limitations in functionality and usability**. It has been observed that more than 20% of adolescents who use wearables stop doing so after the first few weeks due to the lack of functionality and the characteristics of the device. In addition, one of the main negative aspects reported by adolescents is that some wearable models require a mobile device or other technology to operate, which considerably limits their usability. Therefore, the ease of use of wearables is crucial, especially for use with schoolchildren and adolescents, as this may be their first contact with this type of technological device.
- **Connectivity issues:** the need for an internet connection for some of these devices is a significant drawback. Most schoolchildren and adolescents do not have regular access to the internet, so they are dependent on Wi-Fi connections. When a wearable device requires an internet connection to function, this considerably limits its use by this population.
- **Device evolution:** although this might seem like a positive thing, it can sometimes be a limiting factor that discourages adolescents from using these devices. The rapid evolution of these technologies means that every year a new and improved version of the same wearable model is released, with new

features. In addition, updates to the mobile apps that sync with wearables tend to focus on the latest version. This makes adolescents frustrated and dissatisfied with their wearable model, making it even more difficult to retain users.

- **Privacy in the use of data by adolescents**. Most of these devices have mobile apps that synchronise the information collected with the device. This information, which includes distance travelled, location and time of day, among other things, can be used by third parties. It should also be noted that users must enter personal data such as their name, email address or age, without knowing, in some cases, how this sensitive data will be utilized.
- **The novelty of using the device:** although at first the use of these devices is novel and schoolchildren use them regularly, as the weeks go by they lose interest, reducing the beneficial effects obtained in the first few weeks. It is important to make schoolchildren and adolescents aware of the possibilities and benefits of using these devices, as otherwise they will abandon them when the initial novelty wears off.
- **Loss of motivation and commitment.** Students who are intrinsically motivated will tend to be more committed to technological learning experiences. The use of wearables can satisfy their basic psychological needs thanks to the personalisation and individualisation that these devices allow, further improving commitment. However, with students who are not intrinsically motivated, it is difficult to achieve adherence to the use of these devices, and the potential benefits disappear.
- **Lack of knowledge about the devices and lack of support**. Lack of knowledge about the advantages provided by these devices means that they are not widely used by schoolchildren and adolescents. However, it is also important to highlight the lack of knowledge among teachers about the possibilities that these devices can offer in the field of Physical Education. More than 80% of teachers indicate that they do not use these devices at any time during Physical Education classes, for a variety

of reasons. This means that these devices are not used during Physical Education classes or during extracurricular activities, as teachers do not integrate them into the curriculum. However, teachers are generally open to using these wearable devices, considering them a useful tool for promoting physical activity. For this reason, specific training is needed to help teachers and all those involved to understand the possibilities and benefits of using wearable devices among adolescents.

- **Institutional barriers to the implementation of wearables**. Despite the aforementioned benefits, educational centres must assess the costs of purchasing and maintaining these devices for use in Physical Education classes, as well as the need to train educators in their correct use. In addition, clear policies must be established for the use of these technologies in the classroom, even more so when it comes to privacy and ethical implications.
- **Individual differences in the use of technology**: the integration of technology into Physical Education classes is complex because it is not equally effective for all individuals. This is because not all students have the same technological competence to use these devices correctly, so the potential benefits are lost when they are used incorrectly.

5. Considerations for promoting physical activity among schoolchildren and adolescents through wearables

The incorporation of wearable devices in education requires specific strategies. Teachers play a crucial role in this process, as their support has a considerable influence on motivation and commitment to use these devices. Furthermore, when teachers show enthusiasm and consider these devices useful for promoting physical activity, they encourage the full involvement of their students, leading to greater acceptance and benefits. Therefore, for the successful implementation of these devices in education, and to maximise the benefits obtained, it is necessary to create a collaborative atmosphere between teachers and students who will be using the wearables together.

Despite the benefits, there are also risks and limitations to the implementation of these devices in education. In this regard, some teachers believe that the inclusion of wearables may do more harm than good, as continuously monitoring students' physical activity levels could lead schoolchildren and adolescents to obsessive or overly competitive behaviour. This highlights the need to establish a framework for action regarding the inclusion of technological devices in education, to clearly define both the positive and negative aspects of their implementation, so that all professionals who want to use them for educational, school, or extracurricular purposes are aware of all the consequences that may arise.

It is vitally important to encourage group work among students, as during this stage of life, many healthy behaviours are acquired by imitating peers and friends. This occurs in the field of physical activity, because if an adolescent is able to align their behaviour with the healthy behaviours of their peers and friends, they are more likely to be motivated and to continue participating in physical activity for a longer period of time. Taking advantage of this social pressure is essential, provided that it is done from a positive perspective and to obtain benefits. A practical example of this would be to create group challenges that require the participation of all students to achieve a goal, involving everyone and fostering a sense of community.

When selecting devices, the one that is best suited to the characteristics and needs of the students with whom work will be performed must be selected. This is because the design and comfort of the devices are critical factors that influence their acceptance among schoolchildren and adolescents. In this regard, comfortable and easy-to-use devices are more likely to be accepted and used for a longer period of time. In addition, if these devices include immediate feedback and provide simple and understandable data, user satisfaction will be higher, facilitating continued use over time.

Finally, the continuous evaluation and adaptation of the use of wearable devices is essential for the success of the intervention. This is because schoolchildren and adolescents must perceive that what they do with wearables at school and/or outside school is useful. Otherwise, motivation will decrease and adherence to the use of these

devices will be lost. Therefore, the continuous evaluation of the integration of wearables into physical activity programmes is essential. This evaluation process will identify effective strategies and possible areas for improvement, making the promotion of physical activity with these devices increasingly easier and generating better results. Considering the comments and feedback provided by students, better strategies for implementing these devices can be created, achieving a greater impact on healthy habits.

6. Conclusions

The use of wearable devices to promote physical activity at school and outside school represents an innovative tool with a great potential to improve the health and well-being of schoolchildren and adolescents. These devices have proven to be effective in increasing motivation, commitment, and adherence to physical activity, providing real-time data that allows for the self-regulation of exercise. At school, the use of wearable devices during Physical Education classes facilitates assessment processes and promotes more interactive learning. However, their implementation faces challenges, such as the lack of resources, the need for teacher training, and technological barriers. Outside of school, wearable devices are becoming established as a flexible alternative for monitoring physical activity, allowing adolescents to set personalised goals and continuously monitor their health status. Their integration with gamified elements and the possibility of sharing achievements make them more attractive and help maintain motivation and commitment to use. However, it is important to consider the limitations of these devices at school and extracurricular settings, including concerns about data privacy, rapid technological obsolescence, and a possible decline in interest over the long term. To maximise their impact, a comprehensive approach is needed that combines technology, education, and intervention strategies tailored to the needs of schoolchildren and adolescents. Wearables can therefore represent a valuable opportunity to promote physical activity among schoolchildren and adolescents, but their success will depend on their proper integration into educational programmes and their continued use over time.

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Chapter 3

Gamification and playfulness in the Physical Education classroom

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Abstract

Gamification is an emerging pedagogical model that uses elements of games in educational contexts, promoting student engagement and motivation. Unlike recreational activities, it requires specific methodological planning. It emerged in 2003 in the business world and was introduced into education in the 2010s and in Spain in 2014. It is based on dynamics such as narrative and progression of difficulty, which are essential for capturing attention. It must also include elements such as points, badges or trophies, rankings, challenges, feedback and resources, which reinforce extrinsic motivation. Other essential aspects are the definition of meaningful goals, uncertainty, intrinsic motivation, and the active role of the teacher. Studies in Physical Education show positive effects on motivation, learning and motor skills, especially in cooperative-competitive structures. Research in this area ranges from single sessions to nine-month programmes, with an average duration of 8.59 weeks. Narrative and challenges are the most common strategies, using technologies such as mobile applications and interactive tools. In general, gamification promotes meaningful learning in primary and secondary education.

Keywords: Learning; Instructional design; Physical Education; Gamification; Motivation.

1. Introduction

The gamification model is an emerging pedagogical model. This means that it forms part of new perspectives on pedagogical application within the classroom. The implementation of this model can lead to confusion, since conducting sessions that use games or play does not imply the application of the gamification model. This is why a methodological justification and conceptualisation is required, as well as an explanation of the practical application of the approach.

This model emerged in 2003 for use in the business world. After being applied in different contexts, it gained popularity in the world of education. Its origins date back to the early 2010s internationally and, specifically in Spain, to around 2014.

With regard to gamification, various authors have defined this term from different perspectives. Burke (2012) describes it as the use of game-like designs and techniques in non-playful contexts to enhance skills and promote development-oriented behaviours. Deterding et al. (2011) consider that this methodology consists of adapting the dynamics of games to an educational environment with the aim of increasing student involvement and participation. In contrast, Pérez-López (2020) emphasises gamification as a process in which the teacher constructs an adventurous experience for the student, the purpose of which is to achieve an educational objective that transcends the end of the activity.

2. Theoretical basis

Werbach and Hunter's classification gave rise to the abbreviation PBL (Points, Badges, and Leaderboards), which represents the most commonly used components in educational gamification. These elements, referred to as the "thin layer" of gamification, are often the most used by teachers. However, although PBLs are a key component, their exclusive and disproportionate use has a limited impact on student learning, as they are often applied in the short term to improve extrinsic motivation alone.

The main components of PBL are detailed below:

- **Points:** these can be classified into different types, the most common being experience points and redeemable points:
    - *Experience points:* these help teachers monitor students' progress towards established goals. They also offer students a visual representation of their progress, reinforcing their effort and positive behaviour.
    - *Redeemable points:* these function as currency within the gamified experience. Their short-term impact is significant if the associated rewards are relevant to the students. However, the excessive use of this type of point should be avoided in order to maintain its effectiveness.
- **Badges or trophies:** these represent recognition, either physical or virtual, of specific achievements. Their main objective is to promote social prestige, either through the desire to collect them or the possibility of showing off achievements to others. However, an excessive use of badges can be counterproductive and detract from their value.
- **Rankings:** rankings allow you to observe the progress of students or teams based on points, badges or other elements. Although they motivate more advanced students, they can demotivate those who are in the lower ranks. It is therefore recommended to analyse the classroom context to decide whether these rankings should be visible or not.

In addition to PBL, certain essential elements related to mechanics and dynamics stand out in gamification. Among the most relevant mechanics the following have been found:

- **Challenges:** these are the tests or tasks in the sessions that do not require special adaptations within the teaching unit. They should be open, flexible and designed for heterogeneous groups. According to flow theory, it is essential to balance the difficulty of the challenge with the satisfaction of overcoming it, thus ensuring student motivation.
- **Feedback:** feedback is the constant communication between teacher and students, essential to ensure continuity of learning.

The teacher should provide regular feedback, helping students to progress.

- **Resources:** both technological and analogue resources enrich the gamified experience. These can include maps, letters, music or other elements that reinforce the narrative and make the experience more immersive.

As for dynamics, these are the foundation on which gamification is based. Two of the most important dynamics are:

- **Narrative:** the narrative is the plot or story in which the entire gamified experience unfolds. It is one of the most important elements due to its ability to motivate and engage students, creating a positive and creative environment. The narrative captures students' attention and implicitly guides them towards the objectives set by the teacher.

A good narrative should have the following characteristics:

  - Be attractive to students.
  - Have a direct relationship with the curricular content.
  - Focus on overcoming a challenge or a heroic mission.
  - Maintain a climate of uncertainty and surprise.
  - Present challenges or enemies to overcome.
  - Introduce the game in a visually appealing way using graphics, maps, or music.

- **Progression:** it should be upward and reflected in the character's advancement or in levels, objects, and challenges. It is important that challenges gradually increase in difficulty throughout the experience to prevent students from losing interest.

In summary, while PBLs constitute the superficial elements of gamification, the dynamics, especially the narrative and progression, are the core that gives it meaning and depth, fostering immersive and meaningful learning.

Gamification must be based on seven key aspects to ensure its effectiveness:

1. **Transcendent objectives:** values, skills or habits that emerge from the student themselves, allowing them to use them as a means to achieve the proposed objective.

2. **Adequate time:** provide the time necessary for students to meet the established objective.
3. **Meaningful narrative:** create a story that is relevant and motivating for students.
4. **Expectation and uncertainty**: generate excitement and curiosity through an exciting and engaging experience.
5. **Intrinsic motivation of the teacher:** the teacher must be aware of the problem at hand, reflect critically on the need for change, know the possible solutions, and assume their role with personal and professional commitment.
6. **Active role of the teacher:** the teacher must constantly energise the experience, providing feedback, narrating the story and guiding the student's progress.
7. **Voluntary participation of students**: it is essential to make students become enthusiastic and immerse them in the proposal, ensuring that they engage voluntarily and remain committed.

3. Effects of gamified programmes applied to schoolchildren

Several researchers have been interested in analysing the effect of gamification and playification programmes in Physical Education classes in both primary and secondary education.

This section discusses the research carried out to date to provide insights into the current state of this research. Only randomised controlled trials published to date are included, i.e. studies that included a control group and at least one experimental group, with pre- and post-test measures and randomisation of the groups.

Table 1 shows the main characteristics of the studies conducted, indicating the author, year, sample size, age of participants, educational stage, and duration of the programme.

It can be observed that the research included was carried out between 2012 and 2024, with a total of 19 randomised controlled trials. There is an equal distribution between studies conducted in primary and secondary education, with 10 and 9 studies, respectively. Despite

being applied from primary education onwards, no study included children under the age of eight. The experimental group ranged in size from 11 to 329 participants, with a mean of 81.58±91.75 participants.

Table 1. Characteristics of randomised controlled trials on gamification and playification in Physical Education

Author(s) (year)	EG and CG size	Age	Educational stage
Zetou et al. (2012)	EG=36; CG=28	10-12	Primary education
Gao et al. (2013)	EG=26; CG=26	10-11	Primary education
González et al. (2016)	EG=11; CG=9	8-12	Primary education
Robertson et al. (2018)	CG=87; EG=70	10-11	Primary education
Quintas et al. (2020)	EG=226; CG=191	10-12	Primary education
Montoya et al. (2021)	EG=26; CG=19	10-11	Primary education
Cenizo-Benjumea et al. (2022)	EG=329; CG=168	8-11	Primary
Kolovelonis et al. (2023)	EG1=36 (cognitive challenges); EG2=34 (health knowledge); GG=32	10-13	Primary
Sotos-Martínez et al. (2023)	EG=35; CG=37	9-11	Primary education
Sotos-Martínez et al. (2024)	EG=250; CG=256	9-11	Primary
Serrano-Durá et al. (2021)	EG=17; CG=19	12-13	Secondary education
Corepal et al. (2019)	EG=132; CG=81	12-14	Secondary education
Lin et al. (2020)	EG=27; CG=25	-	Secondary education
Segura-Robles et al. (2020)	EG=32; CG=32	15	Secondary education
Pérez et al. (2021)	EG=49; CG=49	15	Secondary education

Author(s) (year)	EG and CG size	Age	Educational stage
Sotos-Martínez et al. (2022)	EG=133; CG=142	12-16	Secondary education
Fernandez-Rios et al. (2022)	EG=27; CG=27	14	Secondary education
Sevilla-Sánchez et al. (2023)	EG=20; CG=22	14	Secondary education
Fores-Agilar et al. (2023)	EG=51; GC=51	16.7	Secondary education

Key: EG=experimental group; CG=control group

Tables 2 and 3 present the characteristics of the gamification and playification programmes implemented in the different studies, indicating the duration, learning structure, gamification applied, rewards, methodology, and use of mobile applications or new technologies. The programmes range from those delivered in a single session to others lasting nine months, with an average duration of 8.59±13.25 weeks. The most common duration was between five and six weeks, with a weekly frequency of two sessions per week, which is equivalent to the duration usually used for the development of a teaching unit in Physical Education classes. Of the 19 studies, three were conducted using an individualistic structure, two using a cooperative structure, and the rest (14) using a cooperative-competitive structure. The ramifications are presented through challenges, storytelling, and missions, with challenges and storytelling being the most common. In most studies, points were used as rewards, including badges and rankings. Among the methodologies applied, specific methodologies were found, such as Play and Stay (specific to tennis); Escape Room, dance challenges with mobile devices; board games; and challenges and competitions with and without mobile devices. With regard to the use of new technologies, most included them as part of the programme, with only six out of studies not implementing them. The most widely used mobile application was ClassDojo, used in two studies. In addition, applications such as ClassCraft gamified ICTool, Dance Dance Revolution, FitQuest, Just Dance Now, Tango:H, Pirats' Island, MDE gamification, Powtoon, video marker, Strava, and Instagram were used, as well as other tools such as the WiiFit Plus video game, Genially, Google Drive,

Salticity (GPS), audiovisual material, QR codes, videos, and pedometers.

Table 2. Characteristics of studies on gamification and playification in Physical Education: time, learning structure, type of gamification and rewards.

Author(s) (year)	Time	Learning structure	Gamification	Reward
Zetou et al. (2012)	4 weeks	Individual	Challenges	-
Gao et al. (2013)	3 weeks	Individual	Challenges	-
González et al. (2016)	8 weeks	Coop-Comp	Challenges	Points, badges, and ranking
Robertson et al. (2018)	5 weeks	Coop-Comp	Challenges	Points, badges and ranking
Quintas et al. (2020)	1 month	Coop-Comp	Challenges	Points, badges and ranking
Montoya et al. (2021)	4 weeks	Coop-Comp	Narrative	-
Cenizo-Benjumea et al. (2022)	5 weeks	Individual	Narrative	Insignias
Sotos-Martínez et al. (2023)	6 weeks	Coop-Comp	Narrative	Points, badges and ranking
Kolovelonis et al. (2023)	9 months	Coop-Comp	Challenges and games	-
Sotos-Martínez et al. (2024)	6 months	Coop-Comp	Narrative	Points, badges and ranking
Serrano-Durá et al. (2021)	6 sessions	Coop-Comp	Storytelling	Points, badges and ranking
Corepal et al. (2019)	52 weeks	Coop-Comp	Challenges	Points, badges and ranking
Segura-Robles et al. (2020)	5 weeks	Coop-Comp	Challenges	Points
Lin et al. (2020)	1 session	Coop	Challenges	Points
Pérez et al. (2021)	5 weeks	Coop-Comp	Narrative	Points, badges and ranking
Sotos-Martínez et al. (2022)	5 weeks	Coop-Comp	Narrative	Points, badges and ranking
Fernandez-Rios et al. (2022)	2 sessions	Coop	Narrative and challenges	Awards and levels

Author(s) (year)	Time	Learning structure	Gamification	Reward
Sevilla-Sánchez et al. (2023)	3 weeks	Coop-Comp	Narrative, missions and challenges	Points
Fores-Agilar et al. (2023)	4 weeks	Coop-Comp	Narrative, missions and challenges	Points

Table 3. Characteristics of studies on gamification and playification in Physical Education: methodology applied and mobile applications or new technologies used.

Author(s) (year)	Methodology	Mobile applications or new technologies used
Zetou et al. (2012)	Shooting, ball games and scoring (Play and Stay methodology)	No mobile application
Gao et al. (2013)	Individual dance challenges with mobile devices	Dance Dance Revolution, DDR
González et al. (2016)	Video games with computers	TANGO:H active video game, Wii Fit Plus video game, collaborative online game with multiple players (Pirate's Island)
Robertson et al. (2018)	Challenge-based game with multiple devices	FitQuest (mobile game)
Quintas et al. (2020)	Level-based game with multiple devices.	Just Dance Now and MDE gamification
Montoya et al. (2021)	Challenge-based games with cooperative-competitive board game	No mobile app
Cenizo-Benjumea et al. (2022)	Challenge-based game without devices	Salticity (GPS)
Sotos-Martínez et al. (2023)	Level-based game with computers	ClassDojo
Kolovelonis et al. (2023)	Challenge-based games without devices	No mobile app
Sotos-Martínez et al. (2024)	Level-based game with computers	ClassDojo
Serrano-Durá et al. (2021)	Challenge-based game with multiple devices and escape room	QR codes and videos
Corepal et al. (2019)	Challenge-based game with multiple devices.	Competition with pedometer

Author(s) (year)	Methodology	Mobile applications or new technologies used
Segura-Robles et al. (2020)	Escape room games and flipped classroom	Audiovisual material
Lin et al. (2020)	Board game and augmented reality	No mobile application
Pérez et al. (2021)	Challenge-based game	No mobile app
Sotos-Martínez et al. (2022)	Level-based game with computers	ClassCraft gamified ICT tool
Fernandez-Rios et al. (2022)	Challenge-based cooperative games	No mobile application
Sevilla-Sánchez et al. (2023)	Collaborative challenges and competition	Powtoon: video maker, online version
Fores-Agilar et al. (2023)	Collaborative challenges and competition and mobile applications.	Strava, Instagram, Google Drive, Genially

Table 4 shows the variables assessed by each study, as well as the results found after the programme was implemented. The most researched variable was motivation, with ten studies including it, followed by basic psychological needs, with this variable being included in seven studies. Satisfaction or predisposition towards Physical Education classes or physical activity, as well as learning, knowledge, or academic performance, were investigated in five studies. A smaller number of studies included the variables of physical activity, self-efficacy, fun, physical fitness and executive functions. In addition, other variables were included in a single study, such as sports and rhythmic skills, predisposition to learning, personal and social responsibility, school violence, emotional intelligence, interest, positive behaviours, perception of effort, well-being, flow experience, and intention to be physically active.

Table 4. Variables assessed and results of studies on gamification and playification in Physical Education.

Author(s) (year)	Variables assessed	Results
Zetou et al. (2012)	Sports skill / Satisfaction	Improvement
Gao et al. (2013)	Physical activity / Self-efficacy / Fun	Higher MVPA in dance group / Higher self-efficacy and enjoyment in experimental group

Author(s) (year)	Variables assessed	Results
González et al. (2016)	Biometric variables / Knowledge of healthy habits	No changes / Improved
Robertson et al. (2018)	Physical activity / Self-efficacy	No changes
Quintas et al. (2020)	Rhythmic motor skills / Motivation / Basic psychological needs / Predisposition to learning / Academic performance	Improved
Montoya et al. (2021)	Motivation / Personal and social responsibility / School violence / Basic psychological needs / Emotional intelligence	No changes
Cenizo-Benjumea et al. (2022)	Physical fitness (3JS test, horizontal jump, vertical jump with counter movement, 4x10 metre agility	Improvement
Sotos-Martínez et al. (2023)	Motivation	Improvement in intrinsic motivation
Kolovelonis et al. (2023)	Executive functions / Interest / Fun	Improvement
Sotos-Martínez et al. (2024)	Motivation / Basic psychological needs / Positive behaviour	Improvement
Serrano-Durá et al. (2021)	Health knowledge / Satisfaction and perception of effort during the session / Physical fitness (Sorensen, side bridge, plank)	Improvement in knowledge / Same improvement in physical fitness as CG / Greater satisfaction and perception of effort than CG
Corepal et al. (2019)	Physical activity / Well-being	No changes
Segura-Robles et al. (2020)	Motivation / Basic psychological needs / Satisfaction with sport	Improvement
Lin et al. (2020)	Learning about different subjects / Satisfaction / Flow experience	Improvement
Pérez et al. (2021)	Motivation / Basic psychological needs / Predisposition towards PE / Fun	Tendency towards improvement
Sotos-Martínez et al. (2022)	Motivation / Basic psychological needs	Improvement
Fernandez-Rios et al. (2022)	Motivation / Basic psychological needs / Intention to be physically active	Improvement
Sevilla-Sánchez et al. (2023)	Motivation / Motor learning / Attitudinal and social aspects	No changes in motivation / Improvement in learning
Fores-Agilar et al. (2023)	Motivation	Improvement in intrinsic motivation

Table 5 shows a summary of the variables investigated in the included studies, as well as their results. As can be observed, there was great interest in how gamification affects motivation and basic psychological needs. Almost all of these studies showed a positive effect on these factors after implementing the programme using gamification, regardless of the educational stage, methodology or use of mobile applications or new technologies. There also seemed to be a consensus on its positive effects on satisfaction or predisposition towards Physical Education classes or physical activity; on learning, knowledge, or academic performance; or on fun or physical fitness. It should also be noted that the use of gamification did not seem to improve the level of physical activity. Finally, for the remaining variables, there did not seem to be a consensus, which may be due to the fact that they were investigated in very few studies.

Table 5. Summary of the variables investigated and their results

Variables	Number of studies	Improvement	No change
Motivation	10	8	2
Basic psychological needs	7	6	1
Satisfaction/Attitude towards PE/AF	5	5	0
Learning / Knowledge / Academic performance	5	5	0
Physical activity	3	0	3
Self-efficacy	2	1	1
Fun	3	3	0
Physical fitness	2	2	0
Executive functions	2	1	0
Sports skills	1	1	0
Biometric variables	1	0	1
Rhythmic motor skills	1	1	0
Predisposition to learning	1	1	0
Personal and social responsibility	1	0	1
School violence	1	0	1
Emotional intelligence	1	0	1
Interest	1	1	0
Positive behaviour	1	1	0

Variables	Number of studies	Improvement	No change
Perception of effort	1	1	0
Well-being	1	0	1
Flow experience	1	1	0
Intention to be physically active	1	1	0

4. Practical recommendations

Based on research that included gamification and playification programmes in Physical Education classes, the following practical recommendations are established:

- The use of gamification and play is considered appropriate and effective for their application in both primary and secondary education.
- It is recommended that they be applied through teaching units lasting between five and six weeks, with two sessions per week.
- The organisation can be individualistic, cooperative, or cooperative-competitive, as no differences were found in their use, although the most commonly used was a cooperative-competitive organisation.
- The methodology can be very varied, but it is recommended that it be presented with an attractive narrative, considering the target population, and framed within a specific context including avatars or roles, as well as challenges and tasks.
- The use of reward structures such as scores, badges, and rankings are recommended.
- The use of mobile applications and new technologies will serve as a great resource in the inclusion of gamification. Some examples that previously used with positive results include ClassDojo, ClassCraft, gamified ICTool, Dance Dance Revolution, FitQuest, Just Dance Now, Tango:H, Pirate's Island, MDE gamification, Powtoon, video marker, Strava, Instagram, WiiFit, Genially, Google Drive, Salticiy (GPS), audiovisual material, QR codes, videos and pedometers.

5. Conclusions

Gamification in Physical Education has proven to be an effective tool for improving student motivation, interest, and learning, while promoting the development of physical and social skills. Elements such as points, badges and rankings are useful, but their impact is enhanced when combined with immersive narratives and well-designed progressions that connect with students' interests. While significant benefits have been observed, it is important to balance extrinsic motivators with strategies that promote intrinsic motivation, such as autonomy and enjoyment. Furthermore, although technologies have facilitated the implementation of gamified programmes, analogue approaches can be equally effective if well designed.

To maximise benefits, a recommendation is to design student-centred activities tailored to their context and abilities, promoting inclusion and values such as teamwork and respect. Optimal programmes typically last five to six weeks, with ongoing assessments to adjust the dynamics based on results. Teacher training is key to success, as it will enable the application of effective strategies and the provision of appropriate feedback. With proper planning, gamification not only improves physical performance, but also student engagement, creativity, and comprehensive learning.

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Chapter 4

ICT and LKT as motivational tools in the classroom

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Abstract

Information and Communication Technologies (ICT) and Learning and Knowledge Technologies (LKT) have revolutionised education, impacting student motivation and learning. ICT and LKT promote intrinsic motivation by enabling personalised, interactive learning experiences tailored to students' needs. The use of educational platforms, gamification, and project-based learning increases participation and improves the educational process. In Physical Education, digital tools have transformed the way student performance is assessed and monitored, promoting their commitment to physical activity and healthy habits. Mobile applications, tracking devices and multimedia resources allow training to be adapted, reinforcing motivation and autonomy. However, their implementation faces challenges: the digital divide, information overload, and teacher training. Unequal access to devices and connectivity can limit their effectiveness, while information overload can be distracting. Furthermore, the success of these tools depends on teachers developing the necessary skills to use them effectively.

Keywords: Communication; Physical Education; Information; Achievement; Motivation.

1. Introduction

Motivation is a fundamental aspect to consider in education. It refers to the drive that makes a person do something; or, in other words, the degree of satisfaction with which someone does something. In academic performance, this aspect is crucial at any level of competence, but perhaps even more so in primary and secondary education.

Motivation is the direction and intensity of effort. Delving deeper into this definition in relation to the academic field, it can be defined as the direction and intensity of effort, considering an interactionist view of both tendencies and their focus on a specific context of action.

The influence of motivation on variables such as attention and activation is fundamental in the teaching-learning process. Therefore, teachers must pay special attention to the motivational aspects of students, to understand their mechanisms, even if only at the basic level, in order to implement strategies that facilitate and promote effort by students. In this sense, initial interest should be harnessed to attract children and adolescents to academic activities, promoting their intellectual, social and human development. It is important to be aware that this initial interest will not last forever, as it will only be maintained if the learning experience is stimulating and enjoyable; moreover, it will diminish dramatically if the experience is very stressful.

There are two fundamental theories of motivation: one that focuses on intrinsic motivation and extrinsic motivation, and one that focuses on achievement motivation. In order to develop appropriate and rewarding teaching, teachers must understand how rewards relate to increased effort, for example, or how success-oriented behaviours relate to aspects such as self-confidence or students' perception of competence.

Intrinsic motivation refers to motivation that comes from within oneself, while extrinsic motivation comes from the actions of others. Intrinsic motivation is comparable to an internal fire that drives people to act for the pure satisfaction they find in the activity itself. It is that

force that leads to performing tasks without expecting external rewards, simply because they are enjoyable and make one feel good. When a person is intrinsically motivated, they feel fulfilled when they complete a task, as it becomes a source of personal satisfaction. It gives them the freedom to choose how and when to perform a task, which gives them a sense of control and autonomy. In addition, the person feels capable and competent, which boosts their self-esteem and drives them to keep moving forward. The activity itself becomes meaningful, either because it contributes to something important to the person, because it allows them to learn and grow, or simply because it is interesting and challenging. However, extrinsic motivation is based on the pursuit of rewards or the need to avoid punishment. This type of motivation depends on external factors and not on the individual's will. The person feels motivated as long as the reward or punishment exists but may lose interest once these disappear. Extrinsic motivation can be effective in achieving short-term results, but it does not guarantee long-term commitment or the development of a genuine interest in the task.

When students are intrinsically motivated, their effort will be high and lasting; however, if they are motivated by external factors, such as a reward or the avoidance of punishment, their interest in the task will tend to diminish. According to Deci and Ryan's cognitive evaluation theory, rewards (extrinsic motivation) can affect intrinsic motivation through two processes: a) a control process, when the student perceives that their behaviour is controlled by the reward, leading to a decrease in intrinsic motivation; and b) an informational aspect, when the value of the reward lies in the information it provides to the student (how they perceive and interpret that information), which can cause an increase or decrease in intrinsic motivation, depending on the type of information. In short, according to these authors, all rewards potentially have both a control and an informational aspect.

The teacher's handling of these aspects will be fundamental in promoting adequate learning and satisfying the need for autonomy among children and adolescents. It is important to monitor and work on intrinsic motivation as a means of preventing school failure, as well

as increasing interest and attention in educational activities, promoting deeper and more meaningful learning, and fostering resilience in the face of challenges and the desire to overcome difficulties.

Based on the above, teachers can apply various strategies to promote intrinsic motivation in the learning process, including providing positive feedback, promoting process-oriented goals, setting moderately difficult objectives, offering choices in activities, fostering social relationships among students, using rewards with care, developing a state of flow, and raising awareness of the need for learning.

Achievement motivation in education refers to a student's drive to master a subject, overcome academic challenges, and feel pride in their skills and knowledge. It is the force that drives them to strive for success in a subject, persevere despite difficulties, and celebrate their achievements. In an academic context, achievement motivation can be observed in students who strive for good grades, participate actively in class, and seek opportunities to learn beyond the classroom.

Achievement motivation is the result of the interaction between personal factors (personality traits) and situational factors. Personal factors include the need for achievement, fear of failure, and expectations of success. Situational factors, on the other hand, refer to the difficulty of the task, teacher support, and the classroom environment. The combination of these factors explains why some students feel more motivated than others in different situations. For example, students with a high need for achievement and a low fear of failure tend to choose challenging but achievable tasks, while students with a high fear of failure may avoid difficult tasks or choose tasks that are too easy to ensure success.

Understanding achievement motivation is essential for educators, as they can create highly stimulating learning environments for their students. Some of the most effective strategies for achieving this are: setting realistic but challenging goals, providing positive and constructive feedback, creating a safe and supportive learning environment, promoting autonomy and responsibility, using varied resources and educational technologies, and helping students set specific goals and celebrate their achievements.

It is important to note that there are several factors that can reduce student motivation, such as uninteresting teaching methods, content that does not connect with their interests, unrealistic expectations, or excessive academic pressure. These factors can lead to disinterest, poor academic performance, and even dropping out of school. In this sense, Information and Communication Technologies (ICT) and Learning and Knowledge Technologies (LKT) are allies for increasing motivation by allowing learning to be personalised according to each student's interests and by promoting the use of active methodologies such as gamification and project-based learning. This makes learning more attractive, dynamic and relevant for students, encouraging their participation and commitment.

2. The digital age and its impact on education

The integration of ICT and LKT in education marks a significant evolution in teaching and learning methodologies, reshaping the way knowledge is imparted and accessed in various educational contexts. This integration began to take shape in the second half of the 20th century, with the proliferation of personal computers in the 1980s, which facilitated the transition from traditional, centralised teaching methods to more individualised, technology-driven approaches. The emergence of the Internet in the 1990s further transformed the educational landscape by introducing online learning platforms and resources, thereby expanding access to education for diverse populations, including working adults and those living in remote areas.

Over the years, ICT and LKT have enabled advances in e-learning and blended learning models, allowing educational institutions to create interactive and flexible learning environments that adapt to the different needs and learning styles of students. Key initiatives and policy frameworks, such as the ICT and LKT initiative in schools launched in 2004, sought to address disparities in access to technology and promote digital literacy, thus highlighting the role of policy in fostering equitable educational opportunities. However, this technological integration has not been without challenges, such as the digital divide, privacy issues, and the need for teacher training and preparation, which

continue to spark debate among educators and policymakers about the effectiveness and impact of ICT and LKT in the classroom.

The 1990s saw the rise of the Internet, which transformed communication and information sharing. This era saw the introduction of learning management systems (LMS), starting with platforms such as FirstClass in 1990, which facilitated online learning thanks to their enhanced communication and course management capabilities. In 1997, the launch of Blackboard LMS led to the widespread adoption of online education, making it more accessible to diverse groups, such as working adults and single-parent families.

The 2000s marked a significant expansion in the use of ICT in education, with the emergence of e-learning and blended learning models. Educational institutions began to recognise the value of online platforms for distance learning, allowing students to interact with content in new and interactive ways. The introduction of massive open online courses (MOOCs) in the 2010s further popularised online learning, making educational resources available to a global audience.

As educational technology continues to evolve, contemporary trends suggest a growing emphasis on artificial intelligence, adaptive learning environments, and immersive technologies such as virtual and augmented reality. These innovations have the potential to create highly personalised and engaging learning experiences, while presenting unique challenges related to implementation and resource allocation. Consequently, the discourse regarding the integration of ICT/LKT in education is not only relevant but also essential to understanding the future of learning and teaching in an increasingly digital world.

2.1. The relevance of ICT and LKT in the modern classroom

ICT and LKT play a fundamental role in today's education, promoting more individualised and interactive learning experiences and fostering inclusivity among different groups. Currently, the integration of these technologies in education facilitates access to information, enriches teaching methodologies and optimises the learning process.

ICT provides digital resources that improve classroom management and access to knowledge. Educational platforms such as Moodle,

Google Classroom, and Edmodo allow resources to be centralised, activities to be organised, and assessments to be carried out in a single virtual space, both synchronously and asynchronously. In addition, the inclusion of multimedia resources, such as videos, infographics, texts and, more recently, podcasts, promotes the diversification of teaching strategies and allows for a greater variety of learning styles and strategies. Thanks to the accessibility provided by the digital environment, students can access educational content anytime, anywhere, which expands training opportunities beyond the traditional classroom and opens the door to methodologies such as the flipped classroom, in which students access and prepare content prior to the face-to-face session to promote procedural learning and the connection between theory and practice, or team-based learning, in which the initial phases are based on individual training to later contribute to the common work.

On the other hand, LKTs focus on the pedagogical use of technology to optimise teaching and learning processes. Among the current activities within the classroom, methodologies such as adaptive learning allow educational content to be adapted according to the progress and individual needs of each student through the use of specific platforms, to promote autonomy and individualisation in the teaching-learning process. Another notable example is the use of gamification, which incorporates game dynamics into teaching and stimulates student motivation and engagement. Likewise, collaborative learning tools, such as forums and virtual environments, encourage cooperation and the exchange of ideas among students, promoting more meaningful learning. In addition, artificial intelligence and personalised tutoring systems provide real-time assistance, strengthening educational support.

The incorporation of ICT and LKT in the modern classroom offers multiple benefits. They allow for more personalised teaching, where teachers can adapt the pace and level of difficulty according to each student's performance. They also promote interactivity, using tools such as augmented reality, simulations, and virtual laboratories, to improve the understanding of complex concepts. Formative assessment through digital platforms provides immediate feedback, allowing for

timely pedagogical adjustments. In addition, these technologies promote inclusion by offering accessible resources for students with special educational needs.

2.2. Educational benefits of ICT and LKT and challenges to be faced

As indicated in the previous section, the integration of ICT and LKT in the classroom has brought about a drastic change in the teaching-learning process, offering multiple benefits for both teachers and students. By incorporating interactive digital tools, learning becomes more dynamic and engaging, which increases students' interest and participation and can have a positive effect on their motivation to learn.

In this regard, one of the main benefits in relation to student motivation is the possibility of personalising the teaching-learning process. Adaptive platforms allow each student to progress at their own pace, accessing content tailored to their needs and level of understanding. This autonomy generates greater commitment, as students feel that their learning process is aligned with their abilities and interests, generating realistic goals that they can achieve while acquiring the planned knowledge and skills.

In addition, the interactivity offered by ICT and LKT helps to capture and maintain students' attention. To this end, the use of methodologies such as gamification, which allows game elements to be incorporated into education, turns activities into challenges that encourage competitiveness, effort and reward, which has proven to be an effective tool for improving student motivation towards learning. Similarly, tools such as augmented reality, simulators, and virtual laboratories, allow concepts to be experienced in a practical way, making learning more meaningful and motivating. These LKTs have been successfully implemented in various contexts, both in primary and secondary school education and higher education, including fields as diverse as medicine, industry and entertainment, with very positive results for students.

Collaborative learning, enhanced by ICT, also contributes to improving student motivation in the teaching-learning process. In previous stages, collaboration between students was only possible in face-to-face education and within the shared space provided by the educational centre during school hours. However, the use of platforms that enable student cooperation in their learning process is now widespread, facilitating teamwork and allowing students to support each other and share knowledge, even in distance learning. This dynamic not only strengthens bonds between classmates but also increases intrinsic motivation by creating a sense of community and belonging in the classroom among students who share similar interests and processes.

Another key factor in student motivation is the immediate assessment and feedback provided by LKTs, which give students real-time information on their progress. Recent studies have shown that the use of recurring self-assessments during the teaching-learning process has a positive effect on knowledge acquisition and student motivation, as it allows for a better management of the process by teachers and students. In this regard, it is common to use tests, rubrics, lists, and even games to guide the learning process. Digital tools allow students to receive instant corrections, which helps them identify mistakes and improve their performance without having to wait long periods of time for results. This immediacy reinforces motivation by making learning a continuous process of improvement.

However, it should be borne in mind that, despite these benefits, the incorporation of ICT and LKT in education faces some challenges that may influence their correct use in the classroom. One of the main difficulties that can be encountered is the difference in access to technology. The digital divide remains an obstacle, as not all students have access to technological devices or the internet at home, which can lead to inequalities in participation and engagement in learning. However, there are measures that can mitigate the effect of the digital divide, such as the creation of spaces with free internet access for students, which are already available in many educational centres, or the implementation of programmes for the loan of technological equipment from schools.

Another problem arising from the implementation of ICT and LKT in the classroom is information overload. Sometimes, unlimited access to digital resources makes it difficult for students to differentiate between useful and useless information. The sheer volume of articles, videos, documents, and platforms available can cause confusion, making learning less effective and characterised by the use of resources of dubious quality from unreliable sources. To try to avoid this consequence, it is important for teachers to guide the learning process, by offering quality resources to students and promoting critical thinking in accessing information, enabling them to discern between the different sources consulted.

Associated with the issue of unlimited access to information, another potential drawback has been identified in relation to the use of ICT and LKT. When students are faced with a large amount of content and multiple digital tools at the same time, they may experience stress and anxiety due to the feeling that they never finish learning or that there is too much material to review, which can affect their motivation and academic performance. In addition, information overload can cause students to become easily distracted, using resources superficially and without addressing the content in depth. This can affect their ability to concentrate and retain knowledge, thereby reducing the effectiveness of learning, and creating an excessive dependence on technology for information without developing critical skills such as analysis, synthesis, and data evaluation. The problem of distractions not only affects the depth of knowledge but can also be influenced by access to non-educational platforms while using digital devices. To prevent this problem, it is extremely important for educational centres and teaching staff to use methodologies that require active learning by students, such as project-based learning or problem solving, in which they have to connect theoretical content with its subsequent application, with the aim of generating meaningful learning rather than simply encouraging the consumption of digital content. On the other hand, training and support from the family environment can guarantee the successful incorporation of these tools into the educational context.

Finally, it should be borne in mind that the digital environment is evolving and advancing rapidly, so teacher training is crucial to ensure that ICT and LKT are used effectively to motivate students. If teachers do not have the right training, digital tools can become mere means of transmitting information rather than innovative strategies for learning.

3. ICT and LKT in the context of Physical Education

Physical Education (PE) has traditionally been a highly practical subject focused on developing motor skills and conceptual learning through movement. However, the integration of ICT and LKT has transformed the way this subject is taught and learned, offering new opportunities to improve processes, performance, and student motivation. One of the main impacts is the digitisation of learning and assessment. Thanks to applications and devices such as smartwatches (wearables), physical activity monitoring apps, motion sensors, and interactive platforms, teachers can more accurately track student performance by analysing real-time data on heart rate, endurance, speed and other fitness indicators, while devising innovative educational activities through various platforms. In this case, tools such as instructional videos, simulators, and augmented reality, facilitate the understanding of sports techniques, tactics and game strategies, allowing students to learn at their own pace and reinforce concepts outside the classroom. Another key benefit is the expansion of access to PE, especially in contexts where face-to-face classes may be limited, such as in distance learning or in situations of confinement, such as the recent COVID-19 pandemic. Online platforms and video conferencing have also enabled the continuity of physical learning through guided routines and adapted exercise programmes.

3.1. Benefits of ICT and LKT in Physical Education

The inclusion of ICT/LKT tools in PE is relatively recent, as until a few years ago, they were not considered to be a significant resource for the development of lessons, given the specific characteristics of the subject. However, recent research has indicated that both the use of ICT/LKT in PE classes and the promotion of healthy habits through

these technologies during school hours, in projects based on the subject, have beneficial effects on the physical fitness, diet, body composition, and psychological profile of students, thereby improving their health. While it is true that PE teachers need to be trained and informed about the correct use of these technologies, some of the benefits observed are:

- **Monitoring of physiological variables:** the use of ICT/LKT together with devices and applications to analyse students' progress in different challenges set by schools, such as heart rate during cardiovascular exercise, daily steps based on international recommendations, calories burned in certain activities, or other examples, can help them better understand how physical exercise affects different physiological variables related to health and physical performance, allowing them to become aware of the need to include exercise in their daily lives.
- **Promoting motivation towards the task:** the use of ICT/LKT in the PE classroom allows for the use of strategies that have proven effective in improving student motivation during the teaching-learning process. In this sense, teachers can opt for the use of interactive technologies and gamification that allow them to set percentages for achieving certain objectives, or healthy competition between classmates, to increase students' interest in the proposed activities.
- **Access to visual resources and tutorials:** the creation of audiovisual educational resources is another of the strengths of including ICT/LKT in PE. Providing students with videos, documents, and applications that teach specific sports techniques or skills can improve their specific knowledge, both conceptual and procedural.
- **Inclusion and personalisation:** the use of new technologies is also a valuable resource for ensuring the personalisation of the teaching-learning process, allowing content to be generated that enables students to review aspects covered in class and even practise them outside school hours, providing more

opportunities for development to students whose learning acquisition process follows unconventional paths.

3.2. Practical strategies for integrating ICT and LKT in Physical Education

- **Use of digital applications and platforms:** one of the most effective strategies is the use of monitoring applications and devices to track students' physical performance. Apps such as Google Fit, Strava, and MyFitnessPal allow users to record their daily activity levels, monitor their workouts, and improve their knowledge of eating habits, while smartwatches and activity trackers, such as Fitbit or Garmin devices, help measure heart rate, steps taken, and calories burned. The combination of these elements often significantly improves students' interest in their health in relation to physical exercise.
- **Gamification and challenge-based learning:** Gamification and interactive platforms are another key tool for increasing student motivation. Creating virtual challenges and competitions, such as who can take the most steps in a week or who can complete the most exercise routines, encourages participation. In addition, active video games (exergames), such as the mobile app Pokémon Go, which encourages active play, or other desktop platform games such as Ring Fit Adventure for Nintendo Switch or Xbox Kinect, allow motor skills to be developed in a fun and effective way. Augmented reality can also be used to make exercise more immersive. A clear example of this is the app "Zombies, Run!", which turns a running routine into an interactive gaming experience.
- **Asynchronous educational process:** the use of educational videos and tutorials contributes to autonomous learning and technical improvement. Analysing movements in slow motion with apps such as Hudl Technique helps to correct posture and execution in disciplines such as athletics, swimming, or football. Platforms such as YouTube offer educational content on warm-ups, stretching, and sports strategies. Virtual reality even

allows game techniques and tactics to be visualised in 3D, providing a more immersive learning experience. Pre-recorded routines can also be shared for students to follow from home, and training programmes can be adapted to different levels, ensuring the inclusion of all students.

On the other hand, to improve assessment and self-learning, digital tools such as Google Forms or Socrative can be used to create quizzes on the content taught. Digital training diaries, through blogs or apps such as Evernote, allow students to record their progress and reflect on their performance. In addition, the use of tracking tables in Excel or physical activity management platforms facilitates the analysis and comparison of performance over time.

- **Interdisciplinary projects with ICT and LKT**: finally, the use of ICT/LKT in PE opens the door to the design of interdisciplinary projects between subjects, such as mathematics (e.g. using apps that monitor steps, kilometres, heart rate, or other variables to compile statistics), natural sciences (e.g. linking anatomical structures and their function), or music (e.g. using ICT/LKT for the creation of audiovisual resources by students combining music with body expression), among others, allowing learning to be connected with different areas of knowledge and fostering critical thinking, creativity, and data analysis. These initiatives not only enrich teaching but also prepare students for the responsible and strategic use of technology in different areas of their lives.

3.3. Examples of projects for integrating ICT and LKT in the classroom

Strategy: Use of apps and platforms

- **Authors:** Gómez-Cuesta et al. (2024)
- **ICT and LKT:** Pokémon Go, Pacer, Strava, and MapMyWalk
- **Objective:** To analyse the impact of an intervention promoted by the PE subject, based on the use of mobile applications to record the distance or steps travelled by students aged 12 to

16, on the level of physical activity, physical condition, body composition, and adherence to the Mediterranean diet.

- **Results**: Following this intervention, an increase in daily physical activity, an improvement in body composition, and improvements in physical fitness variables were observed. These changes were more evident in the group with the lowest baseline level of physical activity. In addition, all applications proved to be effective.

Strategy: Gamification and challenges

- **Authors:** Mateo-Orcajada et al. (2023)
- **ICT and LKT:** Pokémon Go
- **Objective:** Pokémon Go is a mobile app that offers both continuous and intermittent (gamified) play. The objectives of this research were to establish the differences in the level of physical activity and its influence on body composition in the adolescent population, considering the Pokémon Go playing style, and to analyse whether previous physical activity influenced the effects of Pokémon Go use on the level of physical activity and changes in body composition.
- **Results:** Continuous play seemed to be more effective in increasing physical activity in adolescents, but changes in body composition occurred similarly with continuous and intermittent play. Therefore, the recreational use of Pokémon Go could be used in education and healthcare to bring about changes in the body composition of this population.

Strategy: Asynchronous educational process

- **Authors:** Mahalingam and Fasella (2017)
- **ICT and LKT:** Learning Management System (LMS)
- **Objective:** To improve student content acquisition by using a modified flipped classroom model in which students were provided with resources to prepare the content. A personal response system was used at the beginning of class to help assess student readiness and lay the foundation for further developing their knowledge and skills. After class, LMS resources and an online homework system helped students reinforce their knowledge and skills.

- **Results:** This asynchronous preparation system before and after the face-to-face class allowed students to improve their knowledge of the subject matter to be worked on, as well as to generate more meaningful knowledge by being able to reinforce the content later on.

Strategy: Interdisciplinary projects

- **Authors:** Trigueros (2024)
- **ICT and LKT:** Pre-existing video game
- **Objective:** This research analysed the viability of gamification for generating meaningful and multidisciplinary learning, while also using it as a motivational tool and a means of acquiring digital skills.
- **Results:** The results confirmed that incorporating such gamified proposals from interdisciplinary methodologies and with technologies increased student motivation, sparking interest in acquiring content from different disciplines, helping to develop meaningful learning, and developing students' digital competence.

4. Conclusions

ICT and LKT have proven to be key tools for fostering motivation in the classroom. Their integration into educational processes allows for the design of more interactive and personalised learning experiences that are aligned with the needs and preferences of students. Motivation, a determining factor in academic performance, can be enhanced through innovative strategies such as gamification, project-based learning, and the personalisation of educational content.

In the field of PE, the incorporation of ICT and LKT has transformed the way in which students participate in physical activities, improving their commitment and promoting healthy habits. Tools such as monitoring devices, digital platforms, and mobile applications, have facilitated more accurate performance tracking, providing valuable information for the continuous improvement of the teaching-learning process.

However, the implementation of these technologies also presents challenges. The digital divide remains a significant obstacle, as not all students have equitable access to devices and connectivity. In addition, information overload can hinder knowledge assimilation, and the lack of teacher training in the use of ICT and LKT limits their educational potential.

Despite these challenges, technology offers an opportunity to modernise education, increase motivation, and improve the quality of learning. To achieve this, it is essential to develop strategies that ensure equitable access to digital resources, train teachers in their effective implementation and promote the responsible use of ICT and LKT in the classroom. Only then can an innovative, inclusive, and meaningful education for the new generations be guaranteed.

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Chapter 5

Use of technologies to improve physical fitness

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Abstract

Sedentary lifestyles among children and adolescents have increased exponentially in recent years, mainly due to the excessive use of electronic devices, which has reduced the level of physical activity. Despite the recommendations from the World Health Organisation, few young people achieve the minimum levels of physical activity, which affects their physical fitness. Factors such as strength, muscular endurance, cardiovascular capacity, flexibility, and body composition, are key to physical performance, health, and disease prevention in adulthood. Although the use of technology can encourage sedentary behaviour, it also offers opportunities to improve physical activity and fitness. Mobile applications, devices, and wearables, allow users to plan and record personalised workouts, which improves motivation. With advances such as biometric sensors, artificial intelligence and immersive platforms, it is essential for these tools to be used with an educational and accessible approach. It is therefore necessary to analyse technologies aimed at improving physical fitness and establish criteria for their effective and responsible use.

Keywords: Cardiovascular capacity; Body composition; Flexibility; Strength; Endurance; Health.

1. Introduction

In recent years, children and adolescents have changed the way they enjoy their free time. In previous decades, it was common to see streets and parks filled with children running, playing, or playing sports. However, today it has become less common to observe these scenes, largely fuelled by the increase in sedentary behaviours.

Although the World Health Organisation recommends at least 60 minutes of moderate to vigorous physical activity every day, the reality is that only 30% of young people achieve these targets. For this reason, it is necessary to investigate the causes of this phenomenon and develop strategies that promote a more active and healthier lifestyle.

To reverse this trend, physical activity and maintaining good physical fitness are key. Aerobic activities improve cardiovascular and metabolic health, as they help regulate blood pressure, control glucose, and improve the lipid profile. Strength exercises and high-intensity interval training have also shown positive results in improving endurance and muscle strength, body composition, and health indicators. It is therefore necessary to encourage regular physical activity during the growth stages, as it increases physical fitness, improves psychophysiological health, and social relationships, which are fundamental aspects of development and maturation.

However, one of the main factors contributing to the increase in sedentary lifestyles is the amount of time young people spend in front of screens. Electronic devices, social media such as Instagram and TikTok, video games, and streaming platforms such as YouTube and Twitch consume a large part of their free time, exceeding seven hours a day, which reduces the time available for sports and increases the risk of obesity, sleep disorders or anxiety and depression problems.

The situation is no better at schools. Although children and adolescents take part in Physical Education classes and extracurricular activities, this time does not compensate for the long hours they spend sitting in class the rest of the day, a problem that is exacerbated when resources are more limited or in environments marked by inequality. In addition, the COVID-19 pandemic has exacerbated this situation by

restricting mobility during the lockdown and reducing physical activity, which has encouraged more sedentary habits. Although life has returned to normal, the habits acquired during this period remain and continue to be a difficult challenge to overcome.

To address this situation, it is essential to promote physical activity at these stages. However, this alone is not enough, as 20% of children are overweight, so it is also crucial to work on physical fitness, including muscle strength and endurance, cardiovascular capacity, and flexibility, to attain a healthy body composition.

1.1. Technology as an ally for improving physical fitness

Paradoxically, the use of technology can be a double-edged sword. Although excessive screen use is linked to a sedentary lifestyle, some technologies can help encourage physical activity. Worldwide, more than 6.8 billion people use smartphones, wearables, and mobile apps such as MapMyWalk or My Fitness Pal, allowing them to design workouts and obtain data on their heart rate, sleep, and stress levels in a simple and inexpensive way. In fact, several studies indicate that the use of these technologies can increase daily physical activity and reduce sedentary time, making them an effective tool for improving health.

At schools, the use of technology is transforming Physical Education classes. Electronic devices, QR codes, and augmented reality, allow the incorporation of mobile apps, interactive games, and immersive activities that help capture students' attention and motivate them to participate. In addition, alternatives have also emerged for those who are not attracted to traditional exercise but enjoy video games. Exergames such as Just Dance, Ring Fit Adventure, and Nintendo Switch Sports, which combine sensors, virtual graphics, and real movements, have proven effective in improving strength, cardiovascular endurance, and flexibility, offering a fun way to stay active.

The integration of technology into everyday life represents an opportunity to promote physical activity. However, it is not enough to reduce levels of physical inactivity; it is also necessary to work on physical fitness to ensure healthy physical and mental development. For all these reasons, this chapter analyses how technologies can contribute

to improving physical fitness among children and adolescents, offering criteria for choosing safe and effective options.

2. Definition and components of physical fitness

Physical fitness is a state that reflects the body's ability to perform daily physical activities with energy, to enjoy leisure time, to prevent disease, and to contribute to physical and mental well-being, delaying the onset of fatigue and allowing for rapid recovery.

It includes components related to performance, health, and quality of life, such as muscle strength and endurance, cardiovascular capacity, flexibility and body composition. All these factors have a direct influence on health, which is why it is important to work on them in combination to promote the comprehensive development of children and adolescents. Although it is not necessary to reach high levels to obtain benefits, it is essential to exceed the intensity of usual efforts to generate adaptations and progress gradually in training loads.

2.1. Muscular Strength and Endurance

Muscular strength and endurance are two of the most important components of physical fitness during the growth stages. Muscular strength is the ability of muscles to generate maximum contraction with a single effort and allows movements such as jumping, sprinting, or pushing objects. Muscular endurance, on the other hand, is the ability of muscles to contract repeatedly over a period of time and allows activities of a certain duration to be maintained without excessive fatigue. Both are essential for increasing muscle mass and the ability to perform daily tasks, such as carrying backpacks or climbing stairs, and play a key role in preventing injuries, maintaining postural control and strengthening bones.

To improve these, it is necessary to perform exercises that involve muscle contractions against external loads or progressive resistance, ensuring that the exercises are safe, motivating and appropriate the level of the student’s development. Activities such as squats, planks, jumps, movements, or even games can be good options. In addition, incorporating varied games and exercises makes training more fun,

improves adherence to the programme, and ensures that children enjoy themselves while strengthening their muscles. Traditionally, methods such as the number of repetitions and sets, or the percentage of maximum repetition (RM) have been used to control the workout loads. Although these methods are effective, they can be difficult and unmotivating for younger children as they require memorising routines and weights for each exercise, as well as controlling variables related to technique or fatigue.

In recent years, advances in technology have revolutionised the planning and monitoring of strength training of children and adolescents. The use of mobile apps, video recordings, and certain devices, facilitates the personalisation of sessions and the quantification of training.

2.1.1. Practical recommendations

Platforms with explanatory videos

Platforms with explanatory videos, such as YouTube, facilitate learning the correct technique for strength exercises. In addition, these resources can be used as inspiration to design adapted exercises and routines. Social media channels such as Instagram, TikTok or even Twitch can be good options, but their content and access must always be supervised.
Examples: @littlesportsespanol @RAFAELNOGUESMARTINEZ @AchieveFitnessBoston

Exercise databases and routine creation

Tools with exercise databases and routine creation allow users to customise workouts according to age, experience level, and individual goals, making it easier to plan progressive and varied sessions. In addition, cloud-based data storage and analysis makes it easy to track progress.
Examples Apps: Training for Kids at Home, Hevy, FitNotes, Jefit, AimHarder, Strong, EFITGOID, Ace Workout

Recording repetitions, times and rest periods

Tracking repetitions, work times, and rest periods is key to strength training. Mobile apps and devices allow users to record this data manually or automatically, making it easier to focus on performance without the need for manual record keeping.
Examples of apps: RepCount, GymCam, Multi timer, SmartWOD Timer, Tabata Timer

Wearable devices

Smartwatches and other wearable devices can measure execution speed, fatigue, or training volume, allowing users to adjust the intensity according to their physical fitness. This ensures an optimal workload and adequate recovery time.
Examples: Spleeft, Apple Watch, Amazfit, Redmi Watch, Galaxy Watch, Garmin

Educational modules on anatomy and physiology

Some apps include educational material on anatomy and how the body works during exercise. This helps users understand the importance of technique, the functions of muscles and joints, and progression in strength training. These tools complement theoretical teaching in a visual and practical way.
Examples: Human Body Adventure, Anatomy by Muscle & Motion, AR Anatomy

Training load control

Quantifying and monitoring training loads are key to progressing without overloading structures, avoiding excessive fatigue and injury. This facilitates the adaptation of the workload according to level, needs and objectives.
Examples: My Jump, 1 Rep Max, Nordic, RPE, Boostcamp, Tracked Strength Training

Biomechanical analysis with sensors and video

Motion sensors and video analysis allow users to evaluate exercise technique, detect errors, and receive real-time feedback. In addition, the

use of these tools reinforces visual learning, making it easier to understand how to perform exercises correctly.
Examples: Kinovea, WL Analysis, Strength by Muscle and Motion, Vibration analysis, Forcedata

Gamification and motivation through challenges

Incorporating games and challenges into training helps develop strength in a fun way. Technology allows users to create personalised challenges, set rewards, and make training more interactive. This encourages consistency and interest in physical activity, which is essential both in Physical Education classes and when exercising at home.
Examples: Fitocracy, Habitica, Sworkit Kids, Ring Fit Adventure, Wii Fit Plus

2.1.2. Criteria to consider when selecting tools

- *Customisation: tools should allow exercises to be adapted to physical ability, age and needs, ensuring that progression is appropriate and motivating.*
- *Safety: it is essential that they include clear explanations and demonstrations of how to perform the exercises correctly to prevent injury.*
- *Accessibility: it is recommended to choose affordable, easy-to-use tools that are compatible with different devices (mobile phones and tablets) to facilitate their use at home and at school.*
- *Scientific basis: it is important that apps are based on principles validated by training experts, ensuring that the recommendations are safe and effective.*

2.1.3. Aspects to avoid when selecting tools

- *Excessive complexity: tools with complicated interfaces or too many features can be difficult to use.*
- *Unrealistic promises: apps or devices that guarantee great results in a short time should be avoided, as these messages often lack scientific basis and can create unrealistic expectations.*
- *High costs and micro-payments: while some technologies may offer benefits, it is important to ensure that they are affordable and*

do not involve micro-payments that expose users to gambling-related expenses or behaviour. It is therefore advisable to look for accessible alternatives that offer similar features at a lower cost.

2.2. Cardiovascular capacity

Cardiovascular fitness is an essential component of health of children and adolescents and one of the most important aspects of physical fitness due to its cardioprotective function. It allows the heart, lungs, and circulatory system to work together to supply oxygen to the muscles during prolonged activities.

Working on this capacity has numerous health benefits. Its development improves metabolic function and reduces the risk of cardiovascular disease, obesity, and type 2 diabetes in adulthood. In addition, it facilitates the performance of daily activities and generates a greater sense of physical and mental well-being. A low level of cardiovascular fitness is an independent risk factor. This means that, in two people with the same levels of cholesterol, fat, or blood pressure, the physically active person will have a lower risk of developing heart disease or suffering from a premature death.

To work on this capacity, it is necessary to perform activities that raise the heart rate and involve large muscle groups, such as running, cycling, swimming, or team sports. These improve aerobic capacity while promoting social interaction and improving self-esteem, helping to reduce stress levels and fostering a positive attitude towards physical exercise. For this reason, cardiovascular endurance work, together with strength training, should be the basis of physical fitness programmes for young people.

To encourage the improvement of cardiorespiratory capacity in children and adolescents, it is important to offer dynamic, varied activities that are tailored to their interests. Although outdoor games, group sports, and recreational activities can be good, young people's preferences are changing, and it is becoming increasingly difficult for them to engage in this type of training.

In recent years, technology has revolutionised cardiovascular endurance training, having a more significant impact than on other aspects of physical fitness. This change began with basic devices such as heart rate bands, which allowed real-time measurement of effort, and evolved into smart devices such as bracelets with advanced sensors, wearables, and mobile apps. These advances have made it possible for anyone, regardless of their level of experience, to record their performance, adjust their training intensity, and receive immediate feedback, making cardiorespiratory training a much more effective, motivating, and tailored experience for individual needs and goals.

2.2.1. Practical recommendations

Planning and monitoring devices and apps

Sports watches, activity trackers, and heart rate sensors allow for the real-time measurement of exercise intensity and the body's response to exertion. In addition, GPS sensors built into these devices and specialised apps make it easy to track distance, speed and pace, providing useful data for adjusting and optimising training.
Examples of devices: Garmin, Polar, Fitbit, Apple Watch, Amazfit, chest straps and optical sensors in wearables.
Examples of apps: Strava, MyZone, TrainingPeaks, Adidas Running, Nike Run Club, Freeletics, Google Fit, Apple Health, MapMyRun, Runtastic, Toteemi, Zwift AI Coach.

Effort, recovery and fatigue analysis

Monitoring parameters such as heart rate variability (HRV) helps assess fatigue and adjust workload on an individual basis, reducing the risk of injury. Although specific devices are usually required to measure these parameters, these tools provide a better understanding of the effects of training at a physiological level and optimise recovery as well.
Examples: Whoop, Oura Ring, Garmin Body Battery, HRV Elite, HRV4Training

Technique and biomechanics analysis

Specialised running analysis apps allow you to evaluate movement mechanics, identify technical errors, and optimise stride efficiency. Video tools, motion sensors, and biomechanical data, are used to analyse factors such as cadence, stride length, ground contact time and movement symmetry. This facilitates technique correction, injury prevention, and performance improvement.
Examples: Ochy, Runmatic, SlowPro, TrackMotion, iAnalyze, Dartfish, Kinovea

Hydration status assessment

Maintaining proper hydration is essential for performance and safety in training. Dehydration can lead to premature fatigue, muscle cramps, and may even increase the risk of heat stroke. Mobile apps help monitor fluid intake and set reminders to prevent dehydration, ensuring proper balance before, during, and after exercise.
Examples: HydrateSpark, Gatorade GX, WaterMinder, Plan Nanny

Assessment tests

Physical tests measure progress in fitness and performance, but they are not always easy or useful in large groups. Mobile apps facilitate the administration and recording of tests such as the Cooper Test, the 20-metre Test, or batteries such as FitnessGram, providing objective data on endurance, strength and speed. These tools optimise assessment in the classroom, accelerate the collection of results, and allow training to be tailored to the individual needs of each student.
Examples: Beep Test Leger Running, VMA Test, PACER, FITNESSGRAM web, Polar GoFit

Gamification and motivation

Mobile apps, games and online platforms can be used to gamify and make training more motivating. Through challenges, rewards, online competitions and augmented reality, technology makes physical activity a more fun experience, increasing motivation and adherence to exercise.
Examples: Pokémon GO, Zombies Run!, The Walk, Geocaching, Orna

2.2.2. Criteria to consider when selecting tools

- *Individualisation: the tool must allow the intensity, duration, and type of training, to be adjusted according to physical fitness level, age, and individual goals.*
- *Motivation: it should include elements that encourage practice, such as challenges, but without creating excessive dependence on external rewards.*
- *Effort monitoring: it is advisable to not only record distance and calories, but also indicate the perception of effort, helping users to regulate themselves autonomously and safely.*
- *Privacy: it is essential that the tool clearly informs users about the collection and use of personal data, guaranteeing the security and confidentiality of user information.*

2.2.3. Aspects to avoid when selecting tools

- *Excessive data without guidance: apps that focus solely on calories burned or steps taken without explaining their meaning can encourage a mechanical and un-educational approach to training.*
- *Dependence on technology for training: some apps can make adolescents feel that they cannot train without a device, rather than developing autonomy and confidence in their ability to exercise without technological assistance.*
- *Geolocation safety: if the app uses GPS (such as running or cycling routes), it should offer options to disable public visibility and ensure privacy protection, avoiding risks such as tracking by third parties or exposure to strangers.*

2.3. Flexibility

Flexibility refers to the ability of joints to achieve their full range of motion without restriction or pain, and its development is essential for maintaining proper posture, performing fluid movements, and preventing injuries. It is influenced by the surrounding tissues, such as muscles, ligaments, tendons and adipose tissue, among others.

Flexibility is especially important in children and adolescents due to the morphological changes that occur during development, which can reduce mobility. Good flexibility during growth allows for a better

adaptation to these changes, improves physical performance, and reduces the risk of future injuries and joint pain. In a context where young people spend many hours sitting in class and at home, or using electronic devices, it is essential to work on flexibility to avoid accumulating muscle tension and discomfort in the neck, back, and shoulders, mainly.

Flexibility is a highly specific quality; in the same person, two joints can have completely different ranges of motion. This is why it is advisable to incorporate mobility exercises and stretches that target different joints, planes, and movements. Methods such as static stretching, which involves holding a position for a certain amount of time, or dynamic stretching, which involves controlled and repeated movements, can be used depending on the situation and needs.

In addition, activities that help to increase range of motion, such as yoga, games that involve joint mobility, or stretching as part of a sports warm-up, can be an attractive option for improving flexibility progressively and safely without it being perceived as a boring activity. Since flexibility varies greatly between individuals due to factors such as sports, age, gender, or bone structure, it is important for exercises to be personalised and performed regularly to prevent loss of mobility over time.

Despite its importance, training this ability often takes a back seat to others such as strength or cardiovascular endurance. This is because stretching is perceived as a secondary, monotonous activity with a slow progress, which makes it difficult to continue performing it. In addition, flexibility training requires some knowledge of anatomy and the correct execution of exercises, which leads many people to decide not to do it, do it incorrectly, or mistakenly believe that it is an innate quality rather than a skill that can be trained.

In the face of these challenges, technology can play a key role in guiding children and adolescents in flexibility training with practical exercise recommendations, techniques, and routines tailored to their goals. These tools are a resource for improving the teaching and execution of flexibility work, as well as a means of making its practice more accessible, attractive, and effective.

2.3.1. Practical recommendations

Platforms and apps with exercises

Mobile apps and digital platforms provide guided stretching and mobility routines, facilitating the teaching and practice of flexibility among adolescents. These tools allow users to follow progressive programmes, adapt exercises to individual needs, and access multimedia content for better movement execution. In addition, many include reminders and progress tracking, which improves adherence to the practice.
Examples of platforms: StretchIt, GOWOD, Pliability, PilatesAnytime, Estiramientos.es, MobilityWOD, MoveWell, StretchLAB.
Examples of channels: @littlesportsespanol, @SuperStretchYoga, @CosmicKidsYoga, @PEwithMrG.
Examples of apps: "Stretching and Flexibility", "Exercises for Flexibility", "Bend: Yoga and Stretching", Glo, Ertigo, "Yoga | Down Dog", "Fitify: Stretching and Mobility", "Yoga Anatomy", "Posture by Muscle & Motion".

Apps for assessment

Mobile apps facilitate the assessment of flexibility through joint range of motion, postural control, and body mobility. These tools allow you to record and compare progress, optimise workouts, and prevent injuries by detecting potential limitations. Some apps use sensors, digital goniometry, or video analysis, to obtain accurate and personalised measurements.
Examples: APECS, PhysioCode, "Goniometro Advance", "My ROM", "Physics Toolbox Sensor Suite", "PhysioMaster: Physical Therapy", Kinovea

2.3.2. Criteria to consider when selecting tools

- *Safety: Poorly executed stretches can cause injuries rather than prevent them. A suitable tool should include clear instructions on how to perform the stretches, recommended times, and provide warnings about positions that could cause injury. It should also offer adjustments for different levels of flexibility and warnings about specific medical conditions.*

- *Educational content: to perform stretches properly, it is essential to understand which muscles and joints are being worked, why, and for what purpose. Basic explanations of anatomy should be included with images or 3D models to help visualise what is being stretched and how it affects mobility and injury prevention.*
- *Personalisation: flexibility is highly specific and individual; not everyone has the same level of flexibility or the same goals. It is important that the practice can be adapted to different conditions, allowing to modify the intensity, duration and difficulty of the exercises according to individual characteristics.*
- *Variety: it is important to have options that include dynamic, static, ballistic, or proprioceptive neuromuscular facilitation (PNF) stretches, allowing the most appropriate technique to be selected according to the context, time of day or activity.*
- *Motivation and adherence: stretching is often perceived as a monotonous activity, which can make it difficult to practise and adhere to a training programme. It is recommended that tools allow for the establishment of challenges, interactive dynamics, or reward systems that reinforce commitment and maintain interest.*
- *Habit formation: for stretching to be effective, it must be done regularly. Reminders or the ability to record progress help to integrate it into the daily routine and facilitate habit formation. Recommending appropriate schedules and combining it with other activities can help to maintain the practice over time.*

2.3.3. Aspects to avoid when selecting tools

- *Generic or unsafe exercises: resources that do not adapt stretches to the user's age, flexibility level or physical fitness capacity can increase the risk of injury. In addition, some apps encourage hyper flexibility without considering user safety. This can be dangerous, especially in adolescents, as it increases the risk of hyperlaxity and ligament damage.*
- *Repetitiveness and lack of variety: prolonged use of the same stretching routine without variation and without professional supervision can lead to imbalances, reducing the effectiveness of training and increasing the risk of postural compensations.*

- *Lack of feedback: apps that do not offer precise instructions or corrections can lead to incorrect execution of stretches, which can result in muscle or joint injuries.*
- *Aggressive or painful stretching: some apps may promote the idea that pain is synonymous with progress, when in fact stretching should be progressive and controlled. Excessive intensity can lead to tears or chronic injuries.*
- *Not including warm-up and cool-down: apps that do not include preparation before stretching and a recovery phase afterwards can cause muscle or joint injuries due to the body not being properly prepared.*

2.4. Body composition

Body composition refers to the proportion and distribution of body mass in different tissues, such as muscle mass, fat mass, bone mass, and viscera. Unlike other components of physical fitness that are more related to movement, it is not measured directly through performance, but through indicators such as body mass index or fat percentage.

The maintenance of a healthy body composition among children and adolescents is essential for proper physical development and maturation, but also for good metabolic health. A proper balance between muscle mass and fat mass contributes to better mobility, enhances physical performance, and reduces the risk of diseases such as obesity, type 2 diabetes, and bone problems in adulthood. Having an adequate body composition does not only mean having a low-fat percentage, but also that the proportions between the different tissues are adequate for the proper functioning of the body on a physical and physiological level. Good muscle mass, together with a healthy level of body fat, contributes to stronger bones and joints, reduces the risk of injury, and the likelihood of developing chronic diseases in the future. That is why it is essential to ensure optimal body composition according to age, gender and level of physical activity, promoting healthy habits that last over time.

To achieve a healthy body composition, it is necessary to engage in physical activities and sports that combine strength and cardiovascular endurance exercises. This, together with an active lifestyle and proper nutritional habits, is essential for improving body composition. However, for many children and adolescents, a lack of information and motivation, coupled with a deficient sociocultural environment, makes it difficult to set realistic goals in relation to their body composition.

In this context, technology can play a fundamental role in monitoring and improving body composition. However, it can also be a problem. On the one hand, it provides access to tools that facilitate the control of healthy habits. On the other hand, children's and adolescents' access to social media and online platforms can distort their perception of reality and their own bodies, placing an excessive focus on body weight control and aesthetics. This, combined with social problems such as bullying, can contribute to the development of behaviours or disorders related to body image and eating.

For this reason, it is essential to establish clear recommendations for choosing tools and resources that can improve it, but from a healthy perspective, including the apps for improving strength and aerobic capacity mentioned above.

2.4.1. Practical recommendations

Healthy habits and diet control

Apps and wearables include features to encourage healthy habits through reminders for physical activity, hydration or rest, as well as offering training plans tailored to goals such as fat reduction or muscle gain. They also include nutritional databases to record calorie intake and energy balance, facilitating the control of macronutrients.
Examples: Yuka, My Fitness Pal, Fitia, Nootric, Oorenji, Aqualert, FitApp, Strongr Fastr
Examples of channels: @xNutricionSalud, @juan_revenga, @JuliaFarre, @Alimentologo, @SergioEspinarOficial, @Midietacojea, @isabelvina

Tracking calorie and macronutrient intake

There are apps that allow users to record their daily diet and calculate their energy balance in relation to your calorie expenditure. Some include barcode scanning or image recognition to facilitate recording. However, accuracy depends on the tool and can lead to an obsessive relationship with food in some cases.
Examples: GoCoCo, MyRealFood, Healthify, FatSecret, Yazio, Lifesum, MyNetDiary, Lose It, Cronometer

Calculation of daily energy expenditure and basal metabolic rate

Devices such as smartwatches estimate calorie expenditure and basal metabolic rate based on movement and heart rate. Although they provide insights into metabolism, their calculations rely on sensors and algorithms that may not be accurate.
Examples: Garmin, Polar, Fitbit, Apple Watch, Amazfit, chest straps and optical sensors in wearables

Sensors and devices for estimating body composition

Some wearables, smart scales, and bioimpedance devices, estimate body fat, muscle mass, and body water. While they do allow for tracking, their accuracy varies depending on hydration, time of day, and device quality, leading to possible fluctuations in their results. Although their accessibility is a plus, accuracy remains limited, and they are not a substitute for other reference methods such as Kinanthropometry.
Examples: Tanita, Xiaomi Scale, Omron, Garmin Index, Aura Strap, Xiaomi Smart Band, Amazfit Bip, Huawei Band, Samsung Galaxy Fit

Body composition estimation apps

Apps with BMI and energy expenditure calculators help estimate body composition. However, many formulas are generalised and do not consider biological maturation or the actual distribution of adipose tissue, which can lead to misinterpretations.
Examples: WeightBot, Spren, Body Composition, BMI Calculator, Daily Calorie Expenditure Calculator, Weight Control & BMI Calculator, Libra Weight Manager

2.4.2. Criteria to consider when selecting tools

- *Comprehensive approach: it should address body composition from a comprehensive approach, combining exercise, nutrition, and healthy lifestyle habits, and encouraging an active lifestyle, a balanced diet, and adequate rest, promoting sustainable changes over time rather than immediate results.*
- *Prevention of risky behaviours: the tool's approach should focus on health and well-being, not obsession with body image. It is important to avoid promoting restrictive diets, idealisation of unattainable bodies, or unhealthy comparisons. It should promote a positive message about physical activity and nutrition, without causing anxiety or guilt. It is essential to avoid "30-day challenge" approaches or miracle solutions that do not generate lasting change.*

2.4.3. Things to avoid when selecting tools

- *Replacing health professionals: some apps give the impression that they can replace a nutritionist, doctor, or physical exercise professional. However, these tools cannot offer a personalised assessment or address specific needs. Relying exclusively on them can lead to mistakes in diet, physical exercise, and health monitoring. One should always consult a professional for a proper assessment.*
- *Encouraging an obsessive relationship with food: apps that require the constant recording of food and calories can cause anxiety and obsessive behaviour in adolescents. Instead of promoting healthy habits, they can encourage a rigid relationship with food, increasing the risk of eating disorders.*
- *Exclusively aesthetic focus: avoid technologies that promote body improvement based on superficial or unrealistic standards rather than a focus on health, well-being, and performance. One must avoid apps with rankings, challenges, or comparisons between users, as these can create psychological pressure and affect adolescents' self-esteem.*
- *Sensationalist or pseudoscientific messages: some tools use exaggerated promises such as "lose weight quickly", promoting extreme diets without scientific backing, which can put health at risk.*

- *Body composition analysis without professional supervision: some apps promise to measure body fat, muscle mass, and other parameters, without accurate tools or professional validation, which can lead to misinterpretation. Body composition assessment should always be carried out under the guidance of a professional.*

3. Future prospects

Technology is transforming the way sport is practised and Physical Education is taught. In the coming years, advances are expected that will enable more personalised, effective, and accessible training.

The development of better biometric sensors and wearable devices, such as smart watches and activity trackers, will improve the accuracy of physiological measurements, such as oxygen consumption, energy expenditure, and heart rate variability. This will facilitate the real-time assessment of physical fitness and allow training to be adapted according to individual abilities. In turn, artificial intelligence and big data analysis will transform the design of exercise programmes. Artificial intelligence will enable the development of training programmes tailored to each person's needs, optimising performance and reducing the risk of injury. In addition, its application in biomechanics will facilitate the detection of postural and technical deficiencies, providing immediate feedback to improve exercise performance.

The actual implementation and practical use of virtual reality and augmented reality will open up new possibilities in the field of exercise and education, allowing for immersive experiences that will make physical activity more educational and entertaining for all ages, promoting healthy habits in a dynamic and interactive way. Another key advance will be the interconnection of health data and remote access to professionals, which will facilitate the development of more accurate exercise recommendations based on scientific evidence. However, this development poses challenges in terms of privacy and information security, so it will be essential to establish regulations that guarantee the protection of user data.

For all these advances to have a positive impact, it will be essential to ensure their accessibility and promote their application with an educational and public health approach.

4. Conclusions

For technology applied to improving physical fitness to truly contribute to better health and well-being, it is essential that its implementation be based on sound scientific and educational principles, instead of marketing campaigns and the promise of "magic" solutions to achieve a goal. Research must continue to explore its effectiveness, analysing its impact on motivation, adherence, and physical fitness improvement. At the same time, it is important to identify potential risks, such as an excessive use of devices, the type of content they offer, or the management of personal data, to ensure that their application is safe.

The incorporation of these tools into education and training must be done in a balanced way, ensuring that they complement teaching without replacing the actual practice of exercise. Their use should be aimed at improving the learning experience, facilitating progress monitoring and promoting healthy habits, but without creating dependence on technology. To this end, it will be essential to provide adequate training to enable users to maximise the benefits without neglecting the fundamental principles of physical activity.

Furthermore, these technologies must be accessible. Technology has the potential to make exercise more accessible and personalised, but without the right conditions, it could create new social divides and inequalities. For this reason, it is necessary to ensure that everyone, regardless of their socioeconomic background, can benefit from these tools by developing inclusive policies and strategies.

Technological applications will therefore continue to transform the way physical activity is practised and taught. However, their impact will depend on how they are integrated into society. Their success will not be determined solely by advances in artificial intelligence, augmented reality, or biometric sensors, but by how they are used to improve education, health, and active living. It is therefore essential to

ensure that these tools are implemented responsibly and made accessible so that their potential can be fully exploited.

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Chapter 6

Teacher training in digital competence through the TPACK model

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Abstract

In the current educational and social context, where digital technology plays a central role in curricula, it is essential to rethink digital pedagogy in order to improve educational quality. Initial and ongoing teacher training is key to effective professional performance that is adapted to the changing demands of the educational environment. This chapter promotes critical reflection among teachers (especially Physical Education teachers) on how their training influences their professional development and, consequently, the continuous improvement of teaching. Teacher training models in line with current needs are presented, with an emphasis on digital competence. Within this framework, the TPACK (Technological Pedagogical Content Knowledge) training model emerges, which effectively integrates technological knowledge (TK), pedagogical knowledge (PK) and content knowledge (CK). These types of knowledge are interrelated in accordance with the curriculum, context, and educational needs. Pedagogical evolution in Physical Education must be conceived as a dynamic process, where experimentation and adaptation are necessary. Training in digital competence is crucial for integrating technological tools and effective pedagogical strategies. Only reflective teaching, based on scientific evidence and the appropriate use of technology, can promote education that motivates students towards an active and healthy lifestyle.

Keywords: Professional development; Teaching/learning strategies; Digital training; Teaching practice.

1. Introduction

Although some theories seek to analyse how to be a good teacher, it is considered that the key lies in the initial and ongoing training of teachers for their proper professional performance. In other words, in order to achieve adequate professional performance, it is essential that teachers receive training that enables them to adapt to the changing demands of the educational environment.

From a pedagogical point of view, a good teacher is capable of transmitting knowledge and training students in skills that, in turn, have a decisive influence on their overall development. Consequently, this chapter explores the importance of teacher training as a key factor in professional performance and how professional development models can offer effective solutions to strengthen teaching and pedagogical skills in order to respond to current educational needs.

Given the growing role of digital technology and its importance in educational curricula, the design and application of adapted methodologies is a challenge for the educational community. Teachers must be able to integrate new digital support tools into their daily practice in a critical, reflective, and pedagogical manner. Today, given the pedagogical and social context, the development of digital competence, supported by the integration of digital technology and its use for educational purposes, must be specifically incorporated into the development of the teaching, learning, and assessment process for students. For all these reasons, this chapter presents professional development models that seek to improve teaching performance, with a special emphasis on those that address the urgent need to develop teachers' digital competence.

This chapter addresses this challenge by presenting professional development models, emphasising the TPACK (Technological Pedagogical Content Knowledge) model as a comprehensive approach that connects three elements that underpin the development of digital competence: technological knowledge (TK, knowledge about technological capabilities and applications that can be integrated into the content); pedagogical knowledge (PK, knowledge about teaching/learning/assessment strategies), and content knowledge (CK, knowledge

about the subject matter to be taught). These three types of knowledge are interrelated and give rise to knowledge about how to use the most appropriate technology in a pedagogical framework adapted to the specific teaching situation.

This model is currently being developed for teacher training in digital competence, promoting innovative teaching that relies on digital support tools to enrich teacher training and, consequently, student learning. Among the subjects studied, it has been implemented for the training of Physical Education teachers. Consequently, this chapter will look at practical examples of interventions based on the TPACK model to learn how to design a proposal, implement it and evaluate its development in the context of Physical Education.

The aim of this chapter is for each teacher to critically reflect on how their training impacts their professional development, which is essential for the continuous improvement of educational quality. In addition, different training models that respond to the current needs of the education system will be presented, with a special focus on the development of digital competence in teachers. Through the study of the TPACK model, participants will understand how to effectively integrate technology, pedagogy, and content into teaching, with special attention to the particularities of the area of Physical Education.

2. Theoretical basis

2.1. Professional development models: How to be a good teacher (of Physical Education) today?

Teacher training is a key factor in professional teaching performance. One of the main concerns that has driven the recent Organic Law on the University System (LOSU) is the need to update teachers' skills in order to contribute to the development of students' skills in their learning process (Organic Law 2/2023, of 22 March).

The literature describes professional development models in teacher training that refer to an approach or set of strategies that guide the continuous training of teachers throughout their careers. The main objective of these models is to improve teachers' pedagogical skills and knowledge, ensuring that they are well prepared to face

the changing challenges of the educational environment. In general, teacher professional development models have been defined as follows:

- *Transmissive models.* Models based on technical aspects rather than issues related to values, beliefs and attitudes that support professional autonomy (what and how to teach).
- *Transitional models.* Models focused on support through mentoring and communities of practice (why and when to teach).
- *Transformative models.* Models that promote awareness of different contexts and realities in order to succeed in the pedagogical and professional work of teachers, to increase their capacity for autonomy and professional agency (who and where to teach).

Traditionally, professional development programmes have strongly focused on technical models of teachers as transmitters of knowledge who provide correct answers to students. Among OECD countries, the most common content included in teacher training courses is subject matter (what to teach) and teaching techniques (how to teach). However, professional development is considered more effective when learning is based on the contextual needs of teachers.

According to the scientific literature, based on these models of professional development in teacher training, being a good teacher is considered to involve mastering the following areas:

- 'What to teach'. Conceptual knowledge with a theoretical-practical approach.
- 'How to teach'. Methodological knowledge in relation to content.
- 'Why and when to teach'. Knowledge to be able to understand, interpret and make critical judgements about one's own teaching practice, evaluating its relevance and applicability to one's specific context.

The scientific basis that has been configured and described as a 'transformative or holistic framework' for comprehensive teacher training, considering the following knowledge include:

- 'What to teach'. Knowledge of instructional and pedagogical skills.
- 'What, how and why to teach'. Knowledge and ability to make decisions about the extent to which research-based considerations are relevant to informing how, what and why to teach.
- 'How and where to teach'. Understanding the importance of teaching experience and practice.
- 'Who to teach' - Reflection on how one trains oneself as a person and a student.
- 'Why and to whom to teach' - Critical capacity regarding the teaching, learning and assessment process.

From an educational and political perspective, the development of professional development frameworks is gaining relevance as tools to promote teacher training from an innovative approach that addresses current educational needs. LifeComp is an example of this. It is a European reference framework that promotes training in innovative teaching methodologies and a focus on the health of teachers and students. For example, this framework highlights the importance of developing the key teaching competence 'Personal, Social and Learning to Learn', which is broken down into nine sub-competences: (i) personal: self-regulation, flexibility and well-being; (ii) social: empathy, communication, and collaboration; and (iii) learning to learn: growth mindset, critical thinking, and learning management. In other words, LifeComp is a framework based on a preventive attitude towards one's own health and the health of others, which helps to discern reliable information from misinformation, to self-regulate emotions, and to manage learning in a flexible manner. In conclusion, training models and programmes based on constructivist pedagogy pursue the comprehensive development of the human being, addressing the specific needs of the educational, social, and cultural context. For example, promoting healthy lifestyle habits that are acquired during the students' training and transferred to their daily lives.

2.2. Digital pedagogy in Physical Education

There is currently a high demand for training in transformative and contemporary pedagogies such as digital pedagogy. This science integrates the use of digital technology to improve teaching and learning processes. According to research on digital pedagogy, quality teaching in the 21st century requires developing an understanding of the complex relationships between technology, content, and pedagogy, and using this understanding to acquire digital competence. This is why training in digital competence is increasingly important in order to meet the needs of the educational community and the requirements of the modern curriculum. With this in mind, the European Digital Competence Framework for Educators (DigCompEdu) was created, considering that the duty to help students become digitally competent requires educators to develop their own digital competence. This European Commission initiative provides a reference framework to promote the professional development of teachers in the digital field and thus integrate it effectively into their teaching.

From the perspective of pedagogy as an education science specialising in training and professional development, two approaches can be identified. On the one hand, we find a "technology-mediated pedagogy", known as technological determinism. This is defined as a school of thought that holds technological development to be the main driver of change in today's society. According to this perspective, digital technology largely determines how people interact with each other, how they behave, how they learn, and how they evolve in the current scenario. For teachers, this idea may be relevant to understanding how the introduction of technology impacts the educational environment, from the way students learn, to the teaching methods used by teachers. Technological determinism in education could lead us to believe that access to certain technological tools, such as digital platforms, artificial intelligence, or mobile devices, can irreversibly change the dynamics within the classroom, shaping the way content is delivered and how students interact with knowledge. However, it is important for teachers to understand that, although technology has considerable power over the way we live and learn, we must continually reflect on its use. For example, from the perspective of technological

determinism, there are studies applied to Physical Education that corroborate the direct relationship between the use of mobile applications and the level of physical activity of students.

On the other hand, "pedagogically-mediated technology" is defined as pedagogical determinism. From this perspective, teachers are considered to be the main drivers of change, and for whom, teaching (application of methodological constructs), together with the development of digital teaching skills, lead to professional teaching success and, consequently, academic success for students. For example, from this perspective, the flipped classroom is considered a pedagogical model that reverses the traditional teaching model. Instead of the teacher being responsible for transmitting theoretical content in class and then the students doing tasks and exercises as homework, in this model, students first learn the theoretical concepts independently, usually through online resources such as videos, readings or interactive materials (outside the classroom), which are then discussed by the teacher and students with a higher level of understanding (in the classroom).

Given these two perspectives, from the constructivist and connectivist (digital) pedagogical approaches, different authors argue for the importance of weaving together and connecting the premises of both approaches for the proper alignment of both pedagogy and technology, in order to support teacher training and, ultimately, student learning. This conceptualisation is defined as "entangled pedagogy", as it considers the union of technology in accordance with the context, objectives, and methods to be developed, with interaction between them being key to achieving the proposed objectives. From this perspective of networked pedagogy, the level of physical activity of students can be influenced by the context (educational or family) that favours practice, by the specific activities proposed during Physical Education sessions, or by the fact that students were already accustomed to using these applications, among other factors.

For all these reasons, in the current educational and social scenario, it is increasingly important to rethink and study digital pedagogy in order to improve the quality of teaching in Physical Education, so

that, through digital support tools, it is possible to achieve the curriculum objectives and promote healthy lifestyle habits. In this regard, one of the main learning objectives that trainers should set themselves is to rethink and analyse the role of digital technology in teaching and learning processes in Physical Education in particular, and in official curricula in general.

2.3. Digital competence in Physical Education

We are currently in a digital age that is inherently complex. New digital tools, artificial intelligence and/or virtual reality, among others, are increasingly being integrated into training, both for teachers and students. Therefore, being flexible in today's society also means being able to improve and adapt digital competence. According to the literature, digital competence is defined as the integration of knowledge, skills or abilities, and attitudes, to effectively use digital technology to perform tasks such as searching for information, creating content, solving problems or working collaboratively, and/or communicating, among others. It refers not only to knowing how to use technological tools, but also to having the skills to use them critically and responsibly in different contexts, whether personal, educational or professional.

In compulsory education in Spain, digital competence is included in the curriculum. Initially, within the framework of Organic Law 2/2006 of 3 May on Education (LOE), digital competence was defined as a key competence in the comprehensive development of students, consisting of the ability to use information and communication technologies (ICT) effectively and critically for learning, work, and participation in society. This competence includes not only the use of digital tools, but also the ability to evaluate information, communicate responsibly and creatively, and solve problems using digital resources, all within an ethical context that respects rights and security in the digital environment. Following educational reforms, Organic Law 3/2020 reinforced the importance of this competence as a basis for comprehensive learning and as an essential part of citizenship education in the digital society. In this sense, digital competence involves knowing how to use devices and programmes, being able to make informed decisions about the use of technology, protecting privacy, and

participating actively and responsibly in the digital society. It is considered a cross-cutting competence that must be developed at all stages of education, promoting training that prepares students to face the challenges of the digital world in a critical, ethical, and competent manner.

In higher education, in accordance with the guidelines established in the LOSU, training contributes to the development of digital competence, which is necessary for the comprehensive training of university students. Specifically, with regard to digital competence, the TPACK model could enable students to function in an increasingly digitalised world. This model would facilitate the integration of digital tools into the curricula, allowing students to acquire practical skills that will be useful in their professional future.

Presently, in higher education, group academic tasks with digital support are becoming increasingly common, developed using methodologies that, in turn, pursue the comprehensive development of students. For example, in initial teacher training in Physical Education, interventions are being developed based on designs that rely on digital technology to achieve curriculum objectives and, in turn, improve digital competence. However, according to the scientific literature, there is a lack of research on the use of digital technology in Physical Education teacher training and its relationship with learning and the commitment of trainee teachers.

For example, in the context of Physical Education, an intervention was developed with teachers in initial teacher training to explore the relationship between a student-centred digital technology approach and intrinsic motivation, the learning climate, and the academic performance of trainee teachers. The intervention was based on digitally supported tasks following six pedagogical phases for the development of each task: (a) searching for information on the Internet (search engines, scientific journals and articles, book chapters, books, etc.); (b) selecting content (compiling the most relevant information according to the objective to be developed); (c) creation of content supported by digital support tools; (d) self-assessment of the creation using a rubric; (e) dissemination of the content via Twitter in an attempt to interact in an online conversation with other people interested in audiovisual

creation; and (f) publication of a reflection on the entire creation process with other classmates. The results showed the benefits of a student-centred digital technology intervention aligned with the objectives and other curricular elements. Some of the digital support tools used during the training were: Blogger, Piktochart, Genially, Powtoon, ThingLink, and Twitter (Figure 1).

The results revealed that the use of active learning environments in the initial training of Physical Education teachers, focused on the creative production of content using digital technology, promoted high levels of intrinsic motivation and academic performance. The choice of tools and novelty were key factors in this process. In addition, the active role of the teacher, who motivated and guided the students through digital pedagogy, was fundamental in creating a connected and positive environment. This student-centred and digital technology-focused approach fostered a more effective learning experience.

In this context, it is essential to continue researching digital pedagogies in Physical Education teacher training programmes, with a focus on transferring these experiences to professional practice. However, the design, development, and sustainability of these digital pedagogies in Physical Education teacher training programmes will continue to be a challenge in the coming years.

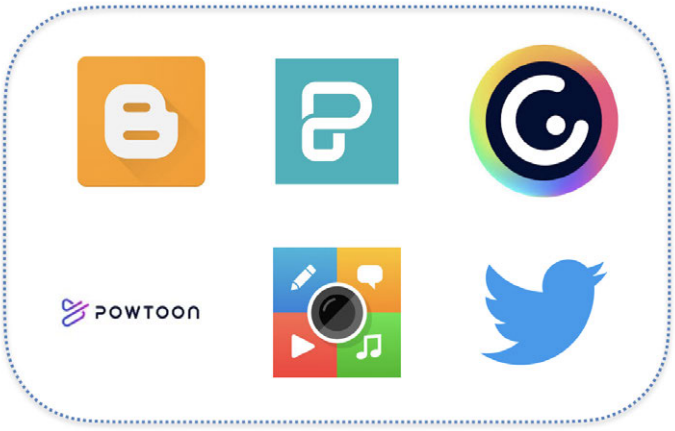

Figure 1. Digital support tools.

2.4. TPACK model in Physical Education

It is considered necessary for the education system to respond to this social reality and include a more modern and comprehensive approach to digital competence, in line with European recommendations on key competences for lifelong learning, especially in higher education. If digital competence is considered fundamental in the educational curriculum for student training, it is a priority for teachers to also have such training in digital competence. The Technological Pedagogical Content Knowledge (TPACK) model has been created for the purpose of digital competence training.

The TPACK model is a framework that describes the knowledge needed to effectively integrate digital technologies into teaching and learning. This model is based on the interaction of three elements that support the development of digital competence: technological knowledge, pedagogical knowledge, and content knowledge, which in turn are interrelated and give rise to: pedagogical content knowledge (PCK, pedagogical knowledge that enables students to acquire the skills specific to the subject); technological knowledge of content (TCK, knowledge about the subject content using technological tools); pedagogical technological knowledge (TPK, knowledge about how technology can be used to acquire new knowledge about the subject content); and pedagogical technological knowledge of content (TPACK, knowledge about how to use the most appropriate technology in a pedagogical framework adapted to the specific teaching situation).

Table 1. Description of TPACK knowledge.

Knowledge	Description
CK	Knowledge of subject content
PK	Knowledge of teaching/learning/assessment strategies
TK	Knowledge of technological tools that can be integrated into the content
PCK	Pedagogical knowledge that facilitates students' acquisition of specific skills or content
TCK	Knowledge of subject content using technological tools
TPK	Knowledge about how technology can be used to acquire new knowledge about the subject content
TPACK	Knowledge of how to use the most appropriate technology in a pedagogical framework adapted to the specific teaching situation

From the perspective of the integrated pedagogy described above, it is considered necessary to have coherence between the three types of knowledge (technological, pedagogical, and content) of the TPACK model (Figure 2). For example, if teaching scientific knowledge in Physical Education, interactive applications should be integrated to allow students to explore scientific concepts, and appropriate methodology must be selected to promote critical thinking among students in working groups.

The TPACK model can guide teachers in making decisions about the use of technology and how it can transform teaching to adapt to the needs of the 21st century. For this reason, most research focused on this model has sought to diagnose teachers' mastery of TPACK knowledge. In general, the literature shows a discourse in favour of its development in order to meet the needs of current teaching practices. Furthermore, the results suggest that TPACK knowledge is not static but may differ due to internal and/or external variables in the context.

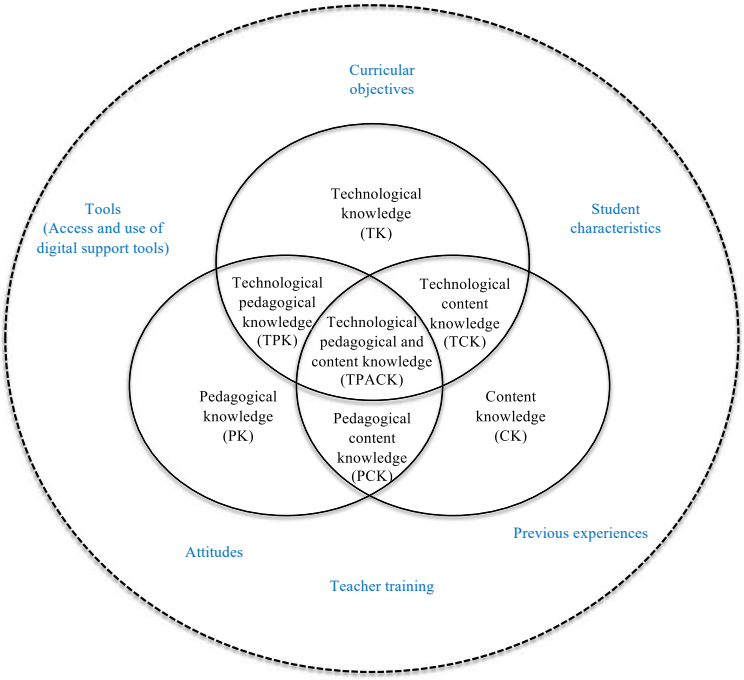

Figure 2. Description of TPACK knowledge and context-specific variables.

In recent years, interventions based on the TPACK model have been implemented for teacher training. Likewise, recent research has demonstrated the benefits of this model, which contributes to the development of teachers' digital competence, allowing them to adapt their educational planning to the pedagogical and social needs of the current context. This model, in turn, could be hybridised with other teaching models. For example, in the context of Physical Education, it has been hybridised with the Cooperative Learning model (Figure 3).

In this study, two experimental groups were analysed: experimental group 1 (EG1) developed a methodology based on the TPACK model and group tasks, and experimental group 2 (EG2) addressed a methodology based on the TPACK model and Cooperative Learning. The results confirmed the effectiveness of digital pedagogy based on the TPACK model for integrating new technologies into training processes. In addition, it was found that Cooperative Learning enhances these benefits. However, further studies are needed on the training of

Physical Education teachers in relation to the use of digital technology and its impact on the commitment of future teachers and subsequent learning.

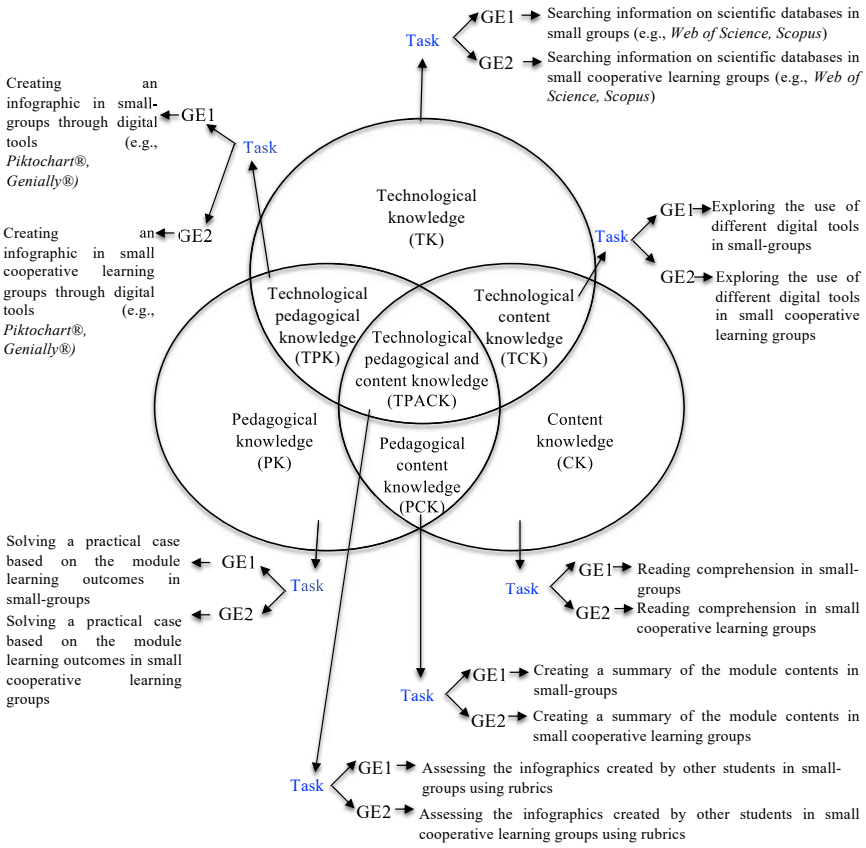

Figure 3. Example of initial training intervention for Physical Education teachers based on the TPACK model and the Cooperative Learning model.

3. Practical recommendations

Teacher training is key to professional teaching performance. Therefore, it is recommended that each teacher reflect on their training and professional performance in line with a transformative or holistic framework that addresses 'What to teach', 'What, how and why to teach', 'How and where to teach', 'Who to teach', and 'Why and to

whom to teach', in order to be critical and, in turn, to lead us as teachers towards improving our own practice.

It is clear that digital technology is increasingly present in curricula and in our daily lives. The Organic Law on the University System (LOSU) itself highlights the importance of training in digital competence. However, it is important that as Physical Education teachers, we understand that although technology has considerable power over the way we live and learn, we must continually reflect on its use.

In this regard, constant reflection is recommended on the development of digital competence in line with the elements of the curriculum, paying special attention to methodology as the backbone of the remaining ones. In this regard, the implementation of models such as TPACK (and even more so with cooperative tasks) could help us integrate digital technology into the teaching and learning processes in Physical Education, achieve curriculum objectives, and even promote healthy lifestyles. For the efficient application of this model, collaborative work between teachers is recommended in order to share good practices on how to integrate technology effectively.

4. Conclusions

The integration of digital technology into Physical Education curricula highlights the need to train teachers in digital competence for its proper incorporation into the teaching and learning process. Models such as TPACK play a fundamental role in the development of this competence, as they enable teachers to effectively integrate technology, pedagogy, and curriculum content. The inclusion of digital pedagogy not only responds to the demands of the current social and educational context, but also fosters comprehensive training beyond the classroom, promoting the appropriate use of new technologies, respect in the digital environment, and the adoption of healthy lifestyle habits.

In this chapter, we have presented various professional development models that identify key areas for teacher reflection, as well as the TPACK model, which facilitates the development of digital competence in educators. However, their effective implementation depends

on continuous training and a process of constant reflection by teachers. This will enable them to adapt their educational practice to the curriculum objectives, as well as to the specific needs of their students and the educational environment in which they work.

In short, teacher training based on scientific evidence is essential to respond to the current demands of the educational environment, ensuring that teachers can integrate technology effectively and reflectively, thus improving both their professional performance and student learning.

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Chapter 7

Consequences of the use of new technologies in the classroom

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Abstract

New technologies have emerged as a fundamental tool for the educational system. Each subject has different needs, objectives and methodologies, and in this case, greater emphasis will be placed on the subject of Physical Education. This is possibly the subject with the highest level of physical participation by students during most sessions, which is why, when entering the world of technology, it is necessary to be aware of the potential risks and opportunities that technological tools may present during their use. Virtual reality, augmented reality, wearables, sedentary lifestyles, and gambling addiction, are some of the topics to be covered throughout the chapter, informing teachers and parents about the possibilities and risks presented by the use of certain tools in and outside the school environment. Finally, some of the possible practical applications of the knowledge covered are discussed, with the main aim of raising awareness and improving critical thinking on the subject.

Keywords: Bullying; Gamification; Inclusion; Innovation; Sedentary lifestyles; Wearables.

1. Introduction

The contextualisation of the topic should begin with a clear definition of the concept of technology. It is understood as the set of theories and techniques by which existing things are transformed or combined to give them another function. It is also defined as the set of methods and tools that help to solve people's everyday problems effectively and more quickly. Originally, the concept of technology was linked to a mechanical approach, referring to physical tools and machines that helped the population in more physical work. Over time and with the advent of computers, technology began to be more closely associated with computing and digitisation, linked to data processing and communication. Throughout the 21st century, the concept of technology became popular as it began to be integrated into the daily lives of most of the population to improve connectivity, with the emergence of smartphones, tablets and social networks. In the last decade, the concept of technology has been absorbed by artificial intelligence and the automation of systems through different mathematical models such as neural networks, Bayesian models, and rule-based processes and expert systems. For all these reasons, it is difficult to define this concept as it is constantly changing alongside the evolution of society.

These advances have had a significant impact on education and have affected student training in education systems that initially included subjects dealing with manual tools and hardware. Over time, subjects such as IT, focused on basic computer use, were incorporated, and more recently, subjects such as Technology and Digitalisation or Computing and Robotics. This change responds to the need to prepare young people for a future dominated by digital technology. However, the creation of new subjects has not been the only change in the education system, as there have also been changes in methodology and teaching resources.

The old overhead projectors have been replaced by projectors, which in turn are being replaced by interactive digital screens. Different types of mobile applications and websites have also been included in many subjects, with the aim of incorporating new technologies

into classroom sessions. However, there is one subject with certain characteristics that differ from all the others, where students are not seated, and where the learning objective has a large physical, social, and practical component, and that is Physical Education (PE).

The integration of new technologies into PE has become a fundamental aspect of current educational practice, promising significant benefits, but also posing notable challenges. Through these technologies, educators are able to increase student engagement, personalise learning experiences, and promote healthier lifestyles. On the other hand, their implementation raises questions about dependence on a stable internet connection, data security, and student privacy. In addition, the excessive use of digital tools can affect the development of motor skills and students' attention span. That is why the aim of this chapter is to discuss the consequences of the use of new technologies in the classroom, with an emphasis on the subject of PE.

2. Benefits of using new technologies in the Physical Education classroom

Educational centres are places where students acquire knowledge and skills for their future development. To this end, in addition to transmitting theoretical concepts, school subjects seek to foster cross-curricular skills that promote better personal and social performance. In this context, the last decade has seen the promotion of the integration of new technologies and Information and Communication Technologies (ICT) with the aim of improving students' digital literacy, preparing them for an increasingly digitalised world. However, given that there are a large number of tools available, some of the most widely used are mentioned and briefly explained below.

Wearables are portable electronic devices such as watches, rings, activity bracelets, or headphones that are capable of recording positioning data, movement, or biometric variables, such as heart rate or temperature. These devices are commonly used by individual athletes, but their use at schools is becoming increasingly common. This is because they allow both students and teachers to measure and record

variables during Physical Education sessions. However, their accessibility remains a barrier for many educational centres due to their cost and the infrastructure required to manage the data obtained.

Mobile applications play a key role in the integration of technology in Physical Education, as they offer accessible tools for creating healthy habits, managing training, and gamifying learning. Google Fit, Strava, MyFitnessPal, Geocaching, and Kahoot!, enable the theoretical teaching of the subject to be more dynamic. These tools are available on mobile devices that students already own and are a more viable and economical alternative to wearables.

Virtual reality (VR) and augmented reality (AR) have begun to be implemented in education in recent years, although their adoption remains limited in most centres due to their cost and the need for specific equipment. In the case of VR, students are immersed in a virtually created space to simulate different spaces or see objects from different perspectives and interact with them. AR, on the other hand, superimposes images or text onto a real-world image by scanning an object or code with a device's camera and projecting an explanatory image about that object onto the screen.

The positive aspects of applying these technologies in the classroom, especially in Physical Education, which has special characteristics due to the layout of the classroom and the physical participation of students, are presented in the following sections.

2.1. Feedback and motivation

The integration of ICT in Physical Education classes has shown positive results among students, increasing participation, motivation, and accessibility, while improving the learning experience.

The inclusion of technology in Physical Education has shown potential for improving academic performance in this subject, although its effects largely depend on factors such as the methodology used and the context of application. One of the most notable benefits is the availability of multiple educational resources on a single device, facilitating access to support materials. In some cases, this makes students feel more comfortable using digital tools. However, this varies among

students and should be considered when using technology in conjunction with other pedagogical approaches.

An example of the use of technology in Physical Education is the recording of sports techniques. When the aim of the session is for students to learn how to perform a sports technique correctly, a demonstration by the teacher or another student provides essential feedback for their learning. In this case, if students record themselves, or if they have images of themselves from different angles while performing the technique, they will be able to learn by imitating a supposed perfect motor pattern, as well as modifying their technique to come as close as possible to that pattern, thus promoting self-learning. Furthermore, if students collect all the images throughout the period of time they spend learning, they will be able to observe their progress, as compared to how they performed at the beginning, and if they have to perform any technical correction exercises, they will be able to receive feedback on their own learning process. However, this process requires guidance from the teacher so that students can correctly interpret their mistakes and make effective adjustments.

With regard to motivation, the vast majority of studies mention student motivation as one of the main benefits of using ICT in the classroom. Among the reasons for this phenomenon, the regular use of digital devices by students has been observed, which can make certain activities more attractive to them. Most students enjoy video games, social media, and ICT, which is the reason why the closer the teaching processes are to things that attract their attention, the more attention they will pay to them. This means that throughout the course, programmes can be implemented in which rewards or progress are obtained on digital platforms similar to games, quizzes, or online competitions, based on problem solving or the achievement of objectives. However, motivation should not depend exclusively on the use of technology, but on factors such as student autonomy, meaningful learning, and interaction with the environment.

2.2. Individualisation and personalisation

Participation in classes is essential for acquiring knowledge and skills on each subject. Therefore, teachers must ensure that all students have all the tools they need to participate in each class. The most common reason for absence or exemption from Physical Education classes is medical, such as medical treatment or injury, but sometimes these conditions can last for long periods of time. Therefore, as with students with special educational needs, everyone must have the same opportunities to participate and learn in the sessions, ensuring that they are part of the group.

In these situations, educational technologies can facilitate the individualisation of learning and the adaptation of sessions. Studies have confirmed that the use of ICT can contribute to a more personalised approach to teaching, allowing students to record and analyse their progress according to their own limits, without falling into comparisons with their peers. In addition, in situations where diversity makes certain activities difficult, VR has shown potential as a complementary tool. Some research has pointed to its use in providing immersive experiences in sport, allowing students with reduced mobility to interact with simulated physical activity environments. Furthermore, VR-based exercises have been shown to increase participation and demonstrate potential improvements in muscle strength, cardiorespiratory fitness, balance, speed, and agility of people with physical and intellectual disabilities. These tools enable people with different educational needs to participate in activities safely and to transfer the skills they have acquired in the real world to virtually planned sessions.

2.3. Access to educational resources and tools

Teachers play a key role in teaching and integrating new technological tools to enhance student learning. Beyond the accumulation of theoretical knowledge, teaching practices that include the use of technologies can broaden learning possibilities and promote student autonomy. The inclusion of new technologies in the Physical Education classroom provides students with new tools that can help them solve problems.

Physical Education is an ideal subject for discovery learning, as it allows direct experimentation through movement and interaction with different technological resources. For example, students can use motion analysis apps to study their posture and technique in sports such as high jump or ball throwing, identifying areas for improvement and applying biomechanical principles. Another significant application is the use of digital tools for self-assessment and training planning. Using apps that record data such as heart rate, speed or endurance, students can interpret information about their own physical fitness and design improvement strategies based on scientific principles of sports training. In addition, they can compare their progress over time and reflect on the importance of acquiring healthy habits. These proposals will always depend on the technical capabilities of each centre, but the availability of online resources can offer accessible options to complement learning.

2.4. Data use and management

Technologies offer multiple benefits in Physical Education by facilitating data and document management for both teachers and students. Technologies have greatly simplified the process of accessing large amounts of data thanks to different types of centralised platforms. The use of systems such as virtual campuses allows for the creation of activities such as forums, debates, and group work, or a space where resources can be stored for students to use in class. Access to a large number of online resources can be an advantage, but it is essential to support students in selecting and validating this content.

In terms of sessions, technologies such as VR and AR offer new teaching possibilities. Teachers can design learning scenarios in simulated environments and make changes to the environment in which the activity will take place in advance, without the need to be physically present at the school, which facilitates planning and experimentation in different contexts. These technologies allow students to be placed in scenarios that encourage active exploration, problem solving and experiential learning. In addition, they can be particularly useful for teaching complex motor skills or situations that are difficult to replicate in the school environment, such as adventure sports, anatomy

applied to movement, or biomechanical analysis of the body in action. However, their use does not replace real physical practice but should act as a complement or a means to achieve learning objectives.

The use of devices such as wearables allows real-time data on student activity to be recorded, which can contribute to more personalised teaching. These devices allow teachers to record the intensity of physical activity at all times through the heart rate of all students, which facilitates learning about effort management, as well as the distance covered. This provides everyone with a tool that allows them to monitor activities without the intervention of the teacher.

Finally, this type of device would allow teachers to obtain information about students' physical activity outside the classroom, which could facilitate the proposal of complementary activities to promote healthy habits. In addition, it can be a very interesting tool not only for teachers, but also for parents who want to know how much physical activity their children are getting throughout the day. However, its use must respect the autonomy of students and ensure that data on their physical activity is collected with their knowledge and consent.

All this data managed and recorded before, during and after each session, enables teachers to plan more accurately by considering the abilities and needs of their students.

3. Risks and drawbacks of technology in the classroom

ICT can help and be beneficial in many ways, but its use also carries risks and negative effects if not implemented properly. The Programme for International Student Assessment (known as PISA) found that although the number of students classified as heavy users of ICT increased between 2009 and 2018, no significant positive effects on academic performance were observed, as the use of ICT can have negative repercussions on the teaching and learning process. For example, the use of smartphones in classrooms leads students to engage in activities unrelated to the lessons being taught, negatively affecting memorisation and comprehension, and taking up to 20 minutes to regain focus in class after participating in non-academic activities. This

affects both the students who engage in these activities and their classmates who are looking at the same screen. It is true that new technologies in the classroom are not limited to mobile phones, but these are the main devices used as, they are the medium for the applications used in the classroom.

The misuse and extensive use of the internet have also been linked to an increase in cyberbullying and intimidation, with 47.7% of children aged 6-10, 56.4% of children aged 11-13 and 59.9% of children aged 14-18 reporting that they have experienced it. In other words, a greater use of these devices with internet access increases exposure to cyberbullying, with the number of cases increasing with age due to the rise in smartphone ownership.

3.1. Challenges in implementing technologies in the classroom

One of the main challenges in integrating new technologies into the classroom is the existence of various barriers that can hinder their implementation. Although the availability of devices among students is increasing, there is still an access gap, especially when specific tools are required that depend on the school's budget or the purchasing power of families. This situation can create inequalities and limit the equitable participation of all students. In addition, some schools have restrictions on the use of devices in the classroom, whether due to regulations, concerns about distraction, or difficulties in managing usage time. This limits the possibilities for leveraging technology as a teaching resource.

One of the most accessible options for use in the classroom today is the mobile phone, a device with which students are familiar. However, its use is not without potential problems. In many cases, activities that have become commonplace, such as the use of web applications in the classroom, such as Kahoot!, are highly dependent on stable internet connections. The mobile networks of many schools are not usually able to support large numbers of devices connected at the same time, which, combined with an activity that is commonly programmed to have a time limit for responses, can lead to problems in its development. Furthermore, the configuration of different applications

is constantly changing, which may limit the number of users who can interact at the same time in a session or make configuration difficult. All these technical problems can disrupt lessons and frustrate both teachers and students.

3.2. Physical and social distancing

Over time, the use of technology in education has increased, sparking debates about its impact on social interaction among students. This is because there is a decline in the social interaction that is usually encouraged in the educational environment. This phenomenon is particularly relevant in subjects such as Physical Education, where collaboration and interpersonal communication have traditionally been key aspects. When students focus on a screen instead of actively participating and interacting with their peers, this can lead to social isolation and hinder communication and collaboration, which are essential in the school environment.

Interpersonal social interaction is essential in the educational development of students, and the use of technology in the classroom can have a positive or negative influence on their development. Through communication and collaboration in the classroom, children and adolescents learn to relate to their peers, family and friends, among others. While digital tools can facilitate communication and collaboration in virtual environments, their excessive or inappropriate use can reduce the quantity and quality of face-to-face interactions among students. Therefore, it is important that the integration of technology in education does not replace teamwork, debate and face-to-face interaction, but rather complements them in a balanced way.

Although it is true that new technologies have improved communication between people, deferred learning, and distance learning, this easiness also make these students feel more isolated than those who attend in person.

This lack of face-to-face interaction between students, or between students and teachers, can have a negative impact on the development of social skills and the formation of interpersonal relationships, which are essential aspects of personal development. Furthermore,

although the use of ICTs allows teaching to be adapted to the individual needs of students, it can also lead to a reduction in opportunities for socialisation when learning is based exclusively on individual activities. It is important that the integration of technology in education does not limit interaction between students but rather encourages collaborative methodologies that enable learning through observation, discussion and teamwork.

3.3. Sedentary lifestyle

The increased use of electronic devices in everyday life can have a negative impact on physical activity levels, especially among children and adolescents, which has also been the case in schools for a long time. In most schools, students spend approximately 70-75% of their school day sitting down, in addition to spending approximately 65% of their time sitting outside of school.

To reduce this sitting time during class, various studies have explored strategies such as combining periods of standing and sitting in the classroom or using furniture that allows students to alternate between both positions. These have been shown to be effective in reducing the amount of time students spend sitting, as well as being useful for improving their concentration. However, the use of certain technologies in education also poses challenges in this regard. Emerging technologies such as VR and AR have been promoted as immersive tools for learning in various subjects, including Physical Education. However, it is important to consider that the most immersive experience in sports practice is still real physical activity. In addition, their implementation presents barriers such as the high cost of equipment and the need to design appropriate virtual environments.

On the other hand, one of the main problems is how students use their free time at school. There has been an increase in the use of different types of devices such as gaming consoles, phones, and tablets, which are used during breaks between classes, thus displacing time that was commonly used for games or sports. This has led to a replacement of periods of moderate or intense activity with rest periods with low energy expenditure. This change contrasts with the recom-

mendations from the World Health Organisation (WHO), which recommends that children and adolescents engage in at least 60 minutes of moderate-intensity physical activity every day and at least 3 days a week of vigorous-intensity aerobic activity.

The prevalence of childhood overweight and obesity is on the rise in Spain, and a sedentary lifestyle is one of the main triggers, along with a poor diet. That is why various associations and institutions have warned about the impact of excessive use of electronic devices in children's leisure time, as it can encourage sedentary habits. In this regard, the WHO emphasises the importance of limiting the time spent on sedentary activities, especially screen-based leisure activities. This is why some Physical Education teachers do not consider it necessary to use technology in the classroom, as it can reduce the amount of active practice time.

3.4. Gambling addiction

Access to mobile devices by minors increases their exposure to different types of online content. Traditionally, gambling and betting have been practices exclusive to adults, but recent studies have revealed that adolescents are also beginning to have access to these environments. In 2020, it was estimated that 20.6% of Spanish adolescents gambled money on some type of betting game, the most common being sports betting. In addition, it was found that of children between the ages of 11 to 16 who participated in gambling, 0.9% had been classified as problem gamblers, and 2.4% were at risk of becoming problem gamblers.

However, entry into these behaviours does not always occur through conventional gambling but often begins within the digital ecosystem in which minors interact on a daily basis, including video games and educational applications. Elements such as microtransactions, loot boxes, and payment-based progression systems, have been identified as possible gateways to patterns of behaviour similar to those of gambling.

Behavioural addictions such as gambling, video games, internet use disorders, and excessive smartphone use, often begin in childhood and adolescence, and if not identified early, could persist

into adulthood. Furthermore, it has been observed that adolescents with gambling addiction and those with problematic video game use may share certain risk factors, such as impulsivity or the pursuit of immediate rewards.

However, while video game addiction is usually more related to the need for progression and competition within the game, in the case of gambling, the risks are strongly associated to the loss of control over finances within the game. A large number of games aimed at children have a significant element of chance and collectibles, often with an easy payment option, which could encourage a predisposition towards possible addictive gambling behaviour or irresponsible consumption in adulthood.

3.5. Teacher training and scope of application

One of the main problems in integrating technology into education is the lack of specific training for teachers. Technology is advancing at a rapid pace, and teachers often do not have enough time or resources to learn how to use new tools effectively. The implementation of technologies in the classroom requires not only technical knowledge but also adequate pedagogical training to design teaching strategies consistent with educational objectives. Without adequate preparation and training, teachers may be forced to integrate digital tools in a superficial manner, without a significant impact on student learning.

Furthermore, the integration of technologies in education has followed different approaches. In some cases, tools have been imposed without a clear alignment with pedagogical objectives, thus imposing the obligation of ICTs without considering whether or not they are appropriate for the educational needs of students. This implementation is often imposed by the administration, which designs general strategies without considering the diversity of cultural and economic contexts.

Access to technology varies according to geographical area and the socio-economic conditions of students. In some cases, the acquisition of devices and other digital resources falls to families, which can lead to inequalities when not all families can afford this investment.

This technological divide can manifest itself in isolation within a group of students or affect an entire school, depending on the region and the resources available. As a result, the differences between students who have access to technology and those who do not are widening, thus deepening the socioeconomic divide at schools.

On the other hand, new laws are emerging, as well as parents' associations that are against the use, or overuse, of technology in the classroom. In recent years, regulations have been passed to regulate the use of devices in schools, such as Article 22 of Law 5/2014 of 9 October on the Social and Legal Protection of Children and Adolescents in Castilla-La Mancha, which states that "Minors shall not keep mobile phones or other communication devices in operation at schools, except in cases expressly provided for in the school's educational project or in exceptional situations, duly accredited." Following this law, several communities opted to further tighten restrictions in order to reduce the use of these devices in response to arguments that young people should be educated in technology, but not in all subjects, as well as to meet the objective of reducing screen time. As a result of this law, several autonomous communities have decided to tighten restrictions on the use of devices at schools. These measures respond to a debate in which, on the one hand, the importance of young people acquiring digital skills is recognised, but on the other hand, it is considered that technology should not be present in all subjects or used indiscriminately. These regulations do not seek to ban technology in education, but rather to regulate its use to ensure that it is used for educational purposes and to avoid distractions in the classroom.

As for teachers' perceptions of technology, it is true that ICTs have facilitated tasks such as data collection and assessment. However, its constant evolution has generated uncertainty among some teachers, especially due to the rapid incorporation of new tools, such as artificial intelligence, whose development has grown exponentially in recent years. These technological changes can represent a barrier for teachers, especially in areas such as Physical Education, where the integration of ICT requires significant methodological adaptations. In addition, the continuous updating of tools and platforms can hinder in-

depth reflection on their implementation, which in some cases leads to superficial integration. When this occurs, technology becomes an ineffective tool, shifting away from its main purpose of improving the teaching-learning process and educational quality.

4. Practical recommendations

4.1. Strategies for integrating technologies in the classroom

The integration of technologies in the classroom should not focus solely on their availability, but on how their use contributes to improving teaching and learning processes. For ICT to be an effective tool, it is essential to design strategies that balance equitable access, digital safety, and the acquisition of technological skills. Below are some key recommendations for their implementation:

- **Pedagogical use of technological devices:** beyond the mere presence of technology in the classroom, its integration must be aligned with active methodologies such as project-based learning, gamification, or personalised learning. Devices (tablets, computers, digital whiteboards) should be used with a clear educational purpose, encouraging interaction, creativity and, critical thinking among students.
- **Ensuring technological equity and accessibility:** although it can be an expensive option, every school should have its own devices, such as tablets, mobile phones, computers or wearables. Having its own devices would allow the school to limit access with other devices to the facilities, without having to sacrifice the technological accessibility of the students. In addition, this would allow each school to control and limit access or browsing, as well as prohibit students from accessing certain web programs.
- **Digital literacy and responsible citizenship:** technology education should not be limited to the use of digital tools, but should include training in critical digital skills, such as information verification, online safety, and personal data

protection. Including these aspects in the curriculum helps to develop responsible digital citizens.

- **Parental control:** rather than a strict parental control approach, it is advisable to promote mediation and support in the use of technology. Workshops for parents on healthy digital habits, screen time management, and online risk prevention, can help reinforce a culture of responsible use inside and outside the classroom.

4.2. Teaching practices

The integration of technology into teaching requires teachers to be proficient in digital tools and know how to use them effectively to improve learning processes. Below are some key recommendations for teaching practice in technological environments:

- **Continuous training in digital skills and innovative methodologies:** it is a fact that technology is constantly evolving, so teachers must continuously update their skills. However, rather than focusing exclusively on specific digital tools, it is crucial that they acquire a broad understanding of digital skills, media literacy, and the use of active methodologies such as project-based learning, gamification, or personalised learning. In this way, each teacher will be able to develop their own tools, considering their needs and abilities. On the other hand, training in specific tools will provide ideas and different approaches, but these are unlikely to suit all groups or educational levels.
- **Selection and pedagogical use of applications and platforms:** technology in the classroom should be used with a clear purpose, not as an end in itself. To ensure its effectiveness, teachers should carefully evaluate the applications and platforms they use, ensuring that they are appropriate for the age, level of development, and needs of their students.
- **Balance between the use of technology and screen-free activities:** schools should encourage healthy habits in the

use of technology, ensuring that its integration into the classroom is balanced and beneficial to students' development. However, outside the academic environment, it is essential to encourage activities that do not depend on electronic devices, so schools should promote activities that stimulate movement, play, and socialisation. To this end, teachers can encourage the practice of sports, traditional games, and group activities that promote the development of social skills and the well-being of students.

5. Conclusions

New technologies are part of the daily lives of students and teachers both inside and outside the classroom. Therefore, it is essential to learn how to use technological devices and resources without creating dependency, allowing young people to see them as tools, understand their functions, and develop technological skills for the future. However, this should not involve excessive restrictions that limit students' development. To this end, it is essential that the educational community works together to guide students towards the appropriate and responsible use of new technologies.

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Chapter 8

Self-assessment of knowledge related to Physical Education through Learning and Knowledge Technologies

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Abstract

The use of digital tools in the teaching-learning process has accelerated in recent years. There are numerous options for designing resources with interactive and innovative approaches that can increase students' attention and motivation. In Physical Education, due to its motor nature, these resources are less present, although they can be an alternative for implementing self-assessment processes so that students can evaluate their level of knowledge of the basic skills covered in the curriculum during the school year. This chapter addresses the concept of Learning and Knowledge Technologies, discussing what they contribute to the teaching-learning process and, more specifically, their value in the assessment process. With regard to the existing repertoire of digital resources, the most common ones (Wayground, Plickers, Genially) are specified, along with their main characteristics. Wayground and Genially are discussed in greater detail, emphasising the inclusion of code in Genially slides, which allows for additional functionalities. Finally, a link to an editable Genially presentation is included as an example.

Keywords: Assessment; Extensions; Genially; Motivation; Digital resources.

1. Introduction

Learning and Knowledge Technologies (LKT) are digital tools, platforms, and resources, designed to facilitate the teaching-learning process, improve interaction, and promote collaboration between students and teachers. These technologies surpass access to information, as they focus on actively using technology to acquire knowledge, develop skills, and foster communication in educational contexts.

In the educational environment, LKT can be used for:

- **Personalise learning:** platforms such as Moodle, Khan Academy, and Google Classroom allow content to be tailored to the needs of each student.
- **Promoting collaborative learning**: tools such as Microsoft Teams, Padlet, and Miro facilitate teamwork and the exchange of ideas.
- **Improving communication:** applications such as Zoom or Meet enable synchronous communication, facilitating online classes and personalised tutoring.
- **Access to multimedia content:** resources such as YouTube, simulators and virtual reality enrich classes with visual and interactive content.
- **Interactive assessment:** technologies such as Kahoot!, Wayground (formerly Quizizz), Socrative, and Genially enable dynamic assessments with immediate feedback.

Integrating LKT into educational processes promotes meaningful, inclusive, and motivating learning, and the development of digital skills that are essential for the challenges of today's society. These tools are evolving at a rapid pace, and what is new at first becomes outdated in just a few years. The integration of Artificial Intelligence (AI) has been a giant step forward, triggering a whole process of adaptation to the correct and harmful uses of this technology.

The use of LKT in Physical Education grants them with a new value that differs from their usual use in other subjects. In this way, learning is enhanced, teaching is personalised, and students are connected to

a wider world of knowledge about physical activity. Their integration is key to making education in this area more inclusive, attractive and efficient.

Physical Education teachers also have other valuable resources at their disposal to enrich their teaching practices and promote meaningful learning in their students in terms of the development of basic skills, which differ from other subjects due to their motor component. Thus, there are tools that allow LKT to be integrated into activities with a marked motor component, beyond other more cross-curricular resources:

- **Interactive lesson design.** LKT enable teachers to design dynamic and interactive lessons. For example, videos can be used to teach sports techniques or analyse physical performance, and apps offer interactive games to analyse movement.
- **Monitoring and evaluating physical progress.** Digital tools, such as physical activity monitoring apps (RunKeeper, Strava, MyFitnessPal), are used to record data such as the number of steps taken, distance travelled, calories burned, and heart rate.
- **Augmented and virtual reality.** These technologies are emerging as an innovative tool for teaching knowledge related to physical and sports activities. With augmented reality, motor skills can be practised safely and enjoyably, while virtual reality allows students to participate in immersive sports simulations.
- **Global awareness and virtual competitions.** Platforms such as Strava Clubs and similar ones allow challenges and competitions to be organised between students from different educational centres or countries, fostering a healthy competitive spirit and promoting a global vision of physical activity.

1.1. The use of technologies for learning and knowledge as a self-assessment process

Assessment is a systematic process by which information is collected, analysed and interpreted in order to measure performance, quality, or the achievement of specific objectives. Among the different types of self-assessment, depending on the agents involved, we find

self-assessment, in which a person analyses their own performance, skills, or knowledge in order to identify strengths and areas for improvement.

LKT play a crucial role in self-assessment, a practice that promotes self-regulation, reflection and autonomous learning among students. Incorporating LKT into these processes enriches the educational experience by offering dynamic, accessible and customisable tools. There are several advantages to using LKT in a self-assessment process:

- **Immediate feedback:** platforms such as Wayground, Google Forms or Socrative allow students to receive instant results and analysis, identifying strengths and areas for improvement in real time.
- **Personalised learning:** through adaptive quizzes or interactive exercises, students can assess their knowledge in a personalised way according to their level of understanding and learning pace.
- **Promotion of autonomy:** LKT motivate students to manage their own progress and develop skills such as decision-making and academic goal planning.
- **Detailed analysis of results:** digital tools provide detailed information in a graphical format that facilitates the interpretation of results. This allows students to identify learning patterns and design strategies for improvement.
- **Motivation through gamification:** the inclusion of game dynamics and interactive elements, such as virtual rewards or leaderboards, makes self-assessment more engaging and fun.
- **Access to various assessment formats:** From multiple-choice questionnaires to interactive practical exercises or virtual simulations, LKT offer a variety of formats for assessing theoretical and practical skills.

The use of LKT in self-assessment encourages more reflective and engaged learning. They help students become aware of their own learning process, identify more clearly what they need to improve, and

develop strategies to achieve their educational goals. Furthermore, they promote a change in the role of the teacher, who is no longer solely an evaluator but becomes a facilitator who guides students on their path towards self-direction and continuous learning.

In conclusion, the integration of LKT into self-assessment is key to preparing students with the reflection and self-management skills that are essential for their academic and personal development.

In Physical Education, at any stage of education, it is necessary to consider the need to implement methodologies that enable functional and meaningful learning for student's everyday lives, based on motor activity. Teachers of this subject must strike an appropriate balance between the essence of the subject, movement, and the acquisition of learning by students, both practical and theoretical. However, the latter should, as far as possible, be based on motor experience. The decrees set out a series of basic knowledge related to specific content that requires a minimum level of knowledge to understand how to approach physical activity correctly, such as: myths and misconceptions related to physical activity; parts of the musculoskeletal system, identifying the main bones and muscles, as well as joints; exercises that work on the strength or flexibility of these muscle groups; proper body posture in everyday activities and sports; and ways to develop different physical abilities, among others.

There are various resources and approaches for working on this content. These range from text-based notes, which are not very attractive, to infographics, which present information in a more visual and appealing way. There are also textbooks from different publishers, although these are not commonly used in Physical Education.

2. Web applications for designing assessment resources

As of today, online assessments are an interesting tool for educational contexts, facilitating the measurement of knowledge, competences, and skills. There are multiple web applications that offer functionalities for the creation and administration of tests and

assessments. The use of one or the other will be based on the objectives set and the context of application. Over time, these evolve, and new applications appear, which requires continuous training and review.

These platforms, known for their gamified approach, have begun to integrate AI to improve personalisation, feedback, and task automation. In Kahoot!, AI can analyse response patterns to identify areas of difficulty for students, suggesting quizzes tailored to their needs. It also helps generate automatic questions based on the content covered by teachers.

Wayground uses AI to adapt the difficulty of questions based on student performance, promoting more personalised learning. It also allows users to generate detailed reports with predictive analytics to help teachers make more informed decisions.

At Genially, AI facilitates the creation of interactive presentations and games by automating design and generating content based on the educational context. This allows teachers to save time and improve the student experience. In addition, this tool incorporates the possibility of designing questions for assessment through AI, simply by entering a text indicating the topic of interest.

Some applications commonly used in the educational context are:

✓ Google Forms

This is a simple and free resource for creating tests. It allows users to add multiple-choice, true/false, or short-answer questions, among others. The results are collected automatically and can be analysed in Google Sheets, facilitating the quick evaluation of the results. In an educational setting, Google Forms is useful for creating automated quizzes with immediate grading, gathering feedback, or even managing event registration. Its ability to generate visual reports facilitates the analysis of responses and allows for the identification of learning patterns.

✓ Kahoot!

This platform is very popular in educational settings due to its interactive and gamified approach. It allows users to design quick quizzes and assessments that participants can answer in real time from any device connected to the internet. This tool has established itself as a key element in transforming learning into dynamic and meaningful experiences. In the educational environment, its impact lies in its ability to gamify sessions, motivate students and strengthen the teaching-learning process.

✓ Socrative

socrative

This is a digital platform that enables quick, interactive, and effective assessments through real-time quizzes, surveys, and exercises. Designed to improve the teaching-learning process, this tool facilitates the collection of student responses, providing immediate results that help to adjust and personalise teaching. In addition, the detailed analysis provided by Socrative drives immediate and effective feedback, promoting continuous assessment that motivates both teachers and students to optimise the educational process. One of the most interesting features of testing with this tool is the ability to view a table with participants' responses in real time, allowing teachers to track whether they are answering correctly or not based on colour (green for correct answers and red for incorrect answers).

✓ Wooclap

wooclap

This gamification tool allows teachers to ask the group questions using a variety of questionnaires, which students answer using a smartphone, tablet, or computer. The answers are displayed in real time, facilitating dynamic and participatory interaction in the classroom. One of its great advantages is the possibility of incorporating a visual presentation and including various questions about the content covered at any point in the slides. Instant answers allow teachers to obtain immediate feedback on students' understanding of the content, facilitating

real-time adjustments to teaching. It offers a variety of question types and activities (multiple choice questions, open-ended questions, surveys, among others), allowing teachers to diversify their teaching methodologies.

✓ Plickers

This is a tool that allows for quick and effective assessments without the need for students to use any electronic devices. Plickers is an application that facilitates formative assessment using printed cards with unique codes assigned to each student. Teachers formulate multiple-choice or true/false questions, and students respond by raising their cards in a specific orientation that indicates the selected answer. Using the camera on a mobile device, the teacher quickly scans the answers and obtains the results in real time.

The system stores the answers, allowing each student's performance to be tracked over time. In addition, it integrates with tools such as Google Classroom, making it easy to use in digital educational environments.

Physical Education presents a particular challenge in terms of assessment, as classes take place in open spaces and have a different dynamic to theoretical subjects. In this context, Plickers is a particularly useful tool due to its ease of use and ability to collect data quickly anywhere, without excessively interrupting the flow of the class.

✓ Wayground

A tool similar to Kahoot!, which allows both real-time mode and asynchronous testing. Its attractive visual design and reporting tools make it an excellent choice for measuring knowledge in a fun and effective way. Wayground is a dynamic and interactive tool for conducting online assessments thanks to its gamified approach. Two of its most attractive features, which stand out for making assessments fun and effective, are the customisation of memes and the use of boosters during the development of questions.

With regard to memes, it is possible to use a specific group of memes or activate the option to choose them at random. Personalised memes for correct and incorrect answers add humour and dynamism to assessments:

- For correct answers (Figure 1): memes can include messages of encouragement, humorous celebrations, or motivational images, positively reinforcing learning. It is advisable that they are related to the content covered in the resource. The system selects one or the other based on the library of memes designed specifically for the teaching intervention.

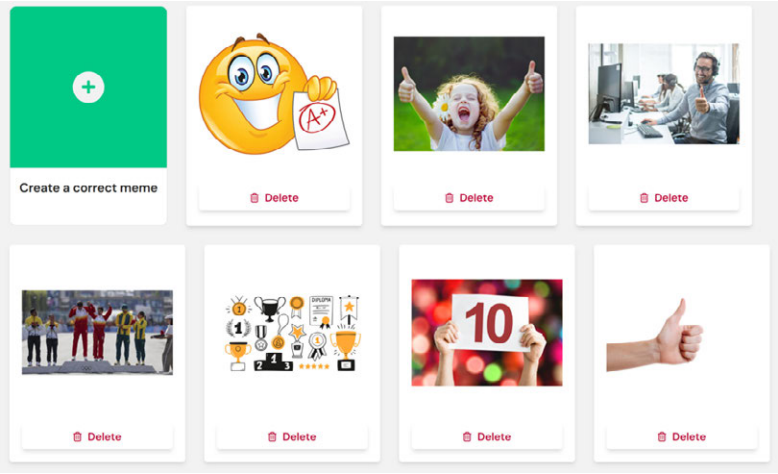


Figure 1. Memes designed for correct answers.

- For incorrect answers (Figure 2): these memes focus on keeping the player's spirits up, using a light-hearted and entertaining approach. Irony plays a very interesting role here. It is also advisable to look for a clear connection with the content being covered.

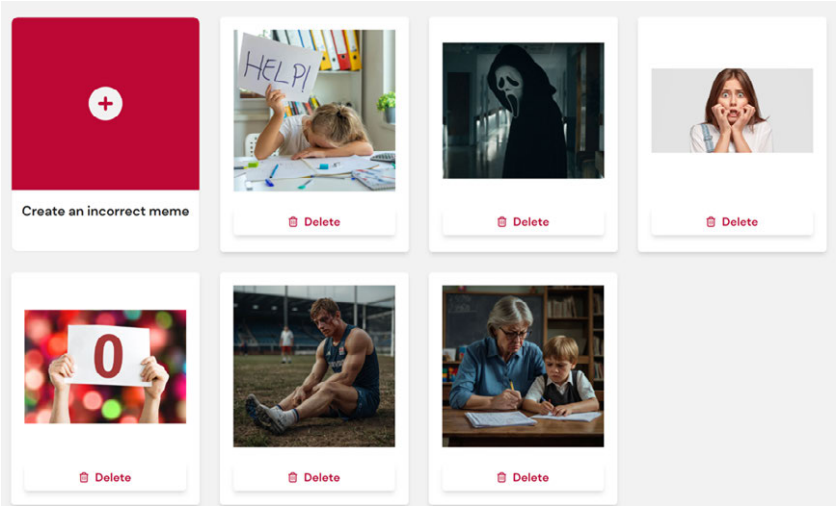


Figure 2. Memes designed for incorrect answers.

While answering questions, Wayground allows users to activate (if desired) boosters as a tool to add excitement and strategy to the game. These are elements that allow players to gain temporary advantages in the quiz, encouraging the use of planning and adaptability skills. If the booster's option is activated, it is necessary to inform students what they are and what advantages they have, as they can use them whenever they want. If this is not done, power-ups can be a barrier and a distraction. There are quite a few power-ups included, so it is necessary to create an infographic to help students the first time they have to use them. Some examples of these are:

- 50/50: eliminates two of the incorrect options, increasing the chances of choosing the correct answer.
- Double points power-ups: multiplies the points earned for a correct answer.
- Super speed: gives more time to answer questions or visually highlights the correct answers after selecting an option.

Table 1 shows the most commonly used boosters in Wayground.

Table 1. Wayground power-ups

Power-up	Icon	What is it for?
Supersonic		Players can get 1.5x the score for 20 seconds when they play at a faster speed
Streak Booster		Boosts the number in the player's streak counter
Gift		Players can send another player an extra score of 800
Double Jeopardy		Players get double the score if they choose the correct answer, but lose it all if they choose the wrong answer
2X		Players get twice the score for answering a question correctly
50-50		Eliminates half of the incorrect answer options
Eraser		Eliminate one wrong option

Another advantage of Wayground, which has also been implemented by other resources, is the use of QR codes for students to submit their answers, thus allowing assessment to be carried out without the need for a mobile device or computer. This makes it more functional for use in a Physical Education class.

✓ Genially

This is an online platform that allows users to create interactive and visual content in a simple and attrac-

tive way. Its main objective is to facilitate the creation of presentations, infographics, games, quizzes, microsites, and other visual resources without the need for advanced design or programming skills. Genially is widely used in education, business, and marketing, thanks to its ability to enrich communication and improve learning.

Main features of Genially:

- **Interactivity**: users can include interactive elements such as buttons, links, pop-ups, and transitions, to enrich the viewer's experience.
- **Pre-designed templates:** the platform offers an extensive library of editable templates that can be adapted to different purposes, such as education, sales, marketing, or storytelling.
- **Ease of use:** Genially has an intuitive drag-and-drop interface, ideal for both beginners, and advanced users.
- **Multiformat:** allows users to create various types of content, such as presentations, infographics, interactive posters, quizzes, and interactive videos.
- **Compatibility:** content created in Genially can be easily integrated into websites, blogs, and learning management platforms (such as Moodle), or shared via a link.
- **Real-time collaboration:** teams can work simultaneously on the same project, similar to other collaborative tools such as Google Drive or Canva.
- **Data analysis:** provides statistics on how users interact with content, allowing users to evaluate impact and adjust strategies.

Genially regularly adds new features to the platform. However, there are certain resources that cannot be implemented, although it is possible to insert code that allows users to customise and extend the functionality of designs using interactive elements, styles or *scripts* that are not available on the platform. These tools are particularly useful for creating educational breakouts, escape rooms, or complex interactive activities with automation and customisation beyond Genially's standard features. Figure 3 (left panel) shows a slide as it would

appear on screen (the text appears in typewriter format with a voiceover) when presenting the resource; while the right panel shows the internal structure of the slide with the inserted code.

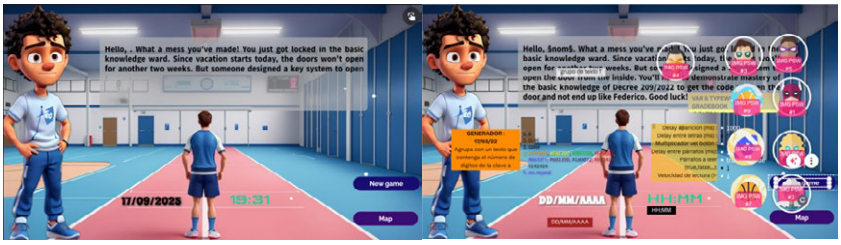


Figure 3. View of a slide as it appears when presenting the resource on screen (left) and internal design of the slide with code inserted to implement other features (right).

The different features can be accessed through different pages, from Genially presentations called "extensions":

- ProfevillaMates is known for creating interactive educational resources in Genially that integrate customised programming elements.

https://gamificacionvillamates.wordpress.com/

- Sandbox provides Genially users with various extensions to achieve features that improve the design of the resource.

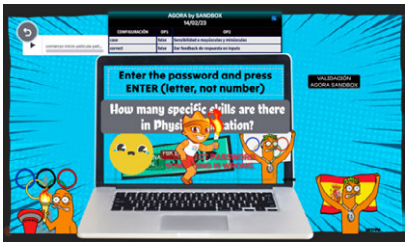
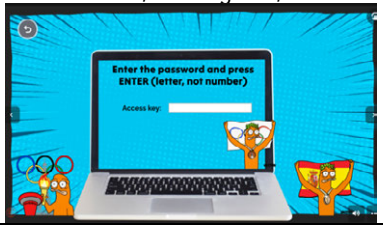
https://sandboxeducacion.es/recursos-genially/extensiones-genially

- S'cape for Genially is another set of tools created by the educational community to extend Genially's functionality.

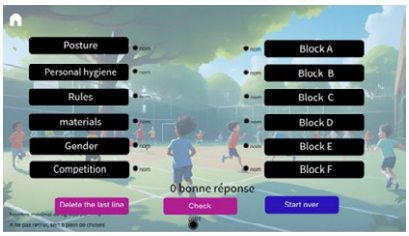
3. Examples of features that can be implemented with Genially

There are many extension options to further enhance Genially templates (Table 2). Here are some examples. A URL and QR code are also included to access a downloadable example. This is precisely one of the advantages of this application. The reusable option can be activated so that anyone can use it according to their needs, modifying anything they want.

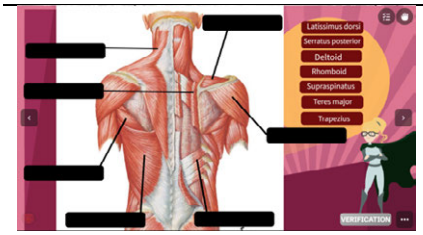
Table 2. Genially features

	Customisation of the presentation, including name, dates and times. In this way, the resource includes the student's name at the moment we want, thus customising a story we create to work on the content. Users can also insert timers to see how long it takes to complete the entire presentation or parts of it.
	Inclusion of keys to move on to the next slides. This can be done in two ways. Genially allows you to activate passwords to view a slide. In this case, you can insert text with a character limit, and the password must be entered to access the next page.
	On the other hand, using code via an extension, it is possible to implement the same action, but with a different format, giving it a more visual character, with images, GIFs, animations, moving text, etc. 

One of the tasks that can be implemented is selection in a specific order. Students are asked to click on each concept following a specific path, and if they are correct, it disappears. If they make a mistake, the system displays all the concepts again, and they must start from the beginning.
In addition, it can be configured so that the order of appearance is different each time.

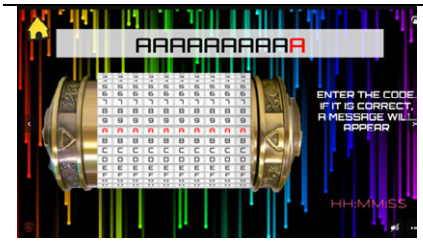


Linking with lines allows concepts to be related. This involves linking elements from both columns and once done, clicking on validate. The system indicates how many correct and incorrect answers there are, but without indicating which are correct and which are not. In this way, lines can be deleted to change the relationships, or the task can be restarted to try to find the correct answer.



On this slide, students must drag the names of the muscles to their correct location. Once in place, they click the check button, and the system will leave those that are correctly placed and return those that are not to the starting point.

There are several options for creating tasks that involve filling in gaps, either by typing the word in the corresponding box or selecting the word from a list. To check whether the chosen word is correct, students can insert images associated with each case. Finally, when all the answers are correct, they can display an icon that allows them to continue with the presentation.



There are different options for including codes that must be entered to move to the next page or obtain key information that helps answer a question in the presentation.
The format for entering the code varies.

Since there are many extensions and possibilities, a reusable presentation is included below that can be downloaded so that each person can modify it and adapt it to their needs, either by changing the content or modifying its structure (Figure 4). This proposal will integrate basic knowledge related to block A (Health and Active Living), block B (Organisation and Management of Physical Activity), and block C (Problem Solving in Motor Situations). From these three blocks, we will select the knowledge that requires greater theoretical knowledge for practical motor application with greater judgement (body posture, myths and false beliefs, physical abilities, etc.).

To move from one slide to another in Genially, there are different types of navigation that can be activated: standard, video, and microsite. In this proposal, the microsite one is used, which allows navigation using links that appear when the question or issue raised is answered correctly.

Let's Start!

https://view.genially.com/67ae31a573e01ae60b502a1e

Figure 4. Reusable presentation

4. Conclusions

The Physical Education subject uses movement as a basic element to develop a learning process focused on the acquisition of skills by students that allow them to self-manage appropriate physical and sporting activities from a physical, psychological, and social perspective. The educational curriculum includes knowledge that is more

theoretical in nature, and in order for students to know if they are developing it properly, digital applications can be used to design materials for self-assessment.

These applications, such as Wayground, Plickers, and Genially, stand out for their ease of use, accessibility, and adaptability to different contexts. When choosing one, it is important to consider the specific needs of the assessment: the type of test, the level of security required, and the data analysis needed. Scientific evidence indicates that the use of these technological tools increases students' motivation to perform the task at hand, showing a greater interest in it. It is very important to select the tool based on the needs and analysis of the educational context in order to design a resource that generates functionality in the self-assessment process, which will allow students to know what level of learning they have achieved at that moment.

These resources cannot become the main focus of Physical Education, due to its motor nature, but should complement the learning process, seeking high significance for students both in the content covered and in the aesthetic design.

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