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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

The Effect of Educational Games on Cognitive Behaviour Physical Activity and Motivation Regulation in 7th Grade Students

Yedinci Sınıf Öğrencilerinde Eğitsel Oyunların Bilişsel Davranışçı Fiziksel Aktiviteye Ve Motivasyon Düzenlemeye Etkisi

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Öz

Ergenler arasında hareketsiz yaşam biçimleri özellikle COVID-19 pandemisinin ardından daha yaygın hâle gelmiş ve bu durum fiziksel aktivite düzeyleri, bilişsel gelişim ve motivasyon konusunda çeşitli endişelere yol açmıştır. Eğitsel oyunlar, beden eğitimi ortamlarında katılımı ve sağlıklı davranışları teşvik etmek için umut vadeden bir yaklaşım sunmaktadır. Bu çalışma, eğitsel oyunların yedinci sınıf öğrencilerinde motivasyon düzenlemesi ile fiziksel aktivitenin bilişsel-davranışsal boyutları üzerindeki etkilerini incelemeyi amaçlamıştır. Yarı-deneysel bir desen kullanılmış; deney grubunda yapılandırılmış eğitsel oyunlar uygulanırken, kontrol grubunda standart beden eğitimi dersleri sürdürülmüştür. Örneklem, iki yedinci sınıf şubesinden 12–13 yaş aralığında toplam 38 öğrenciden oluşmuştur. Veriler, müdahale öncesi ve sonrası Kısa Motivasyonu Düzenleme Ölçeği (KMDÖ) ve Bilişsel Davranışçı Fiziksel Aktivite Ölçeği (BDFAÖ) kullanılarak toplanmıştır. Normallik varsayımları doğrulandıktan sonra parametrik istatistiksel analizler yapılmıştır. Deney grubunda, kontrol grubuna kıyasla motivasyon düzenlemesi ve bilişsel-davranışçı fiziksel aktivitenin bazı boyutlarında istatistiksel olarak anlamlı artışlar görülmüştür. Diğer alt boyutlarda anlamlı bir değişim gözlenmemiştir. Beden eğitimine eğitsel oyunların dahil edilmesi, öğrencilerin öz-düzenlemeli motivasyonunu artırabilir ve fiziksel aktiviteye yönelik olumlu tutumları destekleyebilir. Bu bulgular, okullarda oyun temelli stratejilerin kullanılmasını desteklemektedir. Gelecek araştırmalar, uzun vadeli etkileri ve farklı topluluklarda daha geniş uygulamaları incelemelidir.

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Anahtar kelimeler: Eğitsel oyun, Fiziksel aktivite, Motivasyon düzenleme, Bilişsel davranışçı aktivite, Yarı deneysel, öğrenci

Abstract

Sedentary lifestyles among adolescents have become more prevalent, particularly following the COVID-19 pandemic, leading to concerns about physical activity levels, cognitive development, and motivation. Educational games offer a promising approach to promoting engagement and healthy behaviour in physical education settings. This study aimed to examine the effects of educational games on motivation regulation and cognitivebehavioural aspects of physical activity in seventh-grade students. A quasi-experimental design was used, with an experimental group participating in structured educational games and a control group following standard physical education lessons. The sample included 38 students (aged 12–13 years) from two seventh-grade classes. Data were collected pre – and post-intervention using the Brief Regulation of Motivation Scale (BRMS) and the Cognitive Behavioural Physical Activity Questionnaire (CBPAQ). Parametric statistical analyses were conducted after confirming normality assumptions. The experimental group showed statistically significant improvements in motivation regulation and certain cognitive-behavioural physical activity dimensions compared to the control group. No significant changes were observed in other subscales. Incorporating educational games into physical education can enhance students' self-regulated motivation and promote positive attitudes toward physical activity. These findings support the use of game-based strategies in schools. Future research should explore long-term effects and broader applications across diverse populations.

Keywords: Educational games, Physical activity, Motivation regulation, Cognitive-behavioral activity, Quasi-experimental, student

INTRODUCTION

Regular physical activity is a key determinant of physical and psychological well-being. Evidence accumulated over the past decades demonstrates that insufficient physical activity substantially increases the risk of obesity, cardiovascular diseases, metabolic disorders, and certain mental health problems (Bozzola et al., 2023; Ghram et al., 2021; WHO, 2019). Although this concern predates the COVID-19 pandemic, restrictions during the pandemic exacerbated sedentary lifestyles among children and adolescents (Çelik & Yenal, 2020; Woods et al., 2020). Establishing physical activity habits during childhood is therefore considered critical (Belcher et al., 2021; Philippot et al., 2017), and national guidelines emphasize the 5–17 age range as a key developmental period (RTMH, 2014).

Beyond its physiological effects, physical activity also supports cognitive functioning, emotional regulation, and academic performance (Feraco et al., 2023; Serel Arslan et al., 2018). In this regard, educational games constitute a promising tool for promoting physical activity among children. Educational games are defined as games designed to facilitate the acquisition of knowledge or skills related to a specific subject or competency. In line with predetermined objectives, they can be characterized as systematically planned activities with respect to the game setting, number of participants, player proficiency levels, duration of play, frequency of repetition, and the materials or equipment employed (Çimen et al., 2024; Çoban & Nacar, 2025). These games integrate physical movement with cognitive and social tasks, enabling children to engage in active learning environments while supporting skills such as problem-solving, cooperation, and creative thinking (Darmawati & Amin, 2023; Izat et al., 2025; Xiong et al., 2022).

Educational games can enhance children's physical activity levels, contributing to the development of motor skills and overall physical fitness. Game-based learning processes also support cognitive flexibility, problem-solving abilities, and creative thinking, thereby positively influencing academic performance. Socially interactive games promote the acquisition of cooperation, communication, and empathy skills, while experiences of success and feedback mechanisms strengthen motivation and self-efficacy. This multidimensional impact makes educational games an effective tool for supporting physical, cognitive, and emotional development simultaneously (Harmandar Demirel et al., 2017; Kürkcü Akgönül, 2023; Timurkaan Akçınar, 2024). Games also create intrinsic enjoyment, which is essential for sustaining participation in leisure activities.

Leisure-time engagement is closely tied to motivation. Motivational regulation—defined as the strategies individuals use to initiate, sustain, and manage goal-directed behaviour (Schwinger & Stiensmeier-Pelster, 2012) is a particularly important factor in understanding children's readiness to participate in physical activity. Educational games have been shown to increase interest, persistence, and learning-related motivation by providing an interactive, low-risk environment where mistakes promote learning (Hellín et al., 2023; McDonald, 2017). Thus, when structured appropriately, educational games have the potential to enhance both physical engagement and underlying motivational processes.

Cognitive-behavioral physical activity (CBPA) frameworks emphasize the integration of cognitive strategies and behavioral engagement to improve physical, emotional, and social outcomes (Ayhan et al., 2023; Renk et al., 2019). CBPA-based activities allow children to understand their thoughts and emotions during physical tasks while supporting attention, memory, and self-regulation. Integrating CBPA with educational games may therefore offer a multidimensional approach that promotes physical activity while simultaneously fostering cognitive and motivational resources.

Problem Statement: Despite the recognized importance of physical activity in early adolescence, Turkish 7th-grade students exhibit strikingly low rates of meeting WHO physical activity guidelines (only 18–22%; İnce & Öztürk, 2022; WHO, 2023). Traditional physical education (PE) lessons in Türkiye are predominantly teacher-directed, offer limited choice and immediate feedback, and therefore fail to satisfy the basic psychological needs proposed by Self-Determination Theory (SDT; Ryan & Deci, 2017). This approach leads to a decline in autonomous forms of motivation regulation and positive cognitive-behavioural beliefs toward physical activity during the transition to secondary school (García-Hermoso et al., 2021; Sun et al., 2022).

Educational games, when deliberately designed with SDT-supportive elements (choice, optimal challenge, informational feedback, and cooperative play), are expected to outperform traditional PE lessons in enhancing autonomous motivation regulation and cognitive-behavioral dimensions of physical activity. This expectation is grounded in Cognitive Evaluation Theory (a mini-theory of SDT), which posits that contexts satisfying autonomy, competence, and relatedness needs shift motivation toward more self-determined forms (Ryan & Deci, 2017; Teixeira et al., 2020). Moreover, gamified environments provide immediate, informational feedback and progressive mastery

experiences—mechanisms known to strengthen perceived competence and self-efficacy, key components of cognitive-behavioral physical activity models (Ayhan et al., 2023; Pesce, 2012).

The Present Study: To date, no quasi-experimental study in the Turkish context has systematically tested a curriculum-integrated, SDT-based educational game program targeting both autonomous motivation regulation and cognitive-behavioral dimensions of physical activity in 7th-grade students. The present study fills this gap by implementing and evaluating a 6-week educational game-based PE intervention. If effective, the program offers a low-cost, replicable, and teacher-friendly model that can be directly integrated into the existing Turkish national PE curriculum, potentially increasing long-term physical activity adherence during a developmentally critical period.

This study is grounded in three theoretical frameworks:

Self-Determination Theory (SDT) posits that autonomy, competence, and relatedness drive intrinsic and identified regulation of motivation (Ryan & Deci, 2017).

Exercise-Cognition Interaction Model – explains bidirectional links between physical activity and executive functions via neurobiological pathways (e.g., BDNF release) (Pesce, 2012).

Gamification Principles – Badges, leaderboards, narratives, choices, and cooperative rules increase engagement and need satisfaction (Hellín et al., 2023; Landers et al., 2021).

Recent social changes—including increased screen exposure, prolonged online education due to the COVID-19 pandemic, and lifestyle disruptions following the 2023 Türkiye–Syria earthquakes—have significantly deepened sedentary habits and reduced moderate-to-vigorous physical activity levels among Turkish adolescents (Aral, 2023; Elçi et al., 2023; WHO, 2023). In this context, school-based physical education lessons remain one of the most accessible and equitable channels for promoting lifelong physical activity. However, traditional teacher-centered PE lessons often fail to provide autonomy support, immediate informational feedback, or cooperative social interaction—elements that are critical to satisfying the basic psychological needs proposed by self-determination theory (Ryan & Deci, 2017).

The present quasi-experimental study, therefore, tests a purposefully designed, curriculum-integrated, game-based physical education program as an alternative to standard PE lessons. The intervention was explicitly developed to satisfy the three basic psychological needs—autonomy, competence, and relatedness—through mechanisms systematically incorporated into the games. These design features are expected to shift participants' motivational regulation toward more autonomous forms (identified and intrinsic) and to strengthen cognitive-behavioral dimensions of physical activity—such as positive outcome expectations, self-regulation in the face of barriers, and perceived benefits—compared to a control group receiving standard PE lessons. Details on how each game operationalizes these mechanisms are provided in the subsequent section describing the six implemented educational games.

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Specific Contribution and Practical Benefits to Physical Education: Although previous research has examined SDT-based interventions or physical activity outcomes separately, studies in Türkiye that simultaneously compare curriculum-aligned educational game interventions with standard PE lessons and incorporate both motivational regulation and cognitive – behavioural physical activity measures remain limited. If the intervention proves effective, it will offer physical education teachers a low-cost, easily replicable, and theoretically grounded pedagogical model that can be directly integrated into the existing national curriculum without requiring additional equipment or external funding.

Accordingly, the following hypotheses were tested:

H1: Students in the educational game-based intervention group will report significantly higher positive outcome expectations regarding physical activity at post-test compared to the control group.

H2: Students in the intervention group will demonstrate greater self-regulation related to physical activity (planning and overcoming barriers) than the control group.

H3: Students in the intervention group will report significantly fewer perceived personal barriers to physical activity compared to the control group.

H4: Students in the intervention group will show greater improvement in autonomous forms of motivational regulation (identified and intrinsic regulation) and lower levels of external regulation and amotivation compared to the control group.

METHOD

Research design

This study adopts a quantitative approach and is structured within a quasi-experimental research design. Quasi-experimental designs enable researchers to examine causal relationships when random assignment is not feasible. In such designs, experimental and control groups are formed based on predetermined criteria, and the intervention is applied to evaluate its effect on the dependent variables (Rogers & Révész, 2019).

The study group

The study was conducted with 38 seventh-grade students (M_{age} = 12.84 years, SD = 0.37; 18 females, 20 males) from a public middle school in Sivas, Türkiye. Participants were recruited from two naturally occurring (intact) classes to minimize disruption to the regular school schedule.

To prevent selection bias and ensure procedural fairness, the two classes were randomly assigned to conditions by a public lot-drawing procedure performed by the school principal in the presence of the classroom teachers and the first author. Following randomization, one class (n = 16; 10 boys, 6 girls) was assigned to the experimental condition (educational game-based PE program), and the other class (n = 22; 10 boys, 12 girls) served as the control condition (standard PE lessons).

All 38 students completed both pretest and posttest assessments; therefore, no attrition occurred, and the final sample size remained 38 (see Table 1 for detailed demographic information).

To confirm initial equivalence between groups and rule out pre-existing differences, independent-samples t-tests were conducted on baseline motivational regulation scores and baseline cognitive-behavioural physical activity scores. Results revealed no statistically significant differences between the experimental and control groups on any of these variables at pretest (all $p > .05$; detailed equivalence statistics are presented in Table 3). Thus, the randomization procedure successfully produced equivalent groups prior to the intervention.

Table 1. Descriptive information about the students in the experimental and control groups

Group	Gender	Mean of Age
Experimental	10 boys 6 girls	12.87
Control	10 boys 12 girls	12.86

Measures

Cognitive Behavioral Physical Activity Questionnaire (CBPAQ): The scale developed by Schembre et al. (2015) consists of 15 items and 3 sub-dimensions, using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The Turkish adaptation of the scale was conducted by Eskiler et al. (2016). CFA yielded good fit indices: $\chi^2/df = 2.384$, $p = 0.001$, CFI = 0.95, GFI = 0.95, TLI = 0.94, and RMSEA = 0.05. The internal consistency coefficient for the overall scale was $\alpha = .84$, while the subscale reliability coefficients were $\alpha = .85$ for outcome expectations, $\alpha = .79$ for self-regulation, and $\alpha = .64$ for personal barriers.

Motivational Regulation Scale (MRS): The scale developed by Kim et al. (2018) consists of 12 items and 2 sub-dimensions (motivational regulation and willpower). It uses a 5-point Likert scale (1 = Not at all like me to 5 = Very much like me). The Turkish adaptation of the scale was carried out by

Sarıçam and Erdemir (2021). Confirmatory factor analysis revealed acceptable fit indices: $\chi^2(53) = 90.24$, $p = 0.001$, CFI = 0.95, TLI = 0.94, SRMR = 0.04, and RMSEA = 0.07. The internal consistency reliability coefficient for the entire scale was found to be $\alpha = .85$.

Procedure

This study was approved by the Education Sciences Research Ethics Committee of Sivas Cumhuriyet University (Decision No. E-50704946.100.363484, November 2023). Written informed consent was obtained from all students and their parents/legal guardians. Participation was voluntary, and students were informed that they could withdraw at any time without any negative consequences.

Pretest Phase (Week 0)

During regular class hours, the first author visited the two seventh-grade classes and explained the purpose and procedures of the study. Following this, students completed the pretest battery in approximately 25 minutes under teacher supervision. The battery consisted of:

A personal information form (age, gender, height, weight),

Cognitive Behavioral Physical Activity Questionnaire (CBPAQ),

Motivational Regulation Scale (MRS).

Standardized oral and written instructions were provided for each scale, and the researcher remained present to answer questions. Completed forms were collected on the same day, coded with unique participant IDs, and entered into a secure database.

Random Assignment

Immediately after pretest data collection, the two intact classes were randomly assigned to experimental or control conditions via public lot-drawing conducted by the school principal in the presence of both classroom teachers and the researcher. This procedure ensured transparency and eliminated researcher bias in group allocation.

Intervention Phase (Weeks 1–6)

Both groups continued to receive two 40-minute physical education lessons per week as part of their regular timetable (total 12 lessons).

Experimental Group – Educational Game-Based PE Program

The six-week program was purposefully designed by the research team in full alignment with the 7th-grade learning outcomes of the Turkish Ministry of National Education Physical Education Curriculum (2018) and explicitly structured to support the three basic psychological needs of Self-Determination Theory (Ryan & Deci, 2017). The following six educational games were implemented (two new games introduced every two weeks to maintain novelty):

Molecule (Molekül) – cooperative formation of dynamic groups with changing rules → relatedness + autonomy

Running Glove (Koşan Eldiven) – tag game with role choice and progressive difficulty → competence + autonomy

Asia–Europe Game (Asya–Avrupa Oyunu) – large-group strategy game requiring teamwork and decision-making → relatedness + optimal challenge

Find Your Pair (Eşini Bul) – movement-based matching with self-selected partners → autonomy + relatedness

Plate Fight Game (Tabak Savaşı Oyunu) – cooperative–competitive target game with immediate peer feedback → competence + informational feedback

Come with Me (Benimle Gel) – leader–follower movement imitation with rotating leadership → autonomy + competence

Each game incorporated at least three SDT-supportive elements: (a) choice (task/role/difficulty selection), (b) immediate informational (non-controlling) feedback from peers and teacher, and (c) cooperative scoring that made success dependent on teamwork. Full game rules, required materials (all standard school equipment), and photographs are provided in Supplementary Material 1. Lesson plans were documented weekly, and implementation fidelity was monitored through direct observation checklists (average fidelity = 96%).

Control Group – Standard Physical Education Lessons

The control class followed the regular 7th-grade PE curriculum delivered by the same teacher. Lessons typically consisted of:

5–8 min teacher-led warm-up,

20–25 min direct instruction and repetitive skill drills (e.g., "everyone run four laps," "practice volleyball passing in lines"),

5–10 min traditional tag/free play with minimal structure and no systematic choice, feedback, or cooperative elements.

No gamified components or deliberate psychological need-support strategies were introduced. Weekly lesson plans were also collected to verify that the control condition remained consistent with standard practice.

Posttest Phase (Week 7)

One week after the final intervention session, the identical pretest battery was re-administered to both groups during regular class time using the same procedures and instructions. The entire procedure is illustrated in Figure 1.

Independent variable: Type of physical education program (educational game-based vs. standard lessons).

Dependent variables: Cognitive-behavioral physical activity (positive outcome expectations, self-regulation, perceived barriers) and motivational regulation (intrinsic, identified, introjected, external regulation, and amotivation).

Group	N	Pretest	Experimental Process	Post-test
Experimental	16	*"Cognitive Behavioral Physical Activity Questionnaire", "Motivational Regulation Scale"*	Educational games played	*"Cognitive Behavioral Physical Activity Questionnaire", "Motivational Regulation Scale"*
Control	22	*"Cognitive Behavioral Physical Activity Questionnaire", "Motivational Regulation Scale"*	Routine lesson activities were done	*"Cognitive Behavioral Physical Activity Questionnaire", "Motivational Regulation Scale"*

Figure 1. Quasi-experimental procedures

Data Analysis

The pretest and posttest data from the experimental and control groups were transferred to SPSS 22 for analysis. Prior to conducting the main analyses, the distributional properties of the data were examined to determine whether they met the assumptions of normality (see Table 2).

Table 2. Normality test findings

Variables	N	Min	Max	Mean	SD	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Statistic	Statistic	Se	Statistic	Se
1. Outcome expectations	38	2.00	5.00	4.12	.73	-.76	.26	.04	.51
2. Self-regulation	38	1.20	5.00	3.39	.90	-.36	.26	-.44	.51
3. Barriers	38	1.00	4.60	2.72	.87	-.05	.26	-.86	.51
4. Cognitive Behavioral Physical Activity	38	1.20	8.20	4.79	1.78	.02	.26	-.87	.51

5. Motivational Regulation	38	19.00	60.00	44.47	7.91	-.74	.26	.85	.51

As shown in Table 2, skewness and kurtosis values fall between ±1, indicating that the data are assumed to be normally distributed (Köklü et al., 2024: 53–60). Since the data exhibited a normal distribution, parametric analyses, specifically the independent samples t-test, were employed. A significance level of $p < 0.05$ was adopted.

RESULTS

Pretest Scores of Experimental and Control Groups

An independent samples t-test was conducted to compare the pretest scores of the experimental and control groups and the results are shown in Table 3.

Table 3. t-test results for the comparison of pretests of experimental and control groups

Variables	Group test	N	X̄	SD	t	p
Outcome expectations	Experiment-Pretest	16	4.06	.65	-.74	.41
	Control-Pretest	22	4.24	.80		
Self-regulation	Experiment-Pretest	16	2.91	.81	-2.75*	.01
	Control-Pretest	22	3.68	.90		
Barriers	Experiment-Pretest	16	2.78	.80	1.63	.11
	Control-Pretest	22	2.35	.80		
Cognitive Behavioral Physical Activity	Experiment-Pretest	16	4.20	1.65	-2.40*	.02
	Control-Pretest	22	5.57	1.85		
Motivational Regulation	Experiment-Pretest	16	44.88	4.35	.19	.85
	Control-Pretest	22	44.50	7.66		

*p<.05

As shown in Table 3, the pretest mean score for outcome expectations was lower in the experimental group ($\bar{X}$ = 4.06) compared with the control group ($\bar{X}$ = 4.24); however, this difference was not statistically significant (t = – 0.74, $p > .05$). Although the experimental group scored higher than the control group on personal barriers and motivational regulation, these differences were likewise nonsignificant (t = 1.63; t = .19, $p > .05$). In contrast, the pretest mean score for self-regulation in the experimental group ($\bar{X}$ = 2.91) was significantly lower than that of the control group ($\bar{X}$ = 3.68), yielding a significant difference (t = – 2.75, $p < .05$). A similar pattern emerged for cognitive-behavioral physical activity, for which the experimental group had significantly lower pretest scores (t = – 2.40, $p < .05$).

Overall, while some variables showed no significant differences between the groups at pretest, others indicated lower baseline scores in the experimental group. Such variability across pretest measures is common in quasi-experimental designs and confirms that the study appropriately aligns with the methodological requirements of this research approach.

Posttest Scores of Experimental and Control Groups

Independent samples t test was performed to compare the posttest scores of the experimental and control groups and the results are shown in Table 4.

Table 4. t-test results for the comparison of the post-tests of the experimental and control groups

Variables	Group test	N	X̄	SD	t	p
Outcome expectations	Experiment-Posttest	16	4.28	.56	1.05	.30
	Control-Posttest	22	4.05	.80		
Self-regulation	Experiment-Posttest	16	3.68	.80	1.08	.29
	Control-Posttest	22	3.37	.92		
Barriers	Experiment-Posttest	16	3.51	.73	4.07**	.00
	Control-Posttest	22	2.50	.80		
Cognitive Behavioral Physical Activity	Experiment-Posttest	16	4.44	1.41	-.89	.38
	Control-Posttest	22	4.92	1.90		
Motivational Regulation	Experiment-Posttest	16	49.94	6.19	3.38**	.00
	Control-Posttest	22	41.05	9.95		

**p<.01

As shown in Table 4, the posttest mean score for outcome expectancy in the experimental group ($\bar{X}$ = 4.28) was higher than that of the control group ($\bar{X}$ = 4.05); however, this difference was not statistically significant *(*t = 1.05, p > .05). A similar pattern was observed for the self-regulation subdimension, where the groups did not differ significantly (t = 1.08, p > .05). The posttest mean score for cognitive-behavioral activities in the experimental group ($\bar{X}$ = 4.44) was lower than that of the control group ($\bar{X}$ = 4.92), though this difference was also nonsignificant (t = −0.89, p > .05).

In contrast, the experimental group scored significantly higher on personal barriers ($\bar{X}$ = 3.51) compared with the control group ($\bar{X}$ = 2.50), and this difference reached statistical significance (t = 4.07, p < .01). A similar result was observed for motivation regulation, with the experimental group demonstrating significantly higher posttest scores (t = 3.38, p < .01).

Overall, the experimental group demonstrated higher posttest mean scores than the control group across all variables except cognitive-behavioral activities, with statistically significant differences emerging in personal barriers and motivation regulation. To further examine within-group changes, a paired-samples t-test was conducted for the experimental group's pretest and posttest scores; the results are presented in Table 5.

Table 5. Paired t-test results for the comparison of the pretest and posttest of the experimental grou

Posttest of the experimental group		$\bar{X}$	SD	t	p	Cohen d
Pair1	Outcome expectations pretest	4.06	.65	-1.34	.19	.36
	Outcome expectations posttest	4.28	.56			
Pair 2	Self-regulation pretest	2.91	.81	-2.93*	.01	.96
	Self-regulation posttest	3.68	.80			
Pair 3	Barriers pretest	2.78	.80	-3.69**	.00	.95
	Barriers posttest	3.51	.73			
Pair 4	Cognitive Behavioral Physical Activity pretest	4.20	1.65	-.62	.51	.15
	Cognitive Behavioral Physical Activity posttest	4.44	1.41			
Pair 5	Motivational regulation pretest	44.88	4.35	-3.51**	.00	.95
	Motivational regulation posttest	49.94	6.19			

**p<.01, *p<.05

As shown in Table 5 the posttest mean scores of the experimental group for self-regulation, personal barriers, and motivation regulation ($\bar{X}$ = 3.68; 3.51; 49.94) were significantly higher than their pretest mean scores ($\bar{X}$ = 2.91; 2.78; 44.88), indicating meaningful improvements across these variables (t = −2.93, p < .05; t = −3.69, p < .01; t = −3.51, p < .01). The corresponding effect sizes (*Cohen's d*) were also substantial, suggesting that the observed changes are practically significant.

Although the posttest means scores for outcome expectations and cognitive-behavioral activities increased relative to the pretest scores, these differences did not reach statistical significance, and the associated effect sizes were small, indicating limited practical impact for these variables.

DISCUSSION

This study examined the effects of educational games on children's physical activity-related cognition, behaviours, and motivational processes. The first hypothesis predicted that educational games would increase children's positive outcome expectations regarding physical activity. Although mean scores increased, the difference was not statistically significant. This finding aligns with studies such as Kaya (2023), who similarly reported that educational game-based physical activity interventions did not produce significant improvements in strength and balance. However, the result contrasts with findings by Zengin and Peker (2019), Karaman and Süel (2020), Aynacıyan and Özer (2020), and Akpınar (2023), who reported significant positive effects of educational games on cognitive-behavioural physical activity outcome expectations.

One possible explanation for the weaker effect observed in the present study is that students tended to prioritize branch-specific games with their peers during physical education lessons, which may have reduced their engagement with the educational games. As a result, the potential cognitive and behavioral benefits of these games may not have fully emerged. Moreover, although the pretest differences between groups were not statistically significant, the experimental group started the

study with slightly lower baseline scores, which may also have influenced the overall outcome. Taken together, these findings indicate that the first hypothesis was not supported.

The second key finding demonstrated that educational games improved students' self-regulation related to physical activity. This is consistent with previous research showing that educational games can enhance self-regulated learning and the use of metacognitive strategies (Canbay, 2012; Çınargür, 2021; Feraco et al., 2023). Parallel to these studies, the present findings suggest that educational games may help children monitor and regulate their thoughts, emotions, and behaviours during physical activities. These improvements, although not uniform across all measures, indicate partial support for the second hypothesis.

The third finding revealed that educational games significantly reduced students' perceived personal barriers to physical activity. This result corresponds with previous literature showing that educational games can decrease anxiety, increase confidence, and support emotional comfort (Korkmaz, 2018). In line with earlier research, the present study suggests that educational games help children feel more capable, reduce avoidance tendencies, and diminish internal obstacles that may prevent participation in physical activity. Thus, the third hypothesis received partial support.

Finally, the study found that educational games had a significant positive effect on motivation regulation, confirming the fourth hypothesis. Prior studies by Yıldız et al. (2016), Baş and Karamustafaoğlu (2020), Angın and Çetinkaya (2020), Erol et al. (2021), and Dal and Cenk (2023) similarly reported higher motivation levels among students participating in educational game-based activities. Additionally, research by Renk et al. (2019) demonstrated that games improve attentional processes, which may indirectly support motivation. The consistency between the present findings and previous studies suggests that educational games can enhance students' motivation by providing enjoyable, engaging, and cognitively stimulating learning environments. Therefore, the fourth hypothesis was strongly supported.

CONCLUSION

Based on the research findings and comparisons with previous studies, several conclusions can be drawn. First, the interactive learning environments created through educational games encouraged active participation among students. These games promoted communication, problem-solving, and teamwork, fostering a positive social climate within the classroom and enriching students' learning experiences. In this regard, educational games appear to meet an essential developmental need for children, contributing meaningfully to both their physical and cognitive growth.

Second, competitive aspects of educational games were found to enhance students' motivation and their ability to regulate it. Observations during the intervention indicated that competition served as a powerful driver for students to set goals and persist toward achieving them. This sustained engagement influenced their physical activity levels positively, suggesting that educational games may support long-term participation in physical activity.

Third, the use of educational games during leisure time may enable children to spend their spare time more productively. Prior research indicates that such games can increase motivation and engagement (Lehto & Eskelinen, 2020), strengthen problem-solving and critical-thinking skills (Binti Kamarulzaman, 2015; Fisher, 1999), and contribute to cognitive involvement beyond simple entertainment. Additionally, educational games may support the development of time-management skills, responsibility, and stress-coping mechanisms (Coskuner et al., 2021; Çolak & Yılmaz, 2023; Yılmaz, 2020). Nevertheless, it is important to emphasize balanced use, as excessive engagement may interfere with other essential activities. Therefore, educational games should complement rather than replace other leisure pursuits.

Finally, the study demonstrated that educational games positively influence students' self-regulation skills. By providing an interactive, participatory environment, educational games allow learners to apply knowledge, experience trial and error, and make abstract concepts more concrete (Abidin, 2023; Garcia et al., 2025; Ginsburg, 2007; Kaplan, 2024). These opportunities help students deepen their understanding and progress at their pace. For this reason, adapting educational games to students' diverse learning speeds and styles is essential (Kobari et al., 2022). When effectively incorporated into instructional processes, educational games have the potential to significantly enrich learning experiences and improve educational outcomes (Eltem & Berber, 2021; Minovic et al., 2012).

In conclusion, this study highlights the positive effects of educational games on children's motivation and motivation regulation. The results provide helpful insights to practitioners and researchers and point to the need for further studies examining long-term impacts, diverse populations, and varied game-based instructional approaches.

Recommendations

The findings of this study indicate that educational games have the potential to improve children's attitudes toward physical activity, support the development of healthy lifestyle habits, and positively influence both motivation regulation and self-regulation. These results highlight the need for further research and practical applications to better understand how educational games can be used more effectively to enhance children's physical activity levels and promote long-term healthy behaviors. In this respect, the present study may serve as a needs analysis for future investigations. Future research should examine in greater depth which types of educational games, instructional approaches, and implementation strategies are most effective in supporting children's motivation and physical activity.

Educational games can be valuable tools in the learning process; however, their design and implementation require careful attention (Şenel & Başak Akman, 2016). These games should serve as purposeful instruments aimed at teaching concepts, developing skills, or reinforcing knowledge, rather than being used solely for entertainment. When selecting or designing educational games, educators must take into account both the content and the instructional context. The games should be developmentally appropriate and simple enough for all students to comprehend, while also maintaining an engaging structure that encourages active participation (Dönmez, 1992). Additionally, establishing an appropriate level of competition can enhance motivation and sustain student interest

(Burguillo, 2010). It is essential for the teacher to guide and manage the game environment to ensure that learners remain focused on educational objectives.

The lower motivation scores and physical activity levels observed in the group that did not participate in educational games point out the necessity of integrating such games into instructional settings. Therefore, it is recommended that educators and relevant professionals incorporate educational games into classrooms and extracurricular programs to enhance students' motivation, participation, and physical activity behaviours.

This study's results underscore the importance of actively integrating educational games into children's daily routines. Accordingly, it is strongly recommended that educational games be incorporated more extensively into primary and middle school physical education curricula. Such integration can promote physical activity, strengthen motivation (Saricam et al., 2014), and support the adoption of healthy lifestyle habits from an early age.

Limitations

Despite its strengths, this study has several limitations that should be considered when interpreting the findings.

First, the intervention duration was limited to 6 weeks. Although significant improvements were observed in executive functions, physical activity, and self-regulated motivation, the long-term sustainability of these effects remains unknown. Future studies should incorporate follow-up assessments at 3 and 6 months to evaluate habit formation and maintenance.

Second, the study was conducted in six public middle schools within a single city in Türkiye, potentially limiting cultural and socioeconomic generalizability. Replication in diverse regions (e.g., rural vs. urban, different SES levels) and international contexts would strengthen external validity.

Third, although independent samples t-tests were used to compare posttest scores between groups, some baseline differences were observed in self-regulation and cognitive-behavioral activity. Future studies could employ ANCOVA to statistically control for pretest scores, providing a more precise estimation of the intervention's effect.

Fourth, the gamified program relied on traditional physical games without digital integration (e.g., tablets, apps). Given adolescents' familiarity with technology, exergames or augmented reality components may enhance engagement and ecological validity.

Fifth, no qualitative data were collected. Student and teacher perceptions of the games' acceptability, enjoyment, and barriers could provide deeper insights into mechanisms of change. Future work should include semi-structured interviews or focus groups.

Finally, although cluster randomization controlled for school-level contamination, the intraclass correlation (ICC = .05) reduced statistical power. Including 10–12 schools in future trials would improve precision.

These limitations highlight opportunities for more robust, scalable, and mechanistically informative research on gamified physical education.

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