

Comparison of the Effects of Gamification and Traditional Educational Methods on Students' Basic Psychological Needs and Prosocial and Antisocial Behaviors in Physical Education Classes

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ABSTRACT

Objective: The aim of the present study was to compare the effects of gamification and traditional educational methods on students' basic psychological needs and prosocial and antisocial behaviors in physical education classes.

Methods and Materials: In this quasi-experimental study, the statistical population consisted of seventh-grade female students in Tabriz schools. Two classes were selected using convenience sampling from one of the schools and were then randomly assigned, with one class serving as the experimental group (n = 33) and the other as the control group (n = 25). The experimental group received basketball training through a gamification approach, whereas the control group received the same content using a traditional teaching approach. The intervention was implemented over eight sessions (one session per week, with each session lasting 90 minutes). Data were collected using the Basic Needs in the Game questionnaire developed by Ballou et al. (2024) and the Prosocial and Antisocial Behavior in Sport Scale developed by Kavussanu and Boardley (2009).

Findings: The findings showed that gamification, compared with the traditional method, increased satisfaction of competence and relatedness and reduced autonomy frustration among students. Gamification also increased prosocial behaviors and decreased antisocial behaviors.

Conclusion: Based on these findings, the use of gamification in girls' junior high school physical education classes can be considered an effective approach in the educational process by influencing students' basic psychological needs and prosocial and antisocial behaviors.

Keywords: gamification, physical education, prosocial behaviors, self-determination theory.

1. Introduction

Physical education is a fundamental component of school curricula because it provides students with

structured opportunities to develop motor competence, establish physically active lifestyles, interact with peers, and acquire social and psychological skills that extend beyond the immediate context of sport and exercise. Contemporary

perspectives on physical education therefore emphasize not only improvements in physical fitness or technical proficiency but also students' motivation, psychological well-being, social development, and quality of educational experience. Within this broader educational mission, the manner in which physical education is taught becomes particularly important because instructional strategies can determine whether students experience lessons as meaningful, enjoyable, socially supportive, and personally engaging. Recent reviews indicate that innovative instructional approaches are increasingly being used to transform physical education from predominantly teacher-directed skill practice toward more interactive and motivational learning experiences (Ferraz et al., 2024). This development is particularly relevant during adolescence, when participation in physical activity may decline and students' perceptions of competence, social acceptance, and educational autonomy can become increasingly influential in determining their engagement with physical education.

One instructional strategy receiving substantial attention is gamification. Gamification generally refers to the incorporation of game-design principles and game-like elements into activities that are not themselves conventional games. In education, these elements may include narratives, missions, points, levels, challenges, avatars, teams, immediate feedback, rewards, progress indicators, competition, and cooperation. Rather than simply allowing students to play games, gamification restructures the learning experience by creating meaningful goals, progressive challenges, feedback systems, and social interactions around curricular content. Evidence from physical education suggests that such approaches are feasible and can be positively received by both teachers and students (Fernandez-Rio et al., 2020). More broadly, emerging digital and interactive forms of gamification have also been associated with increased learner engagement by enabling more responsive and participatory educational environments (Banik & Gullapelly, 2025). Gamification has consequently become relevant not only to classroom instruction but also to physical activity promotion, virtual education, skill acquisition, and the development of broader educational competencies (Antonopoulos, 2024; Shafiei Sarvestani et al., 2025).

The growing interest in gamification is partly attributable to its potential to address motivational difficulties that may emerge in conventional educational settings. Traditional physical education frequently relies on teacher-defined tasks, predetermined practice structures, demonstrations,

repetition, and teacher-directed evaluation. Although these methods may be effective for organizing instruction and developing specific motor skills, they do not necessarily provide all students with equally motivating learning experiences. In contrast, gamification can transform required curricular activities into sequences of challenges, goals, achievements, and collaborative experiences that may make learning more personally meaningful. Studies conducted in educational settings outside physical education similarly indicate that gamification can strengthen student motivation by making learning more interactive and goal oriented (Diana et al., 2025). The combination of gamification with other active-learning methodologies has likewise demonstrated favorable effects on personal and motivational factors among secondary-school students (Segura-Robles et al., 2020). These findings support the proposition that gamification should be viewed not merely as an entertainment device but as an instructional architecture capable of modifying how students perceive and engage with learning tasks.

This perspective has particular theoretical relevance when gamification is considered through the framework of self-determination theory. Within this framework, the quality of students' motivation and functioning is closely associated with the satisfaction or frustration of three basic psychological needs: autonomy, competence, and relatedness. Autonomy concerns the experience of volition, psychological freedom, and a sense that one's actions are personally endorsed rather than externally imposed. Competence refers to feeling capable of successfully interacting with the environment, developing skills, and achieving desired outcomes. Relatedness reflects the experience of interpersonal connection, belonging, acceptance, and meaningful relationships with others. Research applying self-determination theory to physical education has consistently demonstrated that students' experiences of these psychological needs are central to their motivation, engagement, well-being, and behavioral functioning (White et al., 2021). Longitudinal evidence further shows that the satisfaction and frustration of psychological needs are important predictors of motivation and well-being in physical education, including technology-mediated and online learning environments (Behzadnia et al., 2024).

It is important to distinguish psychological need satisfaction from psychological need frustration. The absence of satisfaction does not necessarily imply that a need is actively frustrated. A student may, for example,

experience only modest autonomy without necessarily feeling pressured or controlled. Need frustration represents a more actively negative psychological experience involving feelings such as coercion, inadequacy, failure, rejection, or social exclusion. Accordingly, examining only need satisfaction may provide an incomplete understanding of students' experiences. Evidence from physical education demonstrates that supportive teacher behavior can facilitate psychological need satisfaction, whereas controlling interpersonal environments may contribute to need frustration and maladaptive outcomes (Behzadnia, 2021). Research among students with intellectual disabilities likewise demonstrates the educational importance of need-supportive teaching and indicates that instructional environments can be intentionally structured to facilitate more adaptive motivational experiences (Behzadnia et al., 2022). Thus, evaluating both satisfaction and frustration provides a more comprehensive basis for understanding the psychological effects of instructional approaches.

Gamification may be particularly compatible with the satisfaction of basic psychological needs because different game elements can address different dimensions of students' motivational experience. Opportunities to select strategies, assume different roles, make decisions, and progress with reduced teacher dependence may support autonomy. Clearly defined levels, progressively challenging activities, feedback, visible progress, and opportunities for mastery can strengthen competence. Team membership, collaborative challenges, shared narratives, and collective goals can promote relatedness. Research on gamification has demonstrated that specific gamification features are meaningfully associated with intrinsic need satisfaction (Xi & Hamari, 2019). More recent work examining positive and negative gaming experiences has further emphasized the value of assessing both satisfaction and frustration of autonomy, competence, and relatedness rather than assuming that game-like environments are uniformly need supportive (Ballou et al., 2024). This distinction is especially important because gamification can be designed in different ways, and elements such as excessive competition, external rewards, rigid rules, or social comparison could potentially support one psychological need while frustrating another.

Empirical research in physical education generally supports the potential motivational benefits of gamification, although findings are not entirely consistent. Research among secondary-school physical education students has shown that gamified instruction can improve motivation and satisfaction of basic psychological needs (Sotos-Martínez,

Tortosa-Martínez, et al., 2024). Similarly, gamification-based interventions have demonstrated improvements in psychological need satisfaction and positive behavioral outcomes in physical education (Sotos-Martínez, Ferriz-Valero, et al., 2024). A gamified intervention program has also been associated with enhanced motivation, greater satisfaction of psychological needs, and stronger intentions to remain physically active (Fernandez-Rio et al., 2022). Systematic review evidence broadly supports the benefits of gamified learning in physical education while also emphasizing variations across intervention designs, educational levels, outcomes, and implementation procedures (Ferriz Valero et al., 2023). At the higher-education level, gamification has also been linked to improvements in motivation and academic performance within physical education contexts (Ferriz-Valero et al., 2020).

Nevertheless, positive effects should not be assumed to occur automatically. Some investigations have produced more limited or mixed findings. Gamified didactics incorporating exergames have demonstrated psychological benefits among primary-school students, but the magnitude and consistency of effects may differ across particular motivational indicators (Quintas et al., 2020). A gamified classroom-coexistence program involving physical activity similarly demonstrated that the effects of gamification on students' psychological experiences may depend on the particular outcome being evaluated (Dólera-Montoya et al., 2021). Research examining situational motivation in secondary-school physical education has also suggested that gamification does not necessarily produce improvements across every psychological construct when compared with alternative instructional conditions (Real-Pérez et al., 2021). Evidence from a gamified smartphone intervention designed to promote physical activity in children further indicates that effects can be modest and sensitive to intervention design and context (Lapusniak, 2022). Together, these findings emphasize the need for additional controlled comparisons of gamification and traditional teaching rather than assuming universal motivational superiority.

Another important issue concerns the extent to which the intervention is meaningful and appropriately matched to students' interests and perceived capabilities. Personalization of physical education contexts can enhance students' interest and perceived competence, highlighting the importance of designing learning activities that students experience as relevant and manageable (Roure & Pasco, 2022). Gamified learning may provide a particularly useful

structure for accomplishing this because progressive challenges allow students to encounter increasing difficulty while receiving continuous indicators of progress. Gamification may also extend physical activity beyond conventional school instruction. For example, a gamified home-based intervention has demonstrated the feasibility of using game structures to influence physical and cognitive outcomes among young children (Davies et al., 2024), while integrating physical activities with games and gamification has been associated with improvements in the quality of students' leisure experiences (Sefidgar et al., 2024). These findings reinforce the broader potential of gamification to shape engagement with physical activity across multiple contexts.

In addition to motivational outcomes, physical education has an important social and moral function. Students interact continuously with classmates through cooperation, competition, team membership, shared success, failure, rule-following, and interpersonal conflict. Consequently, physical education can provide a natural context for developing prosocial behaviors while also creating situations in which antisocial behaviors may emerge. Prosocial behaviors include voluntary actions intended to support or benefit others, such as helping, encouraging, cooperating with, or showing respect toward teammates and opponents. Antisocial behaviors, by contrast, include behaviors intended to disadvantage, offend, intimidate, or harm others. The assessment of these behaviors has become increasingly important within physical education research, and validated instruments allow prosocial and antisocial conduct toward teammates and opponents to be differentiated systematically (Trigueros et al., 2020). The availability of a psychometrically evaluated Persian version of such measures is particularly important for studying these behaviors within Iranian populations (Hossein Nejad & Mohammadi, 2022).

Self-determination theory provides a useful framework for explaining why instructional environments may influence these social behaviors. Psychological need satisfaction is associated with adaptive interpersonal functioning, whereas need frustration is associated with more maladaptive patterns. Longitudinal research in physical education has identified dual motivational pathways whereby autonomy-supportive environments contribute to need satisfaction and prosocial behavior, while controlling environments contribute to need frustration and antisocial behavior (Jang et al., 2020). Intervention research has similarly shown that autonomy-supportive teaching can

increase prosocial behavior and reduce antisocial behavior through improvements in classroom climate and students' psychological need experiences (Cheon et al., 2023). These findings suggest that educational approaches should be evaluated not only in terms of whether students learn skills or report greater enjoyment, but also according to the type of interpersonal climate and social conduct they generate.

Gamification may contribute to such outcomes because well-designed gamified activities frequently require students to collaborate, coordinate roles, solve challenges together, and pursue shared objectives. Team-based gamification can therefore provide repeated opportunities to practice communication, mutual support, fair play, perspective taking, and collective responsibility. Proposals for gamified physical education have specifically emphasized the potential of this instructional format to foster social and emotional skills among primary-school students (Montesinos et al., 2022). Similarly, gamification through culturally meaningful motor games has been associated with improvements in affective experiences and social interactions in physical education (Gil-Madrona et al., 2022). Teachers themselves also perceive gamification as potentially useful for competency development, particularly competencies related to teamwork, engagement, and social interaction (Martí-Parreño et al., 2021). Qualitative evidence from physical education teacher education additionally suggests that greater involvement generated through gamification can lead students to perceive that they have learned more because they have participated more actively in the educational process (Flores-Aguilar et al., 2023).

The potential social value of gamification extends beyond academic achievement and physical participation. Contemporary literature has increasingly connected gamification with the development of social skills and the promotion of psychological well-being, suggesting that interactive challenges and cooperative structures may create contexts in which social participation itself becomes a mechanism of health promotion (Otani et al., 2024). However, the social consequences of gamification are likely to depend on its design. Competitive structures that emphasize rankings without cooperation could potentially generate social comparison or exclusion, whereas team-based challenges emphasizing collective success may promote supportive peer relationships. Thus, examining actual prosocial and antisocial behaviors provides a more informative assessment of gamification than relying solely on motivation, enjoyment, or perceptions of engagement.

Despite the expanding literature, several important gaps remain. First, much gamification research in physical education has concentrated on motivation, enjoyment, academic performance, or physical activity, while comparatively fewer studies have simultaneously investigated basic psychological need satisfaction, need frustration, and students' prosocial and antisocial behaviors. Second, research frequently focuses on psychological need satisfaction without assessing the parallel process of need frustration, even though the two dimensions can predict substantially different outcomes. Third, findings regarding the motivational benefits of gamification remain heterogeneous, making direct comparison with traditional instructional methods necessary. Fourth, evidence remains relatively limited within culturally diverse educational environments, including Iranian schools, where differences in instructional traditions, peer relationships, school organization, and students' experiences may affect how gamified approaches function. Finally, adolescent girls constitute an important population for such investigation because school physical education may provide a particularly valuable structured environment for supporting motivation, social connection, and continued engagement in physical activity.

Accordingly, rigorous evaluation of gamification in school physical education should extend beyond the question of whether students find gamified lessons enjoyable. It should determine whether the approach creates psychologically supportive conditions, reduces experiences of need frustration, strengthens constructive interactions with peers, and discourages behaviors that undermine the social climate of the class. A comparison with traditional instruction is especially informative because it permits the effects of game-design elements to be evaluated against established teaching practices while maintaining comparable curricular content. Such research can contribute both theoretically, by clarifying the relationship between gamified learning, basic psychological needs, and interpersonal behavior, and practically, by providing physical education teachers with evidence regarding instructional strategies that may simultaneously support motivation and positive social development.

Therefore, the aim of the present study was to compare the effects of gamification and traditional educational methods on the satisfaction and frustration of students' basic psychological needs and their prosocial and antisocial behaviors in physical education classes.

2. Methods and Materials

2.1. Study Design and Participants

The present study employed a quasi-experimental pretest–posttest design with a control group. In terms of its purpose, this study was applied research. Data were collected through field methods. The statistical population consisted of seventh-grade female students from junior high schools in Tabriz. For sample selection, two seventh-grade classes were selected using convenience sampling from one of the schools in the city. Subsequently, one class was randomly assigned to the experimental group (34 students), and the other was assigned to the control group (29 students). All participants were 13 years of age and met the study entry criteria. Inclusion criteria included parental consent, absence of cardiovascular or respiratory problems, absence of physical or motor impairments, and absence of disorders such as hyperactivity or attention deficit. Exclusion criteria included absence from more than two classes and the unwillingness of the student or her parents to continue participation. During the study, one participant from the experimental group and two participants from the control group were excluded due to non-participation in the posttest. Additionally, data from two participants in the control group were identified as outliers and excluded from the final analysis. Ultimately, 58 participants remained in the final analysis, including 33 students in the experimental group and 25 students in the control group.

2.2. Measures

Basic Needs in Gaming Scale: Students' basic psychological needs were assessed using the Basic Needs in Gaming Scale developed by Ballou et al. (2024). This scale consists of 18 items, and its six subscales assess the satisfaction and frustration of all three basic psychological needs in gaming contexts. Each basic psychological need is assessed using six items (three items measuring need satisfaction and three items measuring need frustration). Responses are rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), with 3 indicating neither agree nor disagree. The scale has demonstrated high construct validity (Ballou et al., 2024). In the present study, Cronbach's alpha coefficients were 0.61 for autonomy satisfaction, 0.73 for competence satisfaction, 0.72 for relatedness satisfaction, 0.60 for autonomy frustration, 0.72 for competence frustration, and 0.70 for relatedness

frustration, indicating acceptable to good internal consistency.

Prosocial and Antisocial Behavior in Sport Scale: Students' prosocial and antisocial behaviors were assessed using the Prosocial and Antisocial Behavior in Sport Scale developed by Kavussanu and Boardley (2009). This questionnaire consists of 20 items and includes two subscales assessing prosocial behavior (toward teammates and opponents) and two subscales assessing antisocial behavior (toward teammates and opponents). Items are rated on a five-point Likert scale ranging from 1 (never) to 5 (most of the time), with 3 indicating "sometimes." Confirmatory factor analysis demonstrated a good fit between the model and the data, as well as acceptable standardized factor loadings for the questionnaire (Kavussanu & Boardley, 2009). Furthermore, Hossein Nejad and Mohammadi (2022) reported that the Persian version of the questionnaire demonstrated acceptable validity for both the prosocial and antisocial behavior subscales. In the present study, Cronbach's alpha coefficients were 0.80 for prosocial behavior toward teammates, 0.75 for prosocial behavior toward opponents, 0.80 for antisocial behavior toward teammates, and 0.91 for antisocial behavior toward opponents, indicating satisfactory internal consistency.

2.3. Interventions

To conduct this research, after obtaining the necessary permissions from the provincial Department of Education, one girls' junior high school in Tabriz was selected as the research site. Next, two seventh-grade classes were selected from this school, with one class randomly assigned to the experimental group and the other to the control group. At the beginning of the study, a pretest was administered to both groups. The experimental group then received basketball instruction through a gamification approach during physical education classes, whereas the control group received the same instructional content using the traditional teaching method. The traditional method adopted in this study was the skill acquisition approach (Metzler, 2017), in which the teacher selected and introduced the learning tasks, determined the time allocated for practice, and guided the instructional process, while students actively participated in the practice activities. To minimize potential bias in the traditional teaching group (e.g., designing unengaging or monotonous classes), the research team developed diverse and high-quality instructional sessions for the control group.

Basketball was selected as the instructional content based on the official seventh-grade curriculum, which requires students to be introduced to the sport during physical education classes. Over eight instructional sessions (one session per week, with each session lasting 90 minutes), both groups practiced skills such as ball control and dribbling (including stationary dribbling, zigzag dribbling, obstacle dribbling, speed dribbling, and dribbling under defensive pressure), as well as different types of passing (including chest passes, overhead passes, and bounce passes performed in triangle drills, under simulated defensive pressure, and in combination with dribbling). Each session consisted of three parts: (1) Warm-up: stretching and warm-up exercises to prepare the body for physical activity; (2) Main session: exercises and tasks designed to teach basketball skills; and (3) Cool-down: stretching exercises to facilitate recovery and return the body to a resting state.

Both groups were taught by the same physical education teacher, who was familiar with the traditional teaching method. Before the study began, the teacher received training on the principles and procedures of implementing the gamification approach through a training course supervised by a university expert.

The gamification program was developed based on previous studies in this area (Fernandez-Rio et al., 2020; Fernandez-Rio et al., 2022; Roure & Pasco, 2022), and the following elements were incorporated as key components of the gamification-based learning process:

1) Narrative: The narrative was based on a fictional land called "Basketland" where a group of young heroes known as the "Basketballers" had to unite to save the land from evil creatures.

2) Players, Teams, and Avatars: The teacher first conducted several small basketball games to observe the students' skill levels. Based on these observations, students were fairly assigned to small teams of four to five students. Each team then selected a name, logo, and avatar. In addition, each student selected a character from a predefined list, with each character possessing a unique ability. As the story progressed, additional characters gradually became available for selection.

3) Scoring: Students earned points by learning new skills and correctly performing each basketball drill. Points were awarded based on individual and team performance, cooperation, and adherence to the rules of the game. These points were used to advance through levels and unlock new ones.

4) Levels and Challenges: New levels were unlocked as new learning content was introduced. The activities were designed to progress from simple to complex, allowing students to experience early success and maintain their motivation. Teams could unlock Level 2 and Level 3 based on the total points they earned, and players could change their characters by selecting new ones from a predefined list. Higher-level characters possessed stronger special abilities and earned more points by successfully performing more challenging skills. In addition, every two sessions, a new challenge was introduced to strengthen basketball skills (e.g., completing an obstacle dribbling course as a team in less than one minute without making any mistakes). These challenges, with varying levels of difficulty, engaged students both individually and as team members, and successful completion earned additional points.

5) Collaboration: Team members worked together to complete both individual and team tasks successfully in order to earn points, receive rewards, and advance to higher levels.

6) Immediate Feedback: Players and teams were informed in advance of the criteria for successfully

completing each activity, as well as the number of points awarded for each task. Following each exercise or challenge, the teacher provided immediate feedback to help students identify their strengths and weaknesses and improve their performance.

2.4. Data Analysis

In the present study, descriptive statistics were used to summarize the data using measures of central tendency and dispersion (mean and standard deviation). Inferential statistics were used to analyze the data and test the research hypotheses. First, the normality of the data distribution was assessed. Subsequently, repeated-measures multivariate analysis of variance (MANOVA) was performed using SPSS software. A significance level of $p < .05$ was adopted for all statistical analyses.

3. Findings and Results

Descriptive statistics for the pretest and posttest scores of both study groups on the dependent variables are presented in Table 1.

Table 1

Descriptive statistics related to the dependent variables of the study

Dependent variables	Subscales	Groups	Pretest	Posttest
			M (SD)	M (SD)
Basic psychological needs	Autonomy satisfaction	Experimental	10.79 (1.99)	11.03 (2.53)
		Control	11.44 (1.89)	10.40 (2.53)
	Competence satisfaction	Experimental	12.58 (1.71)	13.36 (1.54)
		Control	13.48 (2.16)	12.48 (2.69)
	Relatedness satisfaction	Experimental	10.64 (2.87)	12.18 (2.09)
		Control	11.84 (2.17)	11.72 (2.75)
Basic psychological needs	Autonomy frustration	Experimental	8.97 (2.35)	7.73 (2.40)
		Control	7.64 (3.12)	8.04 (2.30)
	Competence frustration	Experimental	6.48 (2.41)	5.18 (2.23)
		Control	6.44 (3.70)	6.24 (2.59)
	Relatedness frustration	Experimental	7.24 (2.77)	6.12 (2.72)
		Control	7.12 (3.00)	6.16 (2.23)
Prosocial and antisocial behavior	Prosocial behavior toward teammates	Experimental	14.55 (3.50)	15.82 (3.41)
		Control	15.68 (3.36)	15.08 (3.05)
	Prosocial behavior toward opponents	Experimental	11.09 (2.58)	10.82 (2.73)
		Control	10.80 (2.66)	10.84 (3.31)
	Antisocial behavior toward teammates	Experimental	11.91 (4.68)	10.00 (4.18)
		Control	10.72 (4.03)	10.04 (4.08)
Prosocial and antisocial behavior	Antisocial behavior toward opponents	Experimental	15.21 (6.09)	12.00 (4.72)
		Control	10.72 (4.03)	10.04 (4.08)

To assess the normality of the data distribution, skewness and kurtosis indices were examined. Because the values of both indices for all study variables fell within the acceptable

range of -2 to $+2$, the assumption of normality was considered satisfied. Levene's test was then used to examine the homogeneity of variances at each measurement occasion.

The results indicated that the significance values for all study variables were greater than 0.05; therefore, the assumption of homogeneity of variances was met. Next, an independent-samples t-test was conducted to compare the pretest scores between the two groups. The results showed no significant differences between the experimental and control groups at the pretest stage ($p > .05$). Therefore, a 2 (Time) $\times$ 2 (Group) repeated-measures multivariate analysis of variance (MANOVA) was performed to analyze the data.

In the variables of basic psychological need satisfaction and need frustration, the multivariate analysis showed a significant main effect of time (Wilks' lambda = 0.749, $F(6, 51) = 2.851$, $p = 0.018$, $\eta^2 = 0.251$). The Time $\times$ Group interaction effect was also significant (Wilks' lambda = 0.755, $F(6, 51) = 2.760$, $p = 0.021$, $\eta^2 = 0.245$). However, the main effect of group was not significant (Wilks' lambda = 0.939, $F(6, 51) = 0.556$, $p = 0.763$, $\eta^2 = 0.061$). These

findings indicate that students' scores changed over time and that the pattern of change from pretest to posttest differed according to the type of instruction. Therefore, univariate analyses were conducted to further examine these effects. The results showed that the Time $\times$ Group interaction effect was significant for competence satisfaction ($F(1, 56) = 9.447$, $p = 0.003$, $\eta^2 = 0.144$), relatedness satisfaction ($F(1, 56) = 5.352$, $p = 0.024$, $\eta^2 = 0.087$), and autonomy frustration ($F(1, 56) = 4.008$, $p = 0.050$, $\eta^2 = 0.067$). However, the interaction effect was not significant for autonomy satisfaction ($F(1, 56) = 3.097$, $p = 0.084$, $\eta^2 = 0.052$), competence frustration ($F(1, 56) = 2.188$, $p = 0.145$, $\eta^2 = 0.038$), and relatedness frustration ($F(1, 56) = 0.056$, $p = 0.813$, $\eta^2 = 0.001$). Following these analyses, the effect of time was examined separately within each group. The results are presented in Table 2.

Table 2

Results of Bonferroni post hoc test in basic psychological needs

Subscales	Groups	Mean Difference (pretest-posttest)	Standard Error	Sig
Competence satisfaction	Experimental	-0.788	0.382	0.044
	Control	1.000	0.439	0.026
Relatedness satisfaction	Experimental	-1.545	0.473	0.002
	Control	0.120	0.543	0.826
Autonomy frustration	Experimental	1.242	0.539	0.025
	Control	-0.400	0.619	0.521

According to the results presented in Table 2, competence satisfaction showed a significant increase over time in the gamification group ($p < .05$), whereas the traditional group showed a significant decrease ($p < .05$). Similarly, relatedness satisfaction increased significantly, and autonomy frustration decreased significantly from pretest to posttest in the gamification group ($p < .05$), whereas no significant changes were observed in the traditional group ($p > .05$). These findings indicate that the gamification increased competence satisfaction and relatedness satisfaction while reducing autonomy frustration among students.

In the variables of prosocial and antisocial behaviors, the multivariate analysis showed a significant main effect of time (Wilks' lambda = 0.801, $F(4, 53) = 3.288$, $p = 0.018$, $\eta^2 = 0.199$). The Time $\times$ Group interaction effect was also significant (Wilks' lambda = 0.805, $F(4, 53) = 3.210$, $p =$

0.020, $\eta^2 = 0.195$). However, the main effect of group was not significant (Wilks' lambda = 0.934, $F(4, 53) = 0.933$, $p = 0.452$, $\eta^2 = 0.066$). These findings indicate that students' scores changed over time and that the pattern of change from pretest to posttest differed according to the type of instruction. Therefore, univariate analyses were conducted to further examine these effects. The results showed that the Time $\times$ Group interaction effect was significant for prosocial behavior toward teammates ($F(1, 56) = 4.069$, $p = 0.048$, $\eta^2 = 0.068$) and antisocial behavior toward opponents ($F(1, 56) = 5.592$, $p = 0.022$, $\eta^2 = 0.091$). However, the interaction effect was not significant for prosocial behavior toward opponents ($F(1, 56) = 0.203$, $p = 0.654$, $\eta^2 = 0.004$) or antisocial behavior toward teammates ($F(1, 56) = 1.979$, $p = 0.165$, $\eta^2 = 0.034$). Following these analyses, the effect of time was examined separately within each group. The results are presented in Table 3.

Table 3

Results of Bonferroni post hoc test in prosocial and antisocial behavior

Subscales	Groups	Mean Difference (pretest-posttest)	Standard Error	Sig
Prosocial behavior toward teammates	Experimental	-1.273	0.610	0.041
	Control	0.600	0.700	0.395
Antisocial behavior toward opponents	Experimental	3.212	0.903	0.001
	Control	-0.040	1.037	0.969

According to the results presented in Table 3, prosocial behavior toward teammates increased significantly, whereas antisocial behavior toward opponents decreased significantly from pretest to posttest in the gamification group ($p < .05$). In contrast, the traditional group showed no significant changes in either variable ($p > .05$). These findings indicate that the gamification increased prosocial behavior toward teammates while reducing antisocial behavior toward opponents.

4. Discussion

The present study aimed to compare the effects of gamification and traditional educational methods on students' basic psychological needs and prosocial and antisocial behaviors in physical education classes. The findings showed that, compared with the traditional teaching method, gamification significantly increased competence satisfaction and relatedness satisfaction and significantly reduced autonomy frustration. However, no significant differences were observed between the two instructional approaches in autonomy satisfaction, competence frustration, or relatedness frustration. Regarding social behaviors, the gamification group demonstrated a significant increase in prosocial behavior toward teammates and a significant decrease in antisocial behavior toward opponents compared with the traditional group. In contrast, no significant differences were found between the groups in prosocial behavior toward opponents or antisocial behavior toward teammates. Overall, these findings suggest that gamification can improve selected dimensions of students' psychological need experiences and social behavior in physical education, although its effects do not appear to extend uniformly across all aspects of need satisfaction, need frustration, and interpersonal behavior.

One of the principal findings was that gamification significantly enhanced students' competence satisfaction. This finding is consistent with previous research showing that gamified physical education can strengthen students'

perceptions of competence and mastery. For example, Sotos-Martínez et al. found that gamification positively influenced basic psychological need satisfaction among secondary-school physical education students, including students' perceptions of competence (Sotos-Martínez, Tortosa-Martínez, et al., 2024). Similarly, Fernandez-Rio et al. reported that a gamified intervention improved students' basic psychological needs and motivation compared with more conventional instructional approaches (Fernandez-Rio et al., 2022). Systematic review evidence has also indicated that gamified learning in physical education frequently produces favorable effects on competence and other motivational outcomes (Ferriz Valero et al., 2023). These findings are additionally consistent with research demonstrating that gamification can enhance motivation and academic performance in physical education contexts (Ferriz-Valero et al., 2020).

The increase in competence satisfaction may be explained by several components of the gamification intervention. In the present study, students encountered progressively challenging activities, accumulated points for successful performance, received immediate feedback, advanced through levels, and completed basketball-related challenges. Such features make improvement visible and provide frequent opportunities for students to experience success. According to self-determination theory, competence is more likely to be satisfied when individuals perceive that they can effectively meet environmental demands and observe tangible evidence of progress. Gamification features have been shown to support intrinsic psychological needs when they provide meaningful indicators of achievement and skill development (Xi & Hamari, 2019). Similarly, contemporary assessment of basic needs in gaming contexts highlights mastery, feedback, and perceived effectiveness as important features of positive game experiences (Ballou et al., 2024). The present intervention may therefore have enhanced competence because students were not simply required to repeat basketball skills but were able to interpret successful

performance as progress through a structured challenge system.

The finding that competence satisfaction increased in the gamification group is particularly noteworthy because competence declined significantly in the traditional group. This pattern suggests that the difference between instructional methods may have reflected not only the positive effect of gamification but also the possibility that repeated skill-focused instruction without game-based progression was less effective in sustaining students' perceptions of capability. Contextualized and personalized physical education activities have previously been shown to enhance perceived competence by increasing students' interest and connection with learning content (Roure & Pasco, 2022). Gamification may perform a similar function by embedding technical skill practice within an appealing context characterized by goals, narrative progression, and achievable challenges. The engaging nature of such environments may encourage persistence and provide students with more opportunities to perceive incremental improvement.

Another important finding was that gamification significantly increased relatedness satisfaction. This result is consistent with studies showing that gamified physical education can enhance social connection and the satisfaction of basic psychological needs (Sotos-Martínez, Ferriz-Valero, et al., 2024; Sotos-Martínez, Tortosa-Martínez, et al., 2024). Quintas et al. also demonstrated favorable psychological effects of gamified physical education based on exergames, indicating that appropriately designed gamified learning can contribute to students' positive psychological experiences (Quintas et al., 2020). Furthermore, qualitative evidence suggests that students report greater involvement and stronger engagement when physical education learning is organized through gamified approaches (Flores-Aguilar et al., 2023). The present findings therefore support the view that gamification can create a learning environment in which students feel more socially connected to classmates.

The improvement in relatedness can be explained by the cooperative structure of the intervention. Students were assigned to teams, selected team identities and avatars, worked collectively to complete challenges, accumulated points through both individual and group performance, and cooperated to progress through different levels. These features likely increased the frequency and quality of peer interaction. Unlike instructional structures in which students perform skills largely as individuals under teacher direction,

team-based gamification creates interdependence because one student's contribution can affect the progress of the entire group. Previous research has shown that gamification in physical education can improve social interaction and affective experiences (Gil-Madrona et al., 2022). Gamified physical education activities have similarly been proposed as a means of promoting social and emotional competencies through shared challenges and collaborative participation (Montesinos et al., 2022). Teachers also perceive gamification as useful for developing teamwork and broader competencies that require interpersonal interaction (Martí-Parreño et al., 2021).

The present study additionally found that gamification significantly reduced autonomy frustration, although it did not significantly increase autonomy satisfaction. This distinction is theoretically meaningful. A reduction in autonomy frustration indicates that students may have felt less pressured, constrained, or controlled, even though the intervention did not necessarily produce a sufficiently strong increase in their experience of choice and volition to significantly enhance autonomy satisfaction. Previous research has demonstrated that need satisfaction and need frustration are related but distinct experiences and can respond differently to characteristics of the educational environment (Behzadnia, 2021). Longitudinal research in physical education has likewise shown that supportive interpersonal environments promote need satisfaction, whereas controlling conditions contribute more directly to need frustration (Behzadnia et al., 2024). Thus, gamification may have functioned primarily by reducing experiences of control rather than by substantially increasing students' perceived decision-making freedom.

Several features of the gamified program may explain this result. Students could choose team identities and avatars and participated in a narrative-oriented environment that differed from conventional teacher-directed instruction. These features may have made the educational process feel less controlling and more personally engaging. However, the core learning tasks, curricular content, rules, and skill requirements remained largely predetermined by the teacher and research protocol. Consequently, opportunities for genuine choice may not have been sufficient to produce a significant increase in autonomy satisfaction. This interpretation is consistent with evidence that gamification does not invariably improve every basic psychological need. Real-Pérez et al. found no significant differences in all basic psychological needs between gamified and conventional instructional conditions despite positive trends in motivation

(Real-Pérez et al., 2021), while Dólera-Montoya et al. similarly reported limited effects of gamified physical activity on psychological need satisfaction (Dólera-Montoya et al., 2021). A pilot gamified smartphone intervention also yielded relatively modest changes in motivational outcomes, suggesting that the effects of gamification depend strongly on design and implementation (Lapusniak, 2022).

No significant effects were found for competence frustration or relatedness frustration. These findings may indicate that the participants did not experience high levels of active failure, rejection, or interpersonal exclusion at baseline, leaving less opportunity for substantial reductions following the intervention. Gamification may more readily enhance positive experiences of mastery and connection than reduce negative experiences that are already relatively limited. The findings also emphasize the importance of distinguishing between the enhancement of need satisfaction and the reduction of need frustration. Need-supportive teaching does not necessarily produce equivalent changes in both dimensions. Research in physical education has shown that students' experiences are influenced by the specific interpersonal characteristics of instruction and that psychological need satisfaction and frustration may follow partly independent pathways (Behzadnia et al., 2022; Jang et al., 2020). Therefore, the absence of significant changes in competence and relatedness frustration should not be interpreted as evidence that the intervention lacked psychological value.

Another central finding was that gamification significantly increased prosocial behavior toward teammates. This result supports previous research suggesting that gamification may promote social and interpersonal development in physical education. Gil-Madrona et al. reported that gamified physical education activities can improve social interaction and affective outcomes (Gil-Madrona et al., 2022), while Montesinos et al. emphasized the usefulness of gamified physical education for developing social and emotional skills (Montesinos et al., 2022). The systematic review by Ferriz Valero et al. similarly identified cooperation and positive classroom interaction among the potential benefits of gamified learning (Ferriz Valero et al., 2023). More generally, gamification has been associated with social skill development and psychological well-being because interactive structures encourage communication, participation, and reciprocal engagement (Otani et al., 2024).

The increase in prosocial behavior toward teammates may be closely related to the improvement in relatedness

satisfaction observed in the present study. Students who experience greater interpersonal connection are more likely to cooperate, help one another, provide encouragement, and contribute to shared goals. Research based on self-determination theory indicates that supportive instructional environments can promote prosocial behavior through greater psychological need satisfaction (Cheon et al., 2023). Longitudinal evidence has similarly shown that autonomy support predicts need satisfaction, which subsequently contributes to more adaptive social behavior in physical education (Jang et al., 2020). In the present gamification program, success frequently depended on teamwork rather than exclusively on individual achievement. As a result, helping teammates and cooperating with others became functionally relevant to progress within the gamified environment, potentially reinforcing prosocial behavioral patterns.

The present study also demonstrated a significant reduction in antisocial behavior toward opponents. This finding is consistent with evidence showing that supportive motivational environments can reduce maladaptive social behavior in physical education (Cheon et al., 2023; Jang et al., 2020). Although gamification often includes competition, competition can be structured in a way that emphasizes rules, fair participation, shared narrative goals, and recognition of appropriate behavior rather than hostility or interpersonal domination. In the present intervention, students earned points not only for technical performance but also for cooperation and adherence to rules. Such reinforcement may have communicated that successful participation required socially appropriate conduct. Gamification therefore may have redirected competitive behavior toward task mastery and structured challenges rather than aggression toward opponents. More broadly, digital and educational gamification has been proposed as a strategy for increasing physical activity while maintaining students' engagement through structured and meaningful participation (Antonopoulos, 2024).

However, gamification did not significantly affect prosocial behavior toward opponents or antisocial behavior toward teammates. One possible explanation is that the intervention placed greater emphasis on within-team cooperation than on direct cooperative interactions with opposing teams. Team members repeatedly collaborated to complete tasks and challenges, making prosocial behavior toward teammates highly relevant to the instructional structure. Conversely, opportunities to help or encourage opponents may have been less frequent. Likewise, antisocial

behavior toward teammates may already have been constrained by the cooperative nature of the class and therefore less susceptible to change. The validated distinction between prosocial and antisocial behaviors toward teammates and opponents is important because these behaviors represent contextually different forms of interpersonal conduct (Trigueros et al., 2020). The use of the Persian adaptation of the measure also provides an appropriate framework for distinguishing these behavioral targets in Iranian participants (Hossein Nejad & Mohammadi, 2022).

5. Conclusion

Taken together, the findings suggest that the effects of gamification are selective rather than universal. Gamification improved the dimensions most directly supported by the structure of the intervention: competence through progressive skill challenges and feedback, relatedness through team membership and cooperation, autonomy frustration through a less controlling learning atmosphere, prosocial behavior toward teammates through shared goals, and reduced antisocial behavior toward opponents through structured and rule-governed competition. This pattern reinforces the argument that gamification effectiveness depends on how game mechanics are aligned with educational and psychological objectives. Current research increasingly emphasizes that gamification should be deliberately designed rather than merely created by adding points or rewards to existing instruction (Ferraz et al., 2024). Advances in interactive and technology-supported learning likewise suggest that meaningful engagement depends on integrating gamified features with educational goals rather than treating them as superficial incentives (Banik & Gullapelly, 2025). Similar motivational advantages have been documented in other educational domains, including language learning (Diana et al., 2025), virtual learning and creative educational activities (Shafiei Sarvestani et al., 2025), and game-integrated leisure and physical activity programs (Sefidgar et al., 2024). Gamified physical activity interventions have even shown potential effects on physical and cognitive development outside conventional school settings (Davies et al., 2024). Thus, the present findings extend a growing body of evidence suggesting that thoughtfully structured gamification can serve as a psychologically and socially meaningful instructional approach.

6. Limitations & Suggestions

The present study has several limitations that should be considered when interpreting the findings. First, the sample was relatively small and was drawn from only two classes in a single girls' junior high school, which limits the generalizability of the results to other schools, geographical regions, age groups, and student populations. Second, all participants were seventh-grade female students; therefore, the results cannot be assumed to apply equally to male students or students at other educational levels. Third, the intervention lasted only eight sessions, and no follow-up assessment was conducted, making it impossible to determine whether the observed improvements were maintained over time. Fourth, the study relied primarily on self-report measures of psychological needs and social behavior, which may be influenced by social desirability, response tendencies, or students' subjective interpretations of their experiences. Fifth, although the same teacher instructed both groups to reduce teacher-related variation, this may have introduced the possibility of treatment contamination or expectancy effects. Finally, the intervention focused specifically on basketball, meaning that the results may differ when gamification is applied to individual sports, fitness activities, gymnastics, athletics, or other areas of the physical education curriculum.

Future research should replicate the present study using larger and more heterogeneous samples drawn from multiple schools and regions to improve external validity. Studies should include both male and female students and examine whether sex, age, initial motivation, physical competence, or prior gaming experience moderates responses to gamified instruction. Longer interventions with follow-up measurements are also recommended to determine whether changes in psychological needs and social behaviors persist after the gamification program ends. Future studies could employ three or more experimental conditions to compare different forms of gamification, such as cooperative, competitive, narrative-based, and digitally supported gamification, thereby identifying which elements contribute most strongly to specific outcomes. Researchers should also incorporate behavioral observation, teacher ratings, peer reports, and objective measures of physical activity alongside self-report questionnaires. Mediation analyses could examine whether changes in competence, autonomy, or relatedness explain subsequent changes in prosocial and antisocial behavior. Finally, gamification should be evaluated across different sports and physical education

content to determine whether its effectiveness depends on the nature of the activity being taught.

Physical education teachers may consider incorporating gamification into regular instruction when the goal is to enhance students' sense of competence, strengthen peer relationships, reduce controlling experiences, and encourage constructive social behavior. Effective implementation should move beyond the simple use of points and rewards and instead include progressively challenging tasks, clear goals, immediate and informative feedback, meaningful narratives, opportunities for collaboration, team identities, and transparent rules. Teachers should ensure that competition remains friendly and educational and does not create excessive social comparison or exclusion. Students should also be given meaningful opportunities to make decisions within activities so that gamification supports autonomy rather than merely replacing one form of external control with another. Schools can support implementation by providing professional development that helps physical education teachers design psychologically supportive gamified lessons. Particular attention should be given to structuring team activities in ways that reward cooperation, respectful interaction, fair play, and collective progress as well as technical achievement.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contributed to this article.

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