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Effect of Game-based Instructional on Learning Engagement and Game Performance of Students in Physical Education

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ABSTRACT

Background: There is a notable increase in the use of integrated learning models in physical education (PE). However, there is a lack of available resources that implement teaching games for understanding-sports education (TGfU-SE) to improve learning engagement (LE) and game performance (GP) among university level students. Purpose: This study aims to determine the effect of TGfU-SE on students' LE and GP over a period of 12 weeks. Methods: A true experimental study with a randomized controlled trial (RCT) design for 12 weeks was adopted in this study. Participants were 54 students from Physical Education and Recreation Health at Singaperbangsa University Karawang (Indonesia) who were equally allocated into experimental (TGfU-SE, n = 27, 18.4 ± 0.88 year) and control groups (TGfU, n = 27, 19.0 ± 1.06 year). The Utrecht Work Engagement Scale for Students (UWES-9S) and the Game Performance Assessment Instrument (GPAI) were used. Student's t Paired Samples T-Test and 2 × 2 repeated measures ANOVA test were used to analyze the data. Results: The TGfU-SE model outperformed the TGfU model in terms of boosting LE ($p < 0.05$) and GP ($p < 0.05$). Repeated measures ANOVA shows a significant effect of time, teaching and interaction time x teaching in LE and GP ($p < 0.05$). Conclusion: All components of LE and GP demonstrate a positive improvement as a result of the 12-week implementation of TGfU-SE.

Keywords: Game-based instructional; Engagement; Game Performance

INTRODUCTION

Recently, many different learning models have been performed to be implemented in physical education (PE) (Juliantine et al., 2022), such as student-centered learning, cooperative learning (Casey & Quennerstedt, 2020), and game-centered learning which have been implemented in PE curriculum (Pan et al., 2023). In order to increase students' cognitive, emotional, and psychomotor elements, a variety of techniques models were studied in order to determine the most effective learning model (Arufe-Giráldez et al., 2022). Ferraz et al. (2023), suggest that introducing innovation into a teaching model would improve the learning environment. For instance, PE instruction will be more enjoyable and students will get the lesson content in the best possible way (Juliantine & Setiawan, 2022; Shen & Shao, 2022). Nowadays, game-centered learning techniques are getting greater attention and are being used in PE settings (Ortiz et al., 2023). The game-centered learning model can be defined as a learning approach that prioritizes the presentation of sports games that are engaging, enjoyable, and dynamic for students. Prior research has shown the existence of many game-centered learning paradigms, including teaching games for understanding (TGfU) and sports education (SE) (Casey & MacPhail, 2018; Dockerty & Pritchard, 2023).

Hybrid development between TGfU and SE has gained popularity among scholars globally wordwide (Gil-Arias et al., 2021). TGfU-SE is a type of learning based on authentic sports games (Ortiz et al., 2023), which is carried out over several seasons (Viciana et al., 2020; Li et al., 2022), which aims to generate students with high technical and tactical skills (Calábria-Lopes et al., 2019), and expected to be professional athletes (Tendinha et al., 2021). Prior to the development of hybrid TGfU-SE, previous study showed that both models were proven to have their respective advantages, for example TGfU is a pedagogical tool in improving technical skills (Robles et al., 2020), tactical awareness (Greve et al., 2022), motivation (Gaspar et al., 2021) and physical activity (García-Castejón et al., 2021). Meanwhile, it has been reported that SE positively develops engagement, motivation until physical activity (Franco et al., 2021; Giménez-Meseguer et al., 2022), as well as motor and cognitive domains (Bessa et al., 2021). Basically, TGfU-SE has the same learning attributes, namely student-centered (Gil-Arias et al., 2021), so combining TGfU and SE appropriate approach to get significantly improved learning results in PE (Pan et al., 2023). A recent study reported that hybrid TGfU-SE promises much better results, which showed that learning motivation, enjoyment of responsible sports, and game performance among students improved significantly compared to traditional TGfU (Pan et al., 2023). Based on earlier research that showed how important TGfU-SE adoption is for long-term PE learning, our research focuses on using TGfU-SE to improve students' learning engagement (LE) and game performance (GP).

LE has emerged an essential component in various educational fields, including PE and has become the focus of attention among world research (Gu et al., 2022). Basically, LE is a theoretical framework that elucidates the involvement of students in PE learning activities within an educational environment. LE can be a reference for a lecturer to observe students' engagement in the teaching program (Bertills et al., 2019). LE has three main concepts, namely: vigor, dedication, and absorption (Aronen et al., 2021; Lobo, 2023b). The term vigor is used to describe the behavior of students who are energetic, confident, happy and have great fighting power to achieve a goal

(De Francisco et al., 2020). Dedication can be described as the students' behavior in committed to achieve learning goals as best as possible (Lobo, 2023a). Meanwhile, absorption refers to the students' behavior to involved in various PE activities (Lobo et al., 2023). Students with a high level of LE can gain positive benefits, for example students have more knowledge, skills, and high academic achievements (Hastie et al., 2022). A recent study revealed that students that exhibit high levels of engagement demonstrate beneficial behaviors, including attentiveness, profound interest, and active participation in numerous PE activities (Lobo, 2023b; Otundo & Garn, 2019). In addition, students with high level of LE are more likely to be enthusiastic and to solve learning problems well (Benito Mundet et al., 2021). Meanwhile, Simón-Chico et al. (2023), reported that low LE can cause negative behavior in students, for example low student learning motivation in PE. Facts and data report that among students it has decreased significantly and this is an important problem in PE that must be addressed immediately (Trabelsi et al., 2020). Apart from increasing LE among students, another aspect also needs to be improved, namely game performance (GP).

The result that students must achieve in PE is to have a high GP in a sport (e.g., basketball). A well-developed GP will produce students with good abilities in: decision making, execution skills, and support (Pan et al., 2023). The decision making component is related to students' ability to make the right decisions in attacking and defending (Macías-Romero & Otero-Saborido, 2018). The skill execution describes students' ability to carry out the selected skills efficiently (Arias-Estero et al., 2020). Meanwhile, support is closely related to the students' ability to provide appropriate support for teammates who control the ball by being in a position to receive a pass. Other study reported that student with a high GP has a greater chance to win the competition (Bergkamp et al., 2020). On the other hand, low GP is a trigger for loss and low achievements (Nathan, 2017).

There were several previous studies about TGfU-SE (Gil-Arias et al., 2021; Gouveia et al., 2022; Pan et al., 2023). However, to the best of our current best knowledge, there was still limited research investigating the effect of TGfU-SE versus original TGfU on increasing LE and GP among university students. The aim of our study was to determine the effect of 12 weeks of TGfU-SE on increasing LE and GP among university students.

METHOD

Ethical statement

The study was approved by the Ethics Committee of the State University of Jakarta (Indonesia) under number: 0560/UNJ.39.6.Ps/LT/2023) and adopted the Helsinki rules for research involving humans beings (Helsinki Declaration 2013). Participants and their families were required to sign informed consent form prior to taking part in this research.

60 students from the Department of Physical Education and Recreation Health at Singaperbangsa University Karawang took part in this research. Participants were basketball courses students who studied in the second year university level. Participants were selected based on the inclusion criteria: (i) not injured, (ii) healthy, (iii) not taking part in national or international championships, and (iv) students who were taking basketball courses. Exclusion criteria: (i) injury in the last 3 months, (ii) rarely attended lectures in the last 3 months. From 60 students, 54 were selected on the

basis of inclusion criteria, 6 students were excluded (exclusion criteria). The number of participants was in accordance with the needs of this research based on prior G*Power analysis (v.3.1.9.4). The results of these calculations showed that a minimum of 27 participants was required in each group. Then 54 participants were assigned to experimental group (TGfU-SE, n = 27) and control group (TGfU, n = 27) referring to previous studies (Pan et al., 2023). A detailed schematic is presented in Figure 1 and participant information is presented in Table 1.

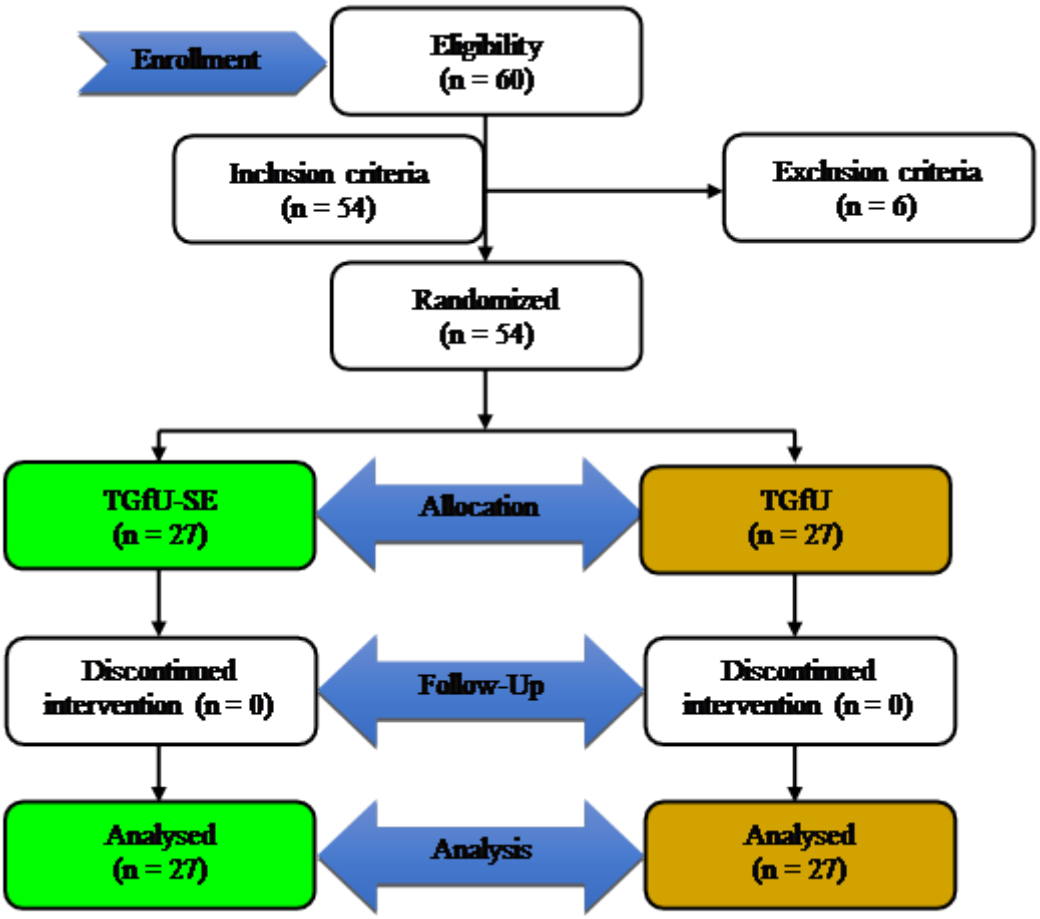

Figure 1. Flow chart

Table 1. Information on the characteristics of TGfU-SE and TGfU participants

Variables	TGfU-SE (n = 27)	TGfU (n = 27)
Gender (male; female)	17;10	15;12
Age (years; M[SD])	18.4 ± 0.88	19.0 ± 1.06
Height (cm; M[SD])	159.0 ± 2.77	160.0 ± 2.74
Weight (kg; M[SD])	56.3 ± 1.51	57.6 ± 2.52
BMI (kg/m2; M[SD])	21.0 ± 1.02	21.1 ± 1.07

Note. TGfU-SE = Teaching games for understanding-sports education, M = Mean, SD = Standard deviation, BMI = Body mass index

Instruments

Learning engagement (LE)

The student LE in PE was assessed using The Utrecht Work Engagement Scale for Students (UWES-9S) (Lobo, 2023b). The instrument consists of three dimensions: vigor (3 items), example question: „When I take PE classes on campus, I feel full of energy. Dedication (3 items), example question: „I am committed to studying hard" and absorption (3 items) example question: „I am proud with my studies". A Likert scale ranged from 0 = „Never" to 6 = „Always" was used to fill out the questionnaire.

Game performance (GP)

The GP of students in basketball course was assessed using the Game Performance Assessment Instrument (GPAI). This instrument has three main assessments, namely: (i) decision making, (ii) skill execution, and (iii) support. This instrument directly evaluated decision making, execution skills, and support carried out by students during the game. The assessment method provided a score of 1 = Very weak performance, 2 = Weak performance, 3 = Moderately effective, 4 = Effective performance to 5 = Very effective performance (Memmert & Harvey, 2008). The scores were added up to assess the final GP score for each student.

Design and Procedures

This research was conducted from November 2023 to January 2024 at Singaperbangsa Karawang State University (Indonesia), and was the subject of true experimental research with a 12-week randomized controlled trial (RCT). At the first meeting (November 1, 2023) all participants carried out a pre-test, namely filling in the LE questionnaire and GP test from 08.00-09.20 am. The first study for the experimental (TGfU-SE) and control groups (TGfU) was conducted from November 04, 2023 to January 23, 2024. On January 26, 2024, all participants completed the LE questionnaire and GP test again from 09.00-10.20 am.

Hybrid Intervention Program TGfU-SE

TGfU-SE learning was carried out over 12 weeks, with three (3) meetings a week, on Monday, Wednesday, and Friday. Basketball material was integrated into the TGfU-SE program. Learning session was carried out for 60 minutes in one meeting. The detail of TGfU-SE program adopted from previous research (Pan et al., 2023), is presented in Table 2

Table 2. TGfU-SE learning program

Season of SE	Lesson	Content	TGfU principle	Features of SE
Pre-season	1–2	**Topic: strategies for 3 vs 3 game** Basic dribble. Basic passing. Basic shoot. 3 vs 3 basketball game.	Create space to try to attack. Tactical in games.	Season affiliation
	3–4	**Topic: effective dribble games** One vs one attack and defense. Two vs two attack and defense. 3 vs 3 basketball game.	Dribble through to create space for an attack. Tactical in games. Decision-making skills.	Season affiliation
Season	5–6	Topic: to win the competition Offensive and defensive tactics. 3 vs 3 basketball game.	Allow teammates to cover and create a space to attack the basket. Tactical in games.	Season affiliation
	7–8	**Topic: shoot with great precision** Jump shot. Game design. 3 vs 3 basketball game.	Should I hold the ball or shoot at the goal? Fast break. Tactical in games.	Season Affiliation. Formal competition Record-keeping
	9–10	**Topic: attack opponent's field** Defense/ skill execution/ support. Change defense to attack. Defense/attack tactical application. 3 vs 3 basketball game.	Where should I shoot at?. Creating and defending space as a team. Tactical in games.	Season. Affiliation. Formal competition. Record-keeping.
Post-season	11–12	**Final for 3 vs 3** Final for 3 vs 3 basketball game. Festivities.	Develop team cooperation competence. Tactical in games.	Season. Affiliation. Formal competition. Record-keeping. Culminating event festivities.

Statistical Analysis

First, descriptive statistics are reported as mean (M) ± standard deviation (SD). Second, we used the Shapiro-Wilk test to check normality for each variable and the data was assumed to be normally distributed ($p > 0.05$). Finally, we used Student's t Paired Samples T-Test to detect changes in LE and GP from pre-test to post-test in both groups (TGfU-SE and TGfU), while testing 2 × 2 repeated measures ANOVA to investigate the effect of (time) pre- vs post-test and (teaching) TGfU-SE vs TGfU, as well as time x teaching interactions on LE and GP. Partial eta squared (η^2p) was used: small (0.01), medium (0.06), and large (0.14) (Gil-Arias et al., 2021) Metzler proposed a range of pedagogical models that include second generation models such as teaching games for understanding (TGfU. The effect size (ES) is interpreted as Cohen's d and the formula: $0.00 \leq d \leq 0.19$ (trivial), $0.20 \leq d \leq 0.49$ (small), $0.50 \leq d \leq 0.79$ (moderate) and $d \geq 0.80$ (large). The level of statistical significance was set at $p < 0.05$. Data analysis was carried out using Jamovi version 23.2.8.

RESULTS

The results of Student's t analysis showed that there was a change in the mean LE value from pre and post-test in both groups ($p < 0.05$) (Table 3). The results of the 2 × 2 repeated measures ANOVA analysis in Table 3 show that there was an effect of (time) pre- vs post-test ($F^{1.52} = 138.6$, $p < .001$, $\eta^2p = 0.727$, (teaching) TGfU-SE vs TGfU ($F1.52 = 5.17$, $p = 0.027$, $\eta^2p = 0.090$) and time x teaching interaction ($F1.52 = 35.6$, $p < .001$, $\eta^2p = 0.406$) for vigor, for dedication (time) pre- vs post-test ($F1.52 = 210.4$, $p < .001$, $\eta^2p = 0.802$, (teaching) TGfU-SE vs TGfU ($F1.52 = 7.22$, $p = 0.010$, $\eta^2p = 0.122$) and time x teaching" interaction ($F1.52 = 49.8$, $p < .001$, $\eta^2p = 0.489$), while absorption (time) pre- vs post-test ($F1.52 = 155.0$, $p < .001$, $\eta^2p = 0.749$, (teaching) TGfU-SE vs TGfU ($F1.52 = 15.8$, $p < .001$, $\eta^2p = 0.233$) and the interaction time x teaching ($F1.52 = 28.7$, $p < .001$, $\eta^2p = 0.356$).

Table 3. Effect of TGfU-SE and TGfU on learning engagement (LE) parameters

Variables	n	Teaching	Pre-test M ± SD	Post-test M ± SD	p	ES	2 × 2 repeated measures ANOVA		
							Teaching	Time	Interaction
LE									
Vigor (score)	27	TGfU-SE	9.41 ± 1.58	13.59 ± 1.53	< .001	-1.87	F1.52 = 5.17 p = 0.027 $\eta^2p = 0.090$	F1.52 = 138.6 p < .001 $\eta^2p = 0.727$	F1.52 = 35.6 p < .001 $\eta^2p = 0.406$
	27	TGfU	10.0 ± 1.51	11.4 ± 1.50	< .001	-1.36			
Dedication (score)	27	TGfU-SE	8.63 ± 1.21	13.78 ± 1.53	< .001	-2.44	F1.52 = 7.22 p = 0.010 $\eta^2p = 0.122$	F1.52 = 210.4 p < .001 $\eta^2p = 0.802$	F1.52 = 49.8 p < .001 $\eta^2p = 0.489$
	27	TGfU	9.52 ± 1.42	11.30 ± 1.41	< .001	-1.36			
Absorption (score)	27	TGfU-SE	10.1 ± 1.20	14.0 ± 1.02	< .001	-2.01	F1.52 = 15.8 p < .001 $\eta^2p = 0.233$	F1.52 = 155.0 p < .001 $\eta^2p = 0.749$	F1.52 = 28.7 p < .001 $\eta^2p = 0.356$
	27	TGfU	10.2 ± 1.42	11.7 ± 1.49	< .001	-1.31			

Note. LE = Learning engagement, ES = Effect size, $p < 0.05$.

The results of Student's t analysis showed that there was a change in the mean GP value from pre- and post-test in both groups ($p < 0.05$) (Table 4). The results of 2 × 2 repeated measures ANOVA analysis in Table 4 shows that there was an effect of (time) pre-test vs post-test ($F^{1.52} = 269.5$, $p < .001$, $\eta^2p = 0.838$, (teaching) TGfU-SE vs TGfU ($F1.52 = 7.35$, $p = 0.009$, $\eta^2p = 0.124$) and the interaction time x teaching ($F1.52 = 46.6$, $p < .001$, $\eta^2p = 0.473$) for decision making, for skill execution (time) pre- vs post-test ($F1.52 = 247.8$, $p < .001$, $\eta^2p = 0.827$, (teaching) TGfU-SE vs TGfU ($F1.52 = 6.74$, $p = 0.012$, $\eta^2p = 0.115$) and time x teaching interaction ($F1.52 = 70.6$, $p < .001$, $\eta^2p = 0.576$), while for support (time) pre- vs post-test ($F1.52 = 88.2$, $p < .001$, $\eta^2p = 0.629$, (teaching) TGfU-SE vs TGfU ($F1.52 = 11.9$, $p = 0.001$, $\eta^2p = 0.186$) and the interaction time x teaching ($F1.52 = 20.4$, $p < .001$, $\eta^2p = 0.282$).

Table 4. Effect of TGfU-SE and TGfU on game performance (GP) parameters

Variables	n	Teaching	Pre-test M ± SD	Post-test M ± SD	p	ES	2 × 2 repeated measures ANOVA		
							Teaching	Time	Interaction
GP									
Decision making (score)	27	TGfU-SE	13.5 ± 1.25	16.4 ± 1.58	< .001	-2.36	F1.52 = 7.35	F1.52 = 269.5	F1.52 = 46.6
							p = 0.009	p < .001	p < .001
	27	TGfU	13.4 ± 1.15	14.7 ± 1.24	< .001	-2.88	η^2p = 0.124	η^2p = 0.838	η^2p = 0.473
Skill execution (score)	27	TGfU-SE	11.7 ± 1.17	17.2 ± 1.69	< .001	-2.73	F1.52 = 6.74	F1.52 = 247.8	F1.52 = 70.6
							p = 0.012	p < .001	p < .001
	27	TGfU	12.9 ± 1.19	14.6 ± 1.15	< .001	-1.34	η^2p = 0.115	η^2p = 0.827	η^2p = 0.576
Support (score)	27	TGfU-SE	12.2 ± 3.01	17.4 ± 1.76	< .001	-1.43	F1.52 = 11.9	F1.52 = 88.2	F1.52 = 20.4
							p = 0.001	p < .001	p < .001
	27	TGfU	12.6 ± 1.12	14.4 ± 1.22	< .001	-1.31	η^2p = 0.186	η^2p = 0.629	η^2p = 0.282

DISCUSSION

This study aims to determine the effect of TGfU-SE for 12 weeks on increasing LE and GP among university students. The findings of this research show that students who took part in the TGfU-SE intervention program for 12 weeks showed an improvement in LE (e.g., vigor, dedication, absorption) and GP (e.g., decision making, execution skills, support) compared to students in regular TGfU group. This may be due to TGfU-SE presenting much more game-based learning with a high competition format between players/teams compared to regular TGfU. Referring to previous research, the TGfU-SE hybrid model was proven to be a positive pedagogical tool in improving aspects related to psychology such as motivation, sport enjoyment (Buendía et al., 2021), responsibility including LE and GP (Pan et al., 2023). Other research also reported consistent results, the TGfU-SE hybrid model has a game-centered approach concept, and it was recognised that this model had a positive effect on autonomy satisfaction and competency components (Gil-Arias et al., 2017)few studies have examined the efficacy of a hybrid TGfU/SE pedagogical model, particularly how a teacher's utilization of such a model impacts on student motivation. The purpose of the current study was to investigate the effect a hybrid TGfU/SE unit, in comparison to direct instruction, on students' perceptions of various aspects of their motivation to engage in physical education (autonomous motivation, basic psychological needs, enjoyment and intention to be physically active. In the TGfU-SE hybrid model, TGfU learning sessions provided opportunities for students to learn decision making skills, execution skills and support in authentic game situations. Meanwhile, the SE learning session provided the completeness of a season competition to enable students apply materials that have been learned previously in TGfU into real game situations

in a season competition. In previous research, TGfU-SE both had positive impacts, TGfU has a stimulus for reducing fat and increasing physical fitness levels (Stojanović et al., 2023), SE model session could provide motivation (Li et al., 2022; Manninen & Campbell, 2022; Tendinha et al., 2021), and engagement (Franco et al., 2021). Therefore, integrating TGfU into a SE program on PE with basketball material provided various benefits including a significant improvement in LE and GP. This is in line with the latest research, the TGfU-SE hybrid model shows an influence on learning motivation, sports enjoyment, responsibility and game performance compared to the TGfU model alone (Pan et al., 2023).

This study has a main strength, namely various movement experiences provided in the TGfU-SE program intervention for students during 12 weeks (3 meeting sessions per week with a duration of one hour per session). An additional benefit of this research was involved participants from university level, this fills the gap in the previous research, because most of research involved high school (Pan et al., 2023), and elementary school students (Gil-Arias et al., 2021). However, there were some limitations in this research. First, participants involved in this study were students came from only one university in Indonesia, so there were limiting factors for generalizing the research findings. This small number of students cause difficulties to generalize the results to other students who apply this pedagogical model in PE. Second, this study only assessed one learning material, specifically basketball, meaning that it is unable to conclude that TGfU-SE has a significant effect on other learning materials. Therefore, is is recommended that future research consider adding students from other universities in Indonesia and adding other materials (e.g., handball, futsal, soccer) TGfU-SE learning.

CONCLUSION

Considering the results obtained in this research, it can be concluded that the TGfU-SE hybrid model intervention program for 12 weeks succeed to encourage a positive increase in all components of LE (e.g., vigor, dedication, absorption) and GP (e.g., decision making, skill execution, support) among university students. Moreover, based on the findings of the study, we confirm that TGfU-SE had better effects than simple TGfU in improving LE and GP.

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