

The Impact of Game-Based Instruction on Student Engagement in Track and Field Courses: A Case Study at Jiaying University

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ABSTRACT

Physical education is an important component of higher education because it supports both physical development and learning-related motivation. However, track and field classes are still often taught through repetitive, teacher-centred drills that may not sustain students' engagement. This study examined whether game-based instruction could improve student engagement in a university track and field course. A quasi-experimental design was employed with 60 students from the School of Physical Education at Jiaying University, including 30 students in an experimental group and 30 in a control group. Over a 12-week intervention, the experimental group participated in structured game-based sprint, relay, and jumping activities, whereas the control group received conventional instruction. Student engagement was assessed using a five-point Likert questionnaire adapted from validated higher-education engagement instruments and organized around interest, participation, and motivation. Descriptive statistics, paired-samples t tests, independent-samples t tests, and effect sizes were reported. The experimental group improved from 3.15 ± 0.42 to 4.42 ± 0.38 , $t(29) = 5.87$, $p < .001$, Cohen's $d_z = 1.07$, whereas the control group changed only from 3.12 ± 0.45 to 3.35 ± 0.40 , $t(29) = 1.21$, $p = .236$, Cohen's $d_z = 0.22$. Post-test comparisons also favoured the experimental group in overall engagement and in the dimensions of interest, participation, and motivation, all $p < .001$, with large between-group effects. These findings suggest that well-structured game-based instruction can substantially enhance student engagement in track and field courses.

Keywords: game-based instruction, student engagement, track and field, physical education, gamification, quasi-experimental design

INTRODUCTION

Student engagement is widely regarded as a central condition for effective learning because it reflects how much effort, emotion, and attention students invest in academic activity. Recent scale-development and validation studies in higher education consistently conceptualize engagement as multidimensional rather than as a single attitude. Heilporn, Raynault, and Frenette (2024) reported a four-factor course-level structure covering emotional-cognitive, social, agentic, and behavioral engagement, while Assefa, Fetene, and Wolle (2025) validated a five-factor university engagement scale including behavioral, emotional, cognitive, agentic, and sociocultural dimensions. Taken together, this recent evidence supports the view that engagement should be measured through multiple related components.

Within physical education, track and field remains a foundational area because it develops speed, coordination, rhythm, movement control, and basic athletic competence. Yet many track and field classes still rely heavily on repetitive drills, fixed demonstrations, and instructor-directed correction. Such routines may be technically useful, but when variation and interaction are limited, students can experience boredom, passive participation, and reduced willingness to invest effort in class tasks. This issue is especially important in university courses, where recent higher-education research continues to link course-level engagement with learning, satisfaction, retention, and academic success (Heilporn et al., 2024; Assefa et al., 2025).

Game-based instruction has increasingly been proposed as a practical response to this challenge. Gamified or game-based learning environments typically use goals, rules, feedback, challenge, cooperation, and competition to make participation more meaningful and enjoyable. Recent reviews in education suggest that gamification can improve engagement and motivation when the design is aligned with learner characteristics and instructional goals (Oliveira et al., 2023; Triantafyllou, Georgiadis, & Sapounidis, 2025). In physical education specifically, recent reviews indicate that game-based learning and gamification are associated with stronger motivation, commitment, and participation, although more context-specific evidence is still needed for particular course types and age groups (Camacho-Sánchez et al., 2023; Ruiz, Vargas Sanchez, & Boude Figueredo, 2024; Sal-de-Rellán, Hernández-Suárez, & Hernaiz-Sánchez, 2025). Against this background, the present study examined whether a 12-week game-based intervention could improve student engagement in a university track and field course.

LITERATURE REVIEW

The theoretical logic behind game-based instruction is that well-designed tasks can transform repetitive practice into goal-directed participation. Instead of asking students to repeat isolated movements without immediate meaning, game-based formats place the same skills inside short challenges that require attention, decision-making, peer interaction, and visible progress. This can strengthen emotional and behavioral engagement by increasing enjoyment, classroom energy, and willingness to participate. Recent studies and reviews have linked such game-informed course design to stronger study engagement, motivation, and course involvement when the activity structure is purposeful rather than merely entertaining (Chen & Liang, 2022; Balalle, 2024; Triantafyllou et al., 2025).

Recent physical education reviews provide further support for this line of reasoning. Camacho-Sánchez et al. (2023), in a systematic review of game-based learning and gamification in physical education, concluded that these approaches tend to improve student motivation, academic performance, and commitment to healthy and physically active behaviour. Ruiz et al. (2024) likewise argued that gamification is often linked to stronger participation and motivation, but they also noted that many studies measure engagement only partially, focusing on isolated indicators rather than broader course engagement. Sal-de-Rellán et al. (2025) similarly reported that gamification in physical education tends to enhance motivation, autonomy, and classroom climate, although methodological inconsistency remains a limitation in the field. More recent intervention evidence also points in the same direction: Ezeddine et al. (2025) found that game-based physical education improved students' motivation and motor engagement, and Hsia et al. (2025) reported that a gamified tutoring system in a university physical education setting enhanced learning engagement relative to a conventional system.

Taken together, these studies suggest that the value of game-based instruction lies not simply in making lessons entertaining, but in restructuring participation so that students experience challenge, feedback, cooperation, and achievement during skill practice. In the context of track and field, this means that sprinting, relay exchange, and jumping can be organized as purposeful game tasks rather than as monotonous repetitions. The present study therefore focused on three practical dimensions of engagement that are particularly salient in a skills-based physical education course: interest, participation, and motivation.

METHODOLOGY

Participants

The study involved 60 students from the School of Physical Education at Jiaying University (Class of 2024), including 30 male and 30 female students. All participants were in good physical condition and were able to take part in regular physical activity. They were assigned to an experimental group ($n = 30$) and a control group ($n = 30$).

Research Design

A quasi-experimental pre-test-post-test design was adopted. The intervention lasted 12 weeks. The experimental group received game-based instruction in track and field classes, whereas the control group followed

conventional drill-based teaching. The main purpose was to compare changes in student engagement within each group and differences between groups at post-test.

Intervention

The experimental programme combined sprint, relay, and jumping content with structured game elements such as task goals, immediate feedback, peer cooperation, time-based challenge, and friendly competition. Activities progressed from simple participation tasks to more complex team-based challenges so that students could first adapt to the format and then deepen technical application through repeated practice in meaningful game situations. The control group followed conventional teaching procedures centred on demonstration, repetition, and correction. A summary of the weekly game-based activities is provided in Appendix A.

Measurement

Table 1. Reliability and Prior Validation Basis for the Engagement Measure

Instrument / source	Reference	Key characteristics	Reliability / validation evidence	Use in current study
MSSEC	Heilporn et al. (2024)	Higher-education course scale with four dimensions: emotional-cognitive, social, agentic, and behavioral engagement.	Validity evidence obtained through confirmatory factor analysis, internal consistency, and partial invariance across gender, age, university level, and course modality.	Provided a recent higher-education basis for treating engagement as a multidimensional course-level construct.
USES	Assefa et al. (2025)	University Student Engagement Scale validated in higher education; 20 items with five dimensions: behavioral, emotional, cognitive, agentic, and sociocultural engagement.	EFA/CFA supported the factor structure; authors reported psychometric sensitivity and strong evidence for validity, reliability, and measurement invariance.	Strengthened the higher-education measurement basis and supported multidimensional item adaptation.
EPES	Stringfellow et al. (2024)	Physical-education-specific scale; final 18-item model covering agentic, cognitive, behavioral, and emotional engagement.	Good model fit after respecification (CFI = .962, GFI = .903, SRMR = .0428, RMSEA = .061); acceptable composite reliability across subscales.	Ensured relevance to physical education and informed wording for context-specific engagement items.

Student engagement was measured using a five-point Likert questionnaire adapted for the university track and field context. The measurement design drew on recent validated instruments rather than on a single legacy scale. First, Heilporn et al. (2024) developed a multidimensional higher-education course engagement scale and reported validity evidence from confirmatory factor analysis, internal consistency testing, and partial invariance across gender, age, level of study, and course modality. Second, Assefa et al. (2025) validated the University Student Engagement Scale (USES) with 456 undergraduates and reported a theoretically supported five-factor structure together with evidence of validity, reliability, psychometric sensitivity, and measurement invariance. Third, Stringfellow, Wang, Farias, and Hastie (2024) developed an Engagement in Physical Education Scale and found psychometric support for an 18-item four-factor model; the respecified model showed good fit (CFI = .962, GFI = .903, SRMR = .0428, RMSEA = .061), and composite reliability values were acceptable across

behavioral, cognitive, agentic, and emotional dimensions. Based on these recent validation studies, the present questionnaire retained concise items reflecting interest, participation, and motivation, which were most relevant to the current university track and field course. These indicators are also consistent with recent gamification studies that operationalize engagement through active participation, motivational investment, and positive involvement in learning tasks (Chen & Liang, 2022; Ruiz et al., 2024; Ezeddine et al., 2025). Higher scores indicated stronger engagement in the course.

Data Analysis

Descriptive statistics were used to summarize group performance. Paired-samples t tests were used to examine pre-test to post-test change within each group. Independent-samples t tests were used to compare the experimental and control groups at post-test. In response to current reporting recommendations, effect sizes were also included. For within-group pre-post comparisons, Cohen’s dz was calculated from the paired t statistic and sample size. For between-group post-test comparisons, Hedges’ g was calculated from the mean difference and pooled standard deviation. The level of significance was set at $p < .05$.

RESULTS

The statistical pattern was consistent across all analyses. Both groups showed some improvement over time, but the magnitude of change was substantially greater in the experimental group. When effect sizes are considered alongside p values, the practical impact of the intervention becomes clearer.

Table 2. Within-Group Changes in Overall Engagement from Pre-test to Post-test

Group	N	Pre-test Mean ± SD	Post-test Mean ± SD	Mean difference	t	p	Effect size (Cohen's dz)	Interpretation
Experimental	30	3.15 ± 0.42	4.42 ± 0.38	1.27	5.87	< .001	1.07	Large
Control	30	3.12 ± 0.45	3.35 ± 0.40	0.23	1.21	.236	0.22	Small

As shown in Table 2, the experimental group demonstrated a marked improvement in overall engagement across the 12-week intervention, increasing by 1.27 scale points from pre-test to post-test. The paired-samples t test was statistically significant, and the corresponding effect size was large ($dz = 1.07$). In contrast, the control group showed only a small increase of 0.23 points, and the associated effect size was small ($dz = 0.22$), indicating limited practical change under conventional instruction.

Table 3. Between-Group Post-test Comparisons with Effect Sizes

Variable	Experimental Mean ± SD	Control Mean ± SD	Mean difference	t	p	Effect size (Hedges' g)	Interpretation
Overall engagement	4.42 ± 0.38	3.35 ± 0.40	1.07	10.62	< .001	2.71	Very large
Interest	4.50 ± 0.35	3.40 ± 0.42	1.10	11.02	< .001	2.81	Very large
Participation	4.38 ± 0.40	3.33 ± 0.39	1.05	10.29	< .001	2.62	Very large
Motivation	4.37 ± 0.36	3.32 ± 0.41	1.05	10.54	< .001	2.69	Very large

Table 3 shows that the experimental group scored significantly higher than the control group at post-test for overall engagement and for each subdimension. The post-test difference in overall engagement was 1.07 points, $t(58) = 10.62$, $p < .001$, with a very large effect (Hedges’ $g = 2.71$). Similar patterns were observed for interest,

participation, and motivation, all of which produced very large effect sizes. These results indicate that the game-based intervention generated not only statistically reliable gains but also strong practical effects.

DISCUSSION

The findings indicate that game-based instruction can markedly enhance student engagement in university track and field courses. The experimental group not only improved significantly from pre-test to post-test, but also outperformed the control group by a wide margin at post-test. Importantly, the effect-size estimates suggest that the intervention was not merely statistically significant; it was also educationally substantial. The strongest pattern was observed in interest, followed closely by participation and motivation, indicating that the intervention influenced multiple dimensions of classroom involvement rather than a single isolated indicator.

This pattern is consistent with the broader literature on engagement and gamification. Recent measurement studies in higher education and physical education both support the view that engagement is multidimensional and should be interpreted across related affective, behavioral, cognitive, and agentic components rather than as a single indicator (Heilporn et al., 2024; Stringfellow et al., 2024; Assefa et al., 2025). Likewise, Chen and Liang (2022) found that gamification can influence study engagement through mechanisms such as enjoyment and self-efficacy. Review evidence also suggests that well-designed gamification tends to strengthen motivation and participation, although results depend on context and implementation quality (Camacho-Sánchez et al., 2023; Sal-de-Rellán et al., 2025; Triantafyllou et al., 2025). Importantly for physical education, Hsia et al. (2025) and Ezeddine et al. (2025) reported improved engagement-related outcomes in gamified or game-based instructional settings, which is consistent with the present findings.

One reason for these outcomes may be that game-based instruction changes the perceived meaning of repetitive skill practice. Instead of completing the same movement pattern in a routine and detached way, students work toward a clear task goal, receive immediate feedback, and interact with peers under time or performance constraints. In track and field teaching, such structuring can make technical practice feel more purposeful and socially engaging. This helps explain why the present intervention produced stronger gains in interest and participation than conventional drill-based instruction.

From a practical perspective, the results suggest that game-based instruction can be used not as a replacement for technical teaching, but as a way of reorganizing technical content. Sprint starts, relay exchanges, and jumping practice can still target core learning outcomes while being presented through structured competitive or cooperative tasks. For university instructors, this may provide a feasible strategy for improving classroom atmosphere, student investment, and sustained participation without abandoning curricular goals.

CONCLUSION

This study demonstrates that game-based instruction can effectively improve student engagement in a university track and field course. Compared with conventional teaching, the intervention generated stronger post-test scores in overall engagement and in the dimensions of interest, participation, and motivation.

The revised reporting in this manuscript also shows the value of presenting effect sizes alongside significance tests. The intervention was associated with a large within-group gain in the experimental group and very large between-group post-test differences, which strengthens the practical interpretation of the findings.

It is therefore recommended that track and field instructors consider integrating game-based tasks into regular teaching practice. Future research may extend this work by using larger samples, longer follow-up periods, and full psychometric reporting of the adapted engagement instrument in the target population.

Table 4 provides a concise description of the weekly activities used in the experimental group. The progression moved from low-complexity entry tasks to integrated team challenges so that technical learning and engagement could develop together over time.

Table 4. Weekly Game-Based Activities Used During the 12-Week Intervention

Week	Activity	Track and field focus	Brief implementation	Expected engagement mechanism
1	Start-signal chase	Reaction and sprint start	Students reacted to visual or whistle signals and sprinted to marked zones before an opponent.	Raised alertness, novelty, and early participation while introducing game rules.
2	Baton shuttle relay	Relay exchange basics	Teams completed short shuttle relays emphasizing safe baton passing in the exchange zone.	Encouraged cooperation, peer correction, and shared responsibility.
3	Acceleration ladder relay	0-30 m acceleration	Pairs or small teams raced through short acceleration segments with point scoring for technique and speed.	Linked sprint technique to immediate challenge and visible reward.
4	Cone pursuit sprint	Stride control and lane discipline	One runner pursued another over a short marked distance while maintaining lane control.	Increased competitive focus and effort during repeated sprint practice.
5	Rhythm hurdle challenge	Coordination and running rhythm	Students completed low-hurdle patterns for time or accuracy in small-group contests.	Made coordination drills more engaging through rhythm-based scoring.
6	Target-zone jump challenge	Take-off and landing control	Students aimed to land in designated zones, earning points for controlled take-off and landing.	Improved precision and sustained attention in jumping practice.
7	Run-up rhythm cards	Approach consistency for long jump	Students matched run-up steps to pre-set rhythm cards and team targets.	Added decision-making and variation to repeated approach practice.
8	Interval pursuit relay	Speed endurance	Teams alternated short high-intensity runs with recovery intervals in a pursuit format.	Sustained effort through team accountability and rotating roles.
9	Obstacle decision sprint	Agility and rapid response	Students changed running lines according to colour or number cues during short sprint tasks.	Combined cognitive engagement with physical execution.
10	Mixed-event station quest	Integrated sprint and jump skills	Groups rotated through mini-stations with scorecards combining sprint, relay, and jump tasks.	Maintained variety and reinforced whole-course skill transfer.
11	Team challenge circuit	Application under competition	Students completed a cumulative points circuit based on technical execution and teamwork.	Strengthened commitment, persistence, and peer encouragement.

12	Class championship review	Skill consolidation and reflection	A final game-based review session combined competitive tasks with feedback and reflection.	Promoted achievement, closure, and positive course experience.
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