FUTURITY Education

DOI: https://doi.org/10.57125/FED.2025.12.07

How to cite: Kanaros, D., & Bourdaniotis, P. (2025). The influence of digital fitness tools on high school students' physical activity and exercise. *Futurity Education, 5*(4), 121–137. https://doi.org/10.57125/FED.2025.12.07

The Influence of Digital Fitness Tools on High School Students' Physical Activity and Exercise

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Received: July 28, 2025 | **Accepted:** November 17, 2025 | **Available online:** December 9, 2025

Abstract: This action research study investigated the impact of digital fitness tools on adolescents' physical activity behaviours and perceptions through a five-month blended learning intervention conducted in a public Greek high school. The study aimed to explore whether a structured educational program, incorporating fitness apps and wearable devices, could effectively promote healthier activity patterns and more positive attitudes toward exercise. A total of 48 students (24 boys, 24 girls) from two randomly selected 10th-grade classes participated in the intervention. The program followed a single-cycle action research design consisting of planning, implementation, and reflection phases. Weekly sessions alternated between in-class instruction, physical activity in the schoolyard using digital tools, and synchronous online teaching via Webex. Educational materials were also uploaded to an asynchronous e-Class platform. Data collection involved a validated and culturally adapted questionnaire administered pre- and post-intervention to measure device usage, physical activity frequency, exercise attitudes, and app-related perceptions. Quantitative data were analysed using paired-sample t-tests and Cohen's d in SPSS,

with significance set at $p < 0.05$. Qualitative feedback was also gathered from collaborative projects and class discussions. Findings revealed a statistically significant increase in students' use of fitness apps and smartwatches, as well as a reduction in sedentary behaviour. Students reported more favourable perceptions of exercise, particularly regarding enjoyment, socialisation, and self-monitoring. The intervention demonstrated the value of integrating digital health tools into school curricula and emphasised the importance of combining technology with pedagogical strategies to sustain engagement. These results suggest that contextually grounded blended learning models can be effective vehicles for promoting active lifestyles among youth. Future research should examine long-term outcomes and adaptation across diverse school settings.

Keywords: digital fitness tools, physical activity, adolescents, action research, sedentary behaviour

Introduction

Physical inactivity represents a significant global health crisis, contributing substantially to the burden of non-communicable diseases and premature mortality. The World Health Organisation (WHO) identifies physical inactivity as a leading risk factor for conditions such as cardiovascular disease, type 2 diabetes, various cancers, depression, and dementia (WHO, 2023). Globally, an alarming proportion of adults (one in four) and adolescents (four in five) fail to meet the recommended physical activity guidelines (WHO, 2024). These guidelines emphasise the importance of at least 60 minutes of moderate-to-vigorous physical activity daily for children and adolescents aged 5-17. The consequences of this widespread inactivity are substantial, with an estimated five million deaths annually attributable to insufficient physical activity. Moreover, disparities in physical activity levels exist across genders, with women and girls often less active than their male counterparts, further exacerbating health inequities. While the benefits of regular physical activity are well-documented, translating this knowledge into sustained behaviour change remains a significant challenge. Modern lifestyles, increasingly characterised by sedentary behaviours and pervasive screen time, have contributed to a decline in physical activity levels, particularly among young people (Woessner et al., 2021). This trend raises a critical question: can technology, often implicated in promoting sedentary behaviour, be effectively harnessed to promote physical activity instead?

The rapid proliferation of digital fitness tools, including smartphones, smartwatches, activity trackers, and a myriad of fitness apps, presents a potential opportunity to address this challenge. These technologies offer a range of features that could make exercise more engaging, accessible, and personalised. Real-time tracking of exercise metrics, personalised goal setting, biometric feedback, and social connectivity are just some of the functionalities that could motivate individuals to become more active. Mobile fitness apps provide users with detailed information on calorie expenditure, distance covered, heart rate, sleep patterns, and other relevant health data, empowering them to develop structured and sustainable exercise routines (Fabbrizio et al., 2023). However, despite the growing popularity of these digital tools, the evidence regarding their long-term impact on physical activity behaviour and exercise adherence remains inconclusive. Some studies have shown promising results, while others have found limited or no effect.

Furthermore, there are concerns about the potential for technology dependence, the accuracy of self-reported data, and the equitable access to these technologies across different socioeconomic groups. This study aims to address these gaps in the literature by examining the influence of digital fitness tools on adolescents' physical activity participation and their perceptions of exercise. We hypothesise that a structured educational intervention promoting the effective use of these tools can lead to positive changes in both behaviour and attitudes.

Research Problem

Despite the proliferation of digital fitness technologies and their increasing use among adolescents, evidence regarding their effectiveness in fostering lasting behaviour change remains inconsistent. Some interventions report meaningful improvements in activity engagement, while others find minimal or short-lived effects. Moreover, little is known about how these tools function within real-life educational environments, particularly in school-based settings where structured support and peer influence may play key roles. There is still insufficient understanding of how personal factors, such as gender, digital skills, or economic background, shape adolescents' willingness or ability to engage with digital technologies. This highlights an urgent need for research that's rooted in real-world settings and focused on practical outcomes. Specifically, we need to explore how educational programs that use digital tools can impact not just physical activity levels but also students' thinking, feelings, and motivation. By conducting this study in an actual school environment, we hope to offer both meaningful insights and hands-on guidance to improve physical education programs and youth-focused public health efforts.

Literature Review

The role of technology in physical activity

Technology is playing a bigger role than ever in health and fitness, offering creative digital tools to get people moving and help reduce sedentary behaviour. From mobile fitness apps and wearables to online platforms, users can now track their activity, set personal goals, and get instant feedback on their progress (Gao & Lee, 2019). This ability to self-monitor is a key strength of digital fitness tools and has been shown to boost awareness and motivation to stay active. Studies also show that adding gamified elements, like step challenges, virtual rewards, or friendly competition, makes workouts more fun and increases commitment to regular exercise (Ozdamli & Milrich, 2023). By applying game design principles, gamification can make exercise more engaging and enjoyable, which may support lasting behaviour change. In addition, today's tech enables highly personalised fitness experiences tailored to individual needs and preferences (Liu et al., 2023). Apps like Google Fit, Apple Health, and Strava allow users to tailor workouts to their fitness levels, preferences, and goals. Wearable devices like Fitbit and Garmin provide real-time biometric feedback, such as heart rate and calorie expenditure, enabling users to optimise their training and track their progress over time. Studies have shown that these self-monitoring behaviours, facilitated by fitness trackers and apps, are associated with greater exercise engagement and adherence (Lewis et al., 2020).

Smart Technologies and Exercise Behaviour

The adoption of wearable technology and mobile fitness apps has significantly altered the way individuals approach exercise. The feedback mechanisms provided by these tools, including calorie counters, heart rate monitors, and step trackers, help individuals quantify their physical activity and set realistic and attainable goals (Shei et al., 2022). This data-driven approach to exercise can be particularly motivating for individuals who are new to physical activity or who struggle with traditional exercise programs. A study by Du et al. (2016) found that participants who used mobile interventions demonstrated greater adherence to exercise programs compared to those who used traditional fitness methods. The researchers attributed this increased adherence to the personalised feedback and support provided by mobile technology. In addition to self-monitoring, many fitness apps incorporate social features that foster a sense of community and accountability (Liu et al., 2024). Platforms like Nike Run Club, MyFitnessPal, and Samsung Health enable users to connect with friends, share their progress, participate in challenges, and receive encouragement. Research by Baig et al. (2023) revealed that users of fitness social networks reported higher levels of motivation and consistency in their exercise participation. The social aspect of these platforms can provide valuable support and encouragement, helping individuals stay on track with

their fitness goals. However, despite these potential benefits, concerns remain regarding user retention and the long-term effects of digital fitness tools. Studies suggest that the novelty effect of smart fitness devices can diminish over time, leading to decreased engagement and eventual abandonment of the technology (Shin et al., 2018). Furthermore, some individuals may develop an unhealthy dependence on technology, prioritising quantified metrics over the intrinsic benefits of exercise and potentially leading to obsessive behaviours (Chen et al., 2023).

Psychological and Physical Effects of Smart Exercise

Beyond their impact on behaviour, digital fitness tools can also have significant psychological effects. The ability to track progress and receive immediate feedback can enhance self-efficacy, the belief in one's ability to succeed in specific situations or accomplish a task (Tenenbaum et al., 2025). Seeing tangible evidence of their progress can reinforce positive behaviour and encourage individuals to continue their exercise routines. Research indicates that goal-setting features within fitness apps can help users develop a more positive relationship with exercise, leading to increased perceived control over their health and well-being (Yang & Koenigstorfer, 2021). By setting achievable goals and tracking their progress, individuals can experience a sense of accomplishment and empowerment. From a physical standpoint, real-time monitoring of physiological data and adaptive training recommendations can contribute to more structured and effective exercise routines (Zheng, 2021). Franklin et al. (2022) found that individuals who used innovative exercise interventions exhibited higher energy expenditure, improved cardiovascular health, and greater adherence to fitness plans than those who used conventional exercise methods. The real-time feedback and personalised recommendations provided by these tools can help individuals optimise their workouts and achieve better results. Despite the many benefits, using technology for exercise also comes with some downsides. Relying too heavily on metrics like step counts or calorie tracking can sometimes lead to obsessive behaviours or anxiety about meeting daily targets (Eikey, 2021). When people become too focused on the numbers, they might lose sight of the broader physical and mental benefits of staying active. There is also the issue of unequal access-people from lower-income backgrounds may not be able to afford premium fitness apps or smart devices, which can widen the gap in participation and create new barriers to healthy living (Fabbrizio et al., 2023). This digital divide raises important questions about fairness and access in tech-driven health programs.

On top of that, some devices and apps do not always provide accurate data, especially when it comes to things like how many calories you have burned (Dyrstad et al., 2014). Inaccurate feedback can lead to confusion and even reduce motivation. Finally, collecting and storing personal health data raises serious concerns about privacy and ethics that need to be carefully addressed (Mittelstadt et al., 2016).

Theoretical Frameworks for Understanding Technology and Exercise

Several theoretical frameworks can be applied to understand the relationship between technology and exercise behaviour. Social Cognitive Theory (Bandura, 1986) emphasises the role of self-efficacy, observational learning, and reinforcement in behaviour change. Digital fitness tools can enhance self-efficacy by providing users with feedback on their progress and demonstrating their capabilities. Observational learning can occur through social features in fitness apps, where users can observe and be inspired by others' achievements. Reinforcement can be provided through virtual rewards, badges, and positive feedback from the app or social network. The Theory of Planned Behaviour (Ajzen, 1991) suggests that attitudes, subjective norms, and perceived behavioural control influence intentions, which in turn predict behaviour. Digital fitness tools can influence attitudes by providing information about the benefits of exercise and tracking progress. Subjective norms can be influenced by social features in apps, which enable users to connect with others and receive social support. Perceived behavioural control can be enhanced by providing users with the tools and information they need to engage in exercise. Self-

Determination Theory (Ryan & Deci, 2000) posits that individuals are motivated by autonomy, competence, and relatedness. Digital fitness tools can promote autonomy by allowing users to choose their own exercise routines and set their own goals. They can enhance competence by providing feedback on progress and offering personalised recommendations. Relatedness can be fostered by social features in apps, allowing users to connect with others and share their experiences.

The Adolescent Context

Adolescence is a critical period for establishing healthy habits, including regular physical activity. However, this age group is also particularly susceptible to the influences of technology and social media. Understanding the specific needs and motivations of adolescents is crucial for designing effective interventions that leverage digital fitness tools. Research suggests that adolescents are more likely to engage in physical activity if it is enjoyable, social, and aligns with their interests (Telford et al., 2016). Digital fitness tools can be tailored to meet these needs by incorporating gamification, social features, and personalised recommendations.

Furthermore, adolescents often rely on peer influence and social norms when making decisions about physical activity. Fitness apps that let users connect with friends and participate in group challenges can tap into this social dynamic to promote greater engagement. However, it is also important to be mindful of the potential adverse effects of social comparison and peer pressure, which can sometimes lead to body image concerns and unhealthy exercise behaviours.

Gaps in the Literature and the Present Study

While the existing literature provides valuable insights into the role of technology in promoting physical activity, several gaps remain. More research is needed to understand the long-term effects of digital fitness interventions on exercise behaviour and adherence. Studies examining the effectiveness of different types of interventions, such as self-monitoring versus social support, are also needed. Furthermore, there is a need for more research that explores the psychological and social factors that influence adolescents' engagement with digital fitness tools and their impact on exercise behaviour. The present study aims to address these gaps by investigating the impact of a structured educational intervention promoting the use of digital fitness tools on adolescents' physical activity participation and their perceptions of exercise. Specifically, this study will examine changes in exercise-related behaviours, attitudes towards exercise, and perceptions of the benefits of fitness apps before and after intervention. The study will also explore the influence of these tools on the frequency and intensity of physical activity, as well as on participants' psychological and physical well-being. By addressing these research questions, this study will contribute to a more comprehensive understanding of how emerging technologies influence health behaviours and inform the development of effective public health policies and interventions to promote physical activity among adolescents.

Materials and Methods

This study employed an action research methodology in a school setting, following a single-phase intervention cycle comprising initial planning, implementation, and reflection/feedback. The intervention was designed as a blended-learning program to promote the use of digital fitness tools among adolescents, aiming to foster awareness and encourage healthier physical activity behaviours.

The participants were 48 students (24 boys and 24 girls) from two randomly selected first-grade high school classes (Grade 10) in a public secondary school in Greece. No inclusion or exclusion criteria were applied. All students were invited to participate, and parental/guardian informed consent was obtained for all minors involved through signed declarations. Anonymity and confidentiality of responses were strictly

preserved throughout the study. The school administration approved the intervention in accordance with relevant ethical guidelines for school-based educational research.

The intervention lasted seven months, beginning in October and ending in April. It began with a pre-test phase in which students completed a structured questionnaire to assess their initial attitudes and behaviours towards physical activity and digital fitness tools. Following this, an introductory theoretical lesson was conducted to present core concepts, including the history and functionalities of sports applications and pedometers.

The educational program followed a blended learning format, with weekly sessions alternating among three different modes: in-class instruction, schoolyard physical activity sessions, and synchronous online lessons via the Webex platform. Complementing the live sessions, a digital classroom (e-Class) hosted weekly educational materials for asynchronous study, with an expected study duration of approximately 30 minutes per week.

In the classroom and online sessions, students were taught theoretical concepts and completed collaborative group tasks, either face-to-face or via Webex. Each week, a new group project was assigned to reinforce learning. During schoolyard sessions, students engaged in physical activities using smartphones, tablets, and smartwatches, applying the skills and knowledge gained from the theoretical instruction. This structure aimed to bridge theoretical understanding with real-world application, ensuring experiential learning and peer collaboration.

The primary research instrument was a structured questionnaire that included both validated and custom-developed items. The questionnaire was adapted from a previously validated tool developed by Valach et al. (2020), which examined the effects of a project using mobile applications and pedometers on adolescents' exercise perceptions. It consisted of 28 items covering five domains: (1) device ownership and app use, (2) frequency and intensity of physical activity, (3) attitudes toward exercise, (4) perceptions of exercise app benefits, and (5) intentions for future activity. The items employed a combination of dichotomous (Yes/No) and Likert-type response formats (e.g., 5-point scales from “Strongly Disagree” to “Strongly Agree”). Where necessary, wording adjustments were made to fit the linguistic and cultural context of Greek high school students, ensuring clarity and relevance.

Data analysis was conducted using SPSS software (version 25). To evaluate the impact of the intervention, paired-sample t-tests were performed comparing pre- and post-intervention scores across all measured variables. Effect sizes were calculated using Cohen’s d to assess the practical significance of observed changes. The statistical significance level was set at $p < 0.05$. Assumptions for parametric testing were considered acceptable given the sample size and data structure.

This methodological approach ensured alignment with the principles of action research, emphasising contextual relevance, reflective practice, and active participation. The integration of blended learning elements, combined with both theoretical and experiential instruction, aimed to enhance student engagement and the potential for meaningful behaviour change. The design also prioritised reproducibility, providing clear documentation of procedures, timelines, and instruments to enable future implementation in similar educational settings.

Results

This section presents the results of the paired-samples t-tests conducted to examine the impact of the educational intervention on students’ use of digital fitness tools, physical activity behaviours, and related perceptions. Effect sizes (Cohen’s d) are reported alongside significance levels to assess the

practical importance of the observed differences. Figures accompanying the tables help visualise the main trends.

Device Usage and Behavioural Changes

The data analysis revealed a series of interesting findings regarding the impact of the educational intervention on the use of digital fitness tools and participants' behaviour. As expected, the use of smartwatches and exercise apps increased significantly after the intervention. The increase in smartwatch use was statistically significant ($t = 2.14$, $p = 0.04$) and was associated with a small-to-moderate effect size (Cohen's $d = 0.45$), suggesting that the intervention encouraged students to integrate these devices into their daily routines. The use of exercise-related apps also increased significantly ($t = 2.30$, $p = 0.03$) with a moderate effect size ($d = 0.47$), indicating a shift from occasional to more consistent usage.

Although smartphone ownership and activity tracker use did not reach statistical significance ($p = 0.16$ in both cases), the observed effect sizes were small ($d = 0.29$), suggesting a mild trend toward increased adoption. Overall, these results suggest that the intervention led to measurable behavioural changes in students' engagement with digital fitness technologies, particularly in tools perceived as multifunctional or gamified, such as smartwatches and mobile apps.

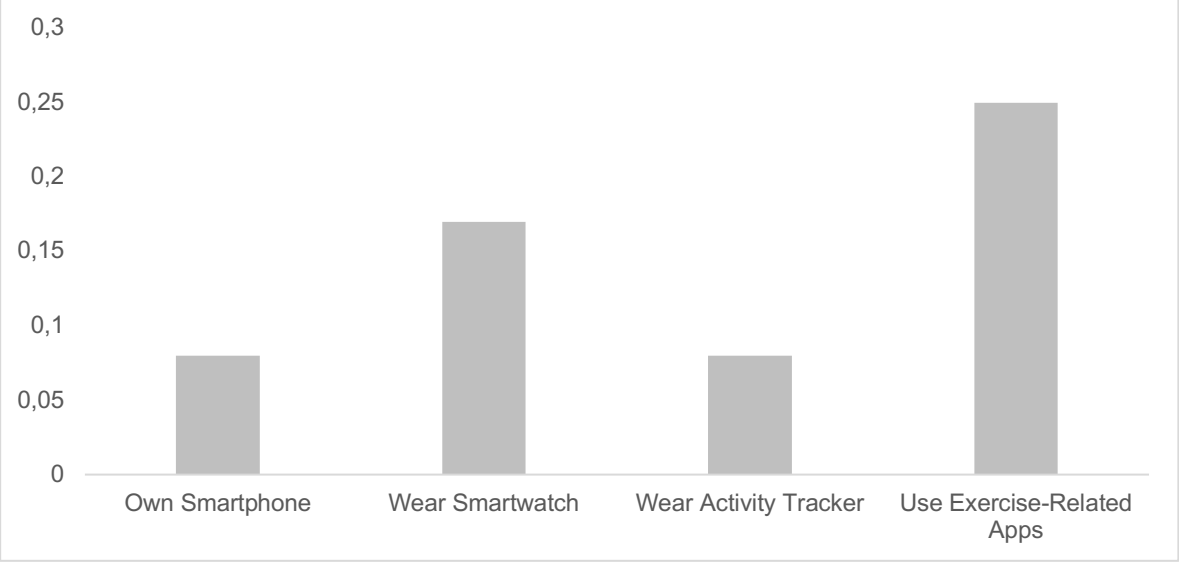
Table 1

Paired differences for device usage

Variable	Paired Differences				t	Sig. (2 tailed)	Cohen's d
	Mean	Std. Deviation	Std. Error Mean				
Do you own a smartphone?	0.08	0.28	0.06		1.45	0.16	0.29
Do you wear a smartwatch?	0.17	0.38	0.08		2.14	0.04	0.45
Do you wear an activity tracker?	0.08	0.28	0.06		1.45	0.16	0.29
Do you use exercise-related apps on your smartphone or smartwatch?	0.25	0.53	0.11		2.3	0.03	0.47

Figure 1

Changes in the Use of Digital Fitness Tools Before and After the Intervention



Frequency and Quality of Physical Activity

Despite the increased use of digital fitness tools, the intervention had a mixed impact on physical activity behaviour. The frequency of exercise app use showed a trend toward an increase, although not statistically significant (t = -1.79, p = 0.09), with a small effect size (d = 0.37). Likewise, no significant changes were detected in exercise intensity (t = 0.43, p = 0.67, d = 0.09) or the variety of physical activities performed during the week (t = 0.00, p = 1.00, d = 0.00), indicating that overall physical activity levels remained stable.

However, a notable finding was the statistically significant reduction in sedentary behaviour (t = -2.39, p = 0.03), accompanied by a moderate effect size (d = 0.49). This suggests that even though participants may not have increased their overall exercise, they did spend less time sitting, which is an important outcome for public health. The intervention therefore contributed to reducing sedentary time, even if it did not significantly enhance active behaviour.

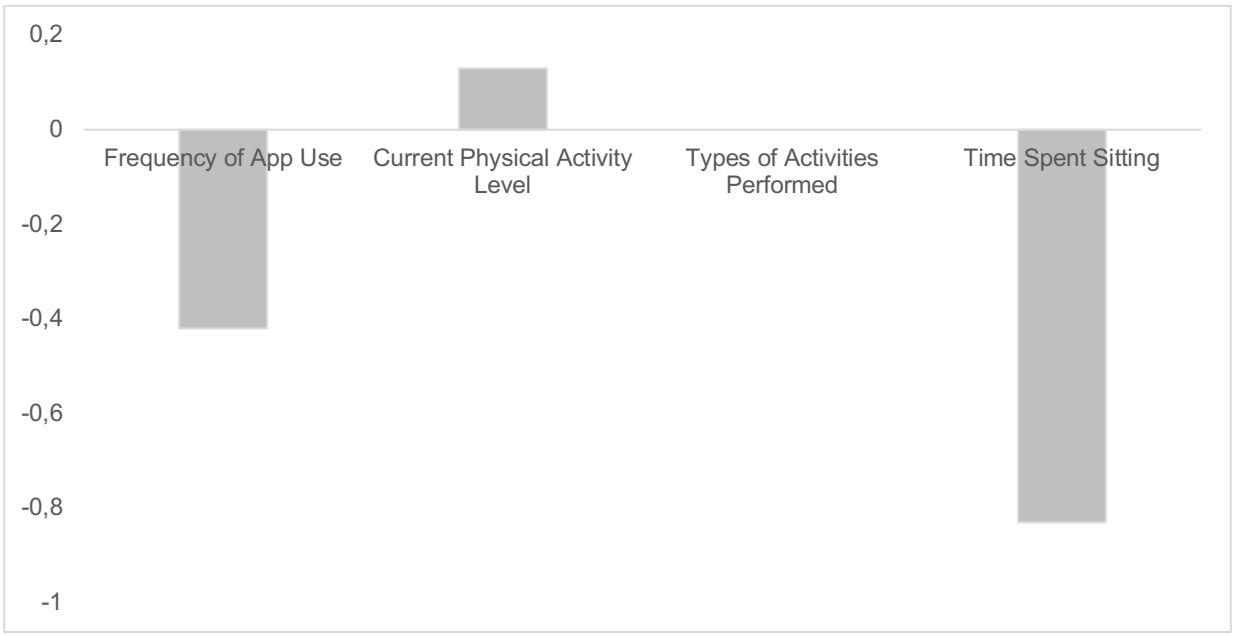
Table 2

Paired differences for physical activity changes

Variable	Paired Differences			t	Sig. (2-tailed)	Cohen's d
	Mean	Std. Deviation	Std. Error Mean			
If yes, how often do you use such apps?	-0.42	1.14	0.23	-1.79	0.09	0.37
Which of the following best describes your current physical activity?	0.13	1.42	0.29	0.43	0.67	0.09
During the last 7 days, which of the following physical activities did you engage in at school, during transportation, or elsewhere?	0.00	0.83	0.17	0.00	1	0.00
During the last 7 days, how much time did you spend sitting on a typical day? (e.g., at home, at school, with friends, watching TV – sleep is not included).	-0.83	1.71	0.35	-2.39	0.03	0.49

Figure 2

Changes in Physical Activity Indicators After the Intervention



Attitudes Towards Physical Activity

The intervention did not lead to any meaningful shifts in students' attitudes toward physical activity. Their enjoyment of sports and exercise stayed about the same (t = 0.77, p = 0.45, d = 0.16), as did their belief in the health benefits of being active (t = 0.20, p = 0.85, d = 0.04). Likewise, there was no noticeable change in the proportion of students who found physical activity boring or unpleasant (t = -0.32, p = 0.75, d = 0.06).

Overall, these consistently small effect sizes suggest that the students' core attitudes toward physical activity remained unchanged. This highlights how difficult it can be to shift deeply held beliefs or emotional responses through short-term educational efforts.

Table 3

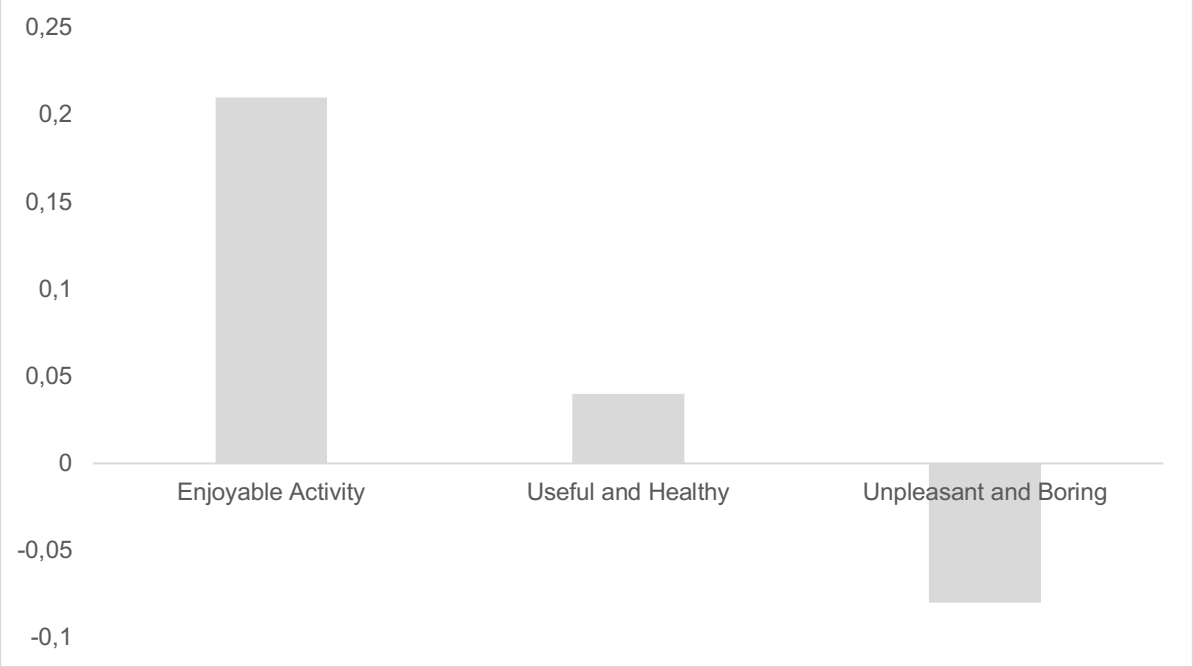
Paired differences for attitudes towards physical activity

Variable	Paired Differences			t	Sig. (2 tailed)	Cohen's d
	Mean	Std. Deviation	Std. Error Mean			
Participating in sports and physical activities (such as walking and running) most days of the week in my free time is an enjoyable activity for me.	0.21	1.32	0.27	0.77	0.45	0.16
Participating in sports and physical activities (e.g. walking, running) most days of the week in my free time is a useful and healthy activity for me.	0.04	1.04	0.21	0.2	0.85	0.04

Participating in sports and physical activities (e.g. walking, running) most days of the week in my free time is an unpleasant and boring activity for me.	-0.08	1.28	0.26	-0.32	0.75	0.06

Figure 3

Changes in Attitudes Towards Physical Activity Before and After the Intervention



Perceptions of the Benefits of Exercise Apps

In contrast to the limited change in general attitudes toward physical activity, participants' perceptions of the benefits of exercise apps showed a marked improvement after the intervention. Significant increases were observed in beliefs that apps help make exercise more enjoyable and playful ($t = 3.39$, $p = 0.000$, $d = 0.69$), facilitate participation in organised sports ($t = 2.85$, $p = 0.01$, $d = 0.58$), and improve physical condition ($t = 2.98$, $p = 0.01$, $d = 0.61$).

Moreover, social aspects of app use were strongly enhanced: participants increasingly believed that apps help them share performance and become more sociable ($t = 4.53$, $p = 0.00$, $d = 0.92$) and more extroverted ($t = 4.76$, $p = 0.00$, $d = 0.97$). The most pronounced effect was observed in the perception that apps can help with weight control ($t = 5.13$, $p = 0.00$, $d = 1.05$), while the belief that apps can link nutrition with exercise also improved significantly ($t = 2.66$, $p = 0.01$, $d = 0.54$).

Even though the intention to engage in physical activity did not significantly increase ($t = 0.86$, $p = 0.40$, $d = 0.18$), the moderate-to-large effect sizes on perceptions suggest that the intervention successfully reshaped participants' beliefs about the usefulness of digital tools in supporting various aspects of a healthy lifestyle.

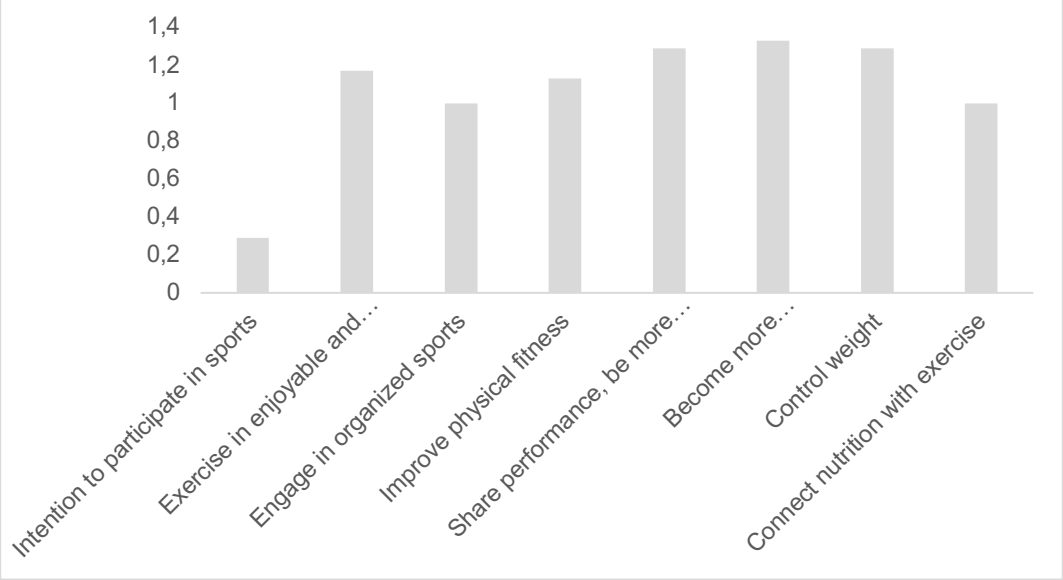
Table 4

Paired Differences for perceptions of fitness app benefits

Variable	Paired Differences			t	Sig (2 tailed)	Cohen's d
	Mean	Std. Deviation	Std. Error Mean			
I intend to participate in sports and physical activities (e.g. walking, running) most days of the week in my free time.	0.29	1.65	0.34	0.86	0.4	0.18
I believe that using exercise apps will help me exercise in an enjoyable and playful way.	1.17	1.69	0.34	3.39	0.000	0.69
I believe that using exercise apps will help me engage in organized sports activities (in clubs or associations).	1	1.72	0.35	2.85	0.01	0.58
I believe that using exercise apps will help me improve my physical fitness.	1.13	1.85	0.38	2.98	0.01	0.61
I believe that using exercise apps will help me share my performance with others and become more social and extroverted.	1.29	1.4	0.29	4.53	0.000	0.92
I believe that using exercise apps will help me become more social and extroverted.	1.33	1.37	0.28	4.76	0.00	0.97
I believe that using exercise apps will help me control my weight.	1.29	1.23	0.25	5.13	0.00	1.05
I believe that using exercise apps will help me connect nutrition with exercise to improve my physical condition.	1	1.84	0.38	2.66	0.01	0.54

Figure 4

Changes in Participants' Perceptions of the Benefits of Exercise Apps Before and After the Educational Intervention



Discussion

This study examined the impact of an educational intervention on adolescents' use of digital fitness tools and their physical activity behaviours. The key findings from the study are as follows: (1) a notable increase in the use of smartwatches and exercise apps, (2) a slight but non-significant rise in how often students exercised, (3) a significant drop in sedentary time, (4) no major shift in attitudes toward physical activity, and (5) improved views on the usefulness of exercise apps.

The increases in smartwatch and app usage (Cohen's d = 0.45 and d = 0.47) align with earlier research indicating that digital tools can raise awareness and support self-monitoring of activity. For example, studies by Gómez-Cuesta et al. (2024) and Chen et al. (2024) found that introducing students to platforms like Strava, MapMyWalk, and smartwatch features boosts their engagement with health tech. These results back up the current findings, highlighting how educational programs-especially those that include gamification and personalised feedback-can promote the adoption of digital fitness tools.

However, despite this rise in tech use, students did not significantly increase the frequency with which they exercised. This mirrors findings from Wang et al. (2024), who reported that while mHealth apps help people track activity, they often fall short of actually increasing physical activity. Similarly, Shin et al. (2019) noted that using apps alone rarely leads to lasting behaviour change unless other motivational supports are in place. Factors like low internal motivation, lack of confidence, or limited social encouragement may be getting in the way. In short, while technology can provide the tools, it does not necessarily inspire the drive to use them consistently.

In contrast, a significant reduction in sedentary time ($t = -2.39$, $p = 0.03$, $d = 0.49$) was observed. This is particularly noteworthy, as it suggests that even without engaging in more structured exercise, participants may have adopted minor behavioural adjustments - such as standing more frequently, walking short distances, or using reminders and prompts from apps to interrupt prolonged sitting. Prior studies (e.g., Domin et al., 2022) support this interpretation, showing that digital interventions often have a more substantial immediate effect on reducing sedentary behaviour than on increasing exercise duration or intensity. The distinction between reducing inactivity and increasing activity is crucial; the former may be a more attainable initial behavioural shift for adolescents, especially within a school context.

Another important finding was the stability in participants' attitudes toward physical activity. There were no significant changes in the perceived enjoyment, usefulness, or unpleasantness of sports. This suggests that deeply held beliefs or emotional responses toward exercise may be resistant to change, especially over a short intervention period. Previous research has emphasised that altering attitudes requires targeted affective strategies, peer modelling, and more prolonged exposure (Vander Ploeg et al., 2020). Therefore, future programs may need to go beyond informational content and focus on affective and social influences to reshape attitudes.

In contrast, perceptions regarding the benefits of fitness apps significantly improved across multiple dimensions, including playfulness ($d = 0.69$), organised activity ($d = 0.58$), physical condition ($d = 0.61$), socialisation ($d = 0.92–0.97$), and weight control ($d = 1.05$). These findings point to a clear shift in how students view the potential of digital tools to support their health-related goals. Even though these changes have not yet translated into more frequent exercise, they may represent a crucial preparatory stage for future behaviour change, as described in models such as the Transtheoretical Model (Prochaska & Velicer, 1997).

A key paradox revealed by the results is the divergence between sedentary time and exercise frequency. While students significantly reduced their sitting time, they did not report exercising more frequently. This discrepancy might reflect a behavioural reality among adolescents, in which small

increases in physical activity (e.g., standing, short walks) are more realistic and achievable than committing to structured workouts. This insight highlights the importance of designing interventions that respect adolescents' lifestyle constraints and motivation levels, promoting incremental change rather than significant shifts.

Limitations

Several limitations must be acknowledged. First, the sample size was relatively small, which limits statistical power and generalizability. Second, the measurement interval was short, possibly too brief to capture long-term behaviour change or the delayed effects of perception shifts. Third, data were self-reported, introducing potential bias due to inaccurate recall or social desirability. Finally, the study lacked objective tracking (e.g., step counters or heart rate monitors), which would have provided more robust measures of physical activity and sedentary time.

In conclusion, the educational intervention successfully increased adolescents' engagement with digital fitness tools and improved their perceptions of these tools' benefits, particularly in social and self-regulatory functions. However, changes in actual physical activity behaviour were limited, with the notable exception of reduced sedentary time. Future interventions should aim to combine digital engagement with motivational, social, and emotional support to translate awareness into sustained physical activity better.

Conclusions

This study set out to explore how an educational intervention could influence adolescents' use of digital fitness tools and the impact on their physical activity habits, perceptions, and attitudes. The findings offer valuable insights into how technology-based health promotion can support youth engagement with physical activity.

One of the most promising outcomes was the noticeable increase in the use of smartwatches and exercise apps among participants. This shift highlights the potential of digital tools to boost self-monitoring and raise awareness around healthy behaviours. However, this increased engagement with technology did not lead to a significant rise in how often students exercised, suggesting that simply introducing or providing access to these tools is not enough on its own. Behavioural change likely depends on deeper psychological and social factors, such as motivation, self-confidence, and encouragement from peers or adults.

Interestingly, the intervention succeeded in reducing the time students spent sedentary. While they may not have exercised more frequently, they were more likely to break up long periods of sitting, possibly influenced by real-time feedback and reminders from the devices. This distinction between reducing inactivity and increasing activity sheds light on the complexity of adolescent behaviour and should be considered when designing future programs.

Although students' overall attitudes toward physical activity remained unchanged, they did report more positive views of fitness apps, particularly regarding their benefits for improving fitness, managing weight, and staying socially connected.

These perception shifts, although not yet translating into behavioural change, may lay the psychological groundwork for future improvements in activity levels.

From a practical standpoint, these findings suggest that schools and physical education programs can play an essential role in integrating digital tools to foster health awareness. Educators and public health practitioners should not only introduce adolescents to these technologies but also embed them in broader pedagogical strategies that cultivate motivation and promote long-term habit formation.

However, several methodological limitations must be acknowledged. The sample size was relatively small, reducing the generalizability of the findings. The short duration between pre- and post-intervention assessments may not have been sufficient to capture long-term behaviour changes. Moreover, reliance on self-reported data introduces the possibility of recall bias and social desirability effects. The lack of objective tracking tools, such as step counters or accelerometers, limits the precision of the measured outcomes. Future research should address these limitations by adopting longitudinal designs, incorporating control groups, and using objective physical activity tracking.

In summary, this study contributes to the understanding of how digital fitness tools can be integrated into adolescent health promotion strategies. It highlights both the promise and the limitations of educational interventions. It offers practical insights for educators and public health stakeholders seeking to promote more active and less sedentary lifestyles among youth.

Suggestions for Future Research

Future research should investigate the long-term impact of digital fitness tools on adolescents' behaviour, particularly whether initial benefits such as reduced sedentary time are sustained over extended periods. Longitudinal studies with multiple follow-up measurements could provide insights into the persistence of behavioural changes and whether ongoing support or reinforcement is necessary to maintain engagement.

Additionally, future studies could explore comparative effectiveness among various digital interventions, such as smartphone applications, wearable fitness trackers, and simple pedometers. Evaluating which tools are most effective in promoting exercise frequency, improving physical condition, and reducing sedentary behaviour can help tailor interventions to different needs and settings.

Moreover, future research should incorporate objective tracking measures-for example, data from step counters or heart rate monitors-rather than relying solely on self-reported measures, which are susceptible to bias. This would increase the accuracy of recorded activity levels and enhance the validity of conclusions.

It is also important to examine gender differences in the use and effectiveness of digital tools, as well as how factors such as socioeconomic status, digital literacy, and cultural norms influence engagement. These variables may moderate the impact of interventions and determine their accessibility and sustainability across diverse student populations.

Finally, integrating qualitative methods, such as interviews or focus groups, could help uncover the psychosocial mechanisms that support or hinder behaviour change, thus contributing to more effective intervention design.

Acknowledgements

None

Conflict of Interest

None

Funding

The Authors received no funding for this research.

References

Ajzen, I. (1991). The theory of planned behaviour. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Baig, W. S., Elahib, H., & Hashmi, N. U. (2023). Impact of social media fitness contents on health and fitness motivation of the users. *Global Digital & Print Media Review, 6*(4), Article 60. https://doi.org/10.31703/gdpmr.2023(vi-iv).05

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice Hall.

Chen, H., Schoefer, K., Manika, D., & Tzemou, E. (2023). The "dark side" of general health and fitness-related self-service technologies: A systematic review of the literature and directions for future research. *Journal of Public Policy & Marketing, 43*(2). https://doi.org/10.1177/07439156231224731

Chen, Y., Tzeng, Y., & Gau, B. (2024). Mobile health-based health literacy weight management intervention using smart devices for adolescents: A convergent mixed-methods pilot study. *Nursing & Health Sciences, 26*(4), Article e13172. https://doi.org/10.1111/nhs.13172

Domin, A., Uslu, A., Schulz, A., Ouzzahra, Y., & Vögele, C. (2022). A theory-informed, personalized mHealth intervention for adolescents (mobile app for physical activity): Development and pilot study. *JMIR Formative Research, 6*, Article e35118. https://doi.org/10.2196/35118

Du, H., Venkatakrishnan, A., Youngblood, G. M., Ram, A., & Pirolli, P. (2016). A group-based mobile application to increase adherence in exercise and nutrition programs: A factorial design feasibility study. *JMIR MHealth and UHealth, 4*(1), Article e4. https://doi.org/10.2196/mhealth.4900

Dyrstad, S. M., Hansen, B. H., Holme, I. M., & Anderssen, S. A. (2014). Comparison of self-reported versus accelerometer-measured physical activity. *Medicine & Science in Sports & Exercise, 46*(1), 99–106. https://doi.org/10.1249/MSS.0b013e3182a0595f

Eikey, E. V. (2021). Effects of diet and fitness apps on eating disorder behaviours: Qualitative study. *BJPsych Open, 7*(5), Article e1011. https://doi.org/10.1192/bjo.2021.1011

Fabbrizio, A., et al. (2023). Smart devices for health and wellness applied to tele-exercise: An overview of new trends and technologies such as IoT and AI. *Healthcare, 11*(12), Article 1805. https://doi.org/10.3390/healthcare11121805

Franklin, B. A., et al. (2022). Physical activity, cardiorespiratory fitness, and cardiovascular health: A clinical practice statement of the American Society for Preventive Cardiology Part II. *American Journal of Preventive Cardiology, 12*, Article 100425. https://doi.org/10.1016/j.ajpc.2022.100425

Gao, Z., & Lee, J. E. (2019). Emerging technology in promoting physical activity and health: Challenges and opportunities. *Journal of Clinical Medicine, 8*(11), Article 1830. https://doi.org/10.3390/jcm8111830

Gómez-Cuesta, N., et al. (2024). A mobile app-based intervention improves anthropometry, body composition and fitness: A randomized controlled trial. *Frontiers in Public Health*. https://doi.org/10.3389/fpubh.2024.1380621

Lewis, Z. H., et al. (2020). The utility of wearable fitness trackers and implications for increased engagement: An exploratory, mixed methods observational study. *Digital Health, 6*, Article 2055207619900059. https://doi.org/10.1177/2055207619900059

Liu, Y., Hong-xue, Z., & Xu, R. (2023). The impact of technology on promoting physical activities and mental health: A gender-based study. *BMC Psychology, 11*, Article 1. https://doi.org/10.1186/s40359-023-01348-3

Liu, Z., Zhang, Y., Zhang, J., & Song, X. (2024). Run for the group: Examining the effects of group-level social interaction features of fitness apps. *Decision Support Systems, 187*, Article 114335. https://doi.org/10.1016/j.dss.2024.114335

Mittelstadt, B. D., et al. (2016). The ethics of algorithms: Mapping the debate. *Big Data & Society, 3*(2). https://doi.org/10.1177/2053951716679679

Ozdamli, F., & Milrich, F. (2023). Positive and negative impacts of gamification on the fitness industry. *European Journal of Investigation in Health, Psychology and Education, 13*(8), 1411–1422. https://doi.org/10.3390/ejihpe13080103

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Shei, R.-J., et al. (2022). Wearable activity trackers – Advanced technology or advanced marketing? *European Journal of Applied Physiology, 122*(9). https://doi.org/10.1007/s00421-022-04951-1

Shin, G., et al. (2018). Beyond novelty effect: A mixed-methods exploration into the motivation for long-term activity tracker use. *JAMIA Open, 2*(1), 62–72. https://doi.org/10.1093/jamiaopen/ooy048

Shin, Y., Kim, S., & Lee, M. (2019). Mobile phone interventions to improve adolescents' physical health: A systematic review and meta-analysis. *Public Health Nursing*. https://doi.org/10.1111/phn.12655

Telford, R. M., et al. (2016). The influence of sport club participation on physical activity and body fat: The LOOK longitudinal study. *Journal of Science and Medicine in Sport, 19*(5), 400–406. https://doi.org/10.1016/j.jsams.2015.04.008

Tenenbaum, G., et al. (2025). Smart sport watch usage: The dominant role of technology readiness. *Technologies, 13*(1), Article 24. https://doi.org/10.3390/technologies13010024

Valach, P., et al. (2020). Effects of a project based on mobile applications and pedometers on adolescent exercise perceptions. *Physical Activity Review, 8*(1), 41–48. https://doi.org/10.16926/par.2020.08.05

Wang, X., Zhu, Y., & Li, R. (2024). Effectiveness of mHealth app–based interventions for adolescent physical activity: A meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity*. https://doi.org/10.2196/51478

Woessner, M. N., et al. (2021). The evolution of technology and physical inactivity: The good, the bad, and the way forward. *Frontiers in Public Health, 9*, Article 655491. https://doi.org/10.3389/fpubh.2021.655491

World Health Organization. (2023). *Physical activity*. https://www.who.int/health-topics/physical-activity#tab=tab_2

World Health Organization. (2024). *Physical activity*. https://www.who.int/initiatives/behealthy/physical-activity

Yang, Y., & Koenigstorfer, J. (2021). Determinants of fitness app usage and impacts of app features on physical activity intentions. *Journal of Medical Internet Research, 23*(7), Article e26063. https://doi.org/10.2196/26063

Zheng, E. L. (2021). Interpreting fitness: Self-tracking with fitness apps through a postphenomenology lens. *AI & Society*. https://doi.org/10.1007/s00146-021-01146-8