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ARTICLE

"STAR WARS™: The First Jedi" Gamification Program: Improvement of Fitness Among College Students

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Purpose: To examine the effects of a 14-week gamification-based physical education teaching program on fitness in college students. ***Method:*** A convenience sample of 112 college students (21.22 ± 2.55 years) was distributed among a gamification-based group or a control group (i.e., traditional teaching). College students from the gamification group used a game-based mobile app under the narrative of "STAR WARS™" with a countdown, so they had to gain lifetime. Cardiorespiratory fitness was assessed by the 20-m shuttle run test. Muscular fitness was measured by the handgrip strength and the standing broad jump tests. ***Results:*** Participants from the gamification program reported a significantly higher cardiorespiratory fitness and upper and lower body muscular fitness at postintervention, indicated by an effect size of 0.86 ($p < .001$), 0.18 ($p = .018$), and 0.52 ($p < .001$), respectively. ***Conclusion:*** Gamification can have an important implication on students' motivation toward higher fitness.

Keywords: aerobic fitness, health, innovation, motivation, university, young adults

Physical fitness is one of the strongest predictors of health throughout the lifespan (Ortega et al., 2018; Raghuveer et al., 2020). Two main components of fitness with documented benefits on health are cardiorespiratory fitness (CRF) and muscular fitness (Fraser et al., 2021; Ortega et al., 2018). Higher levels of CRF have been associated with better physical and brain health (Chu et al., 2016; Imboden et al., 2019; Kaminsky et al., 2019). Likewise, higher muscular fitness in adolescents has been associated with lower risk of all-cause premature mortality and later disability (Henriksson et al., 2018; Ortega et al., 2012).

Health-related fitness can be improved by increasing physical activity (PA; Myers et al., 2015). However, recent global estimates indicated that one in four (27.5%) adults (Guthold et al., 2018) and more than 81% of adolescents (Guthold et al., 2020) do not meet the PA Guidelines recommended by the World Health Organization (Bull et al., 2020). Specifically, college students spend less time doing PA than children or adolescents, not reaching the minimum PA levels recommended by the World Health Organization. This may be a consequence of the university way of life and the acquisition of unhealthy habits, which may also affect their fitness levels (Cabanas-Sanchez et al., 2018; Chacón et al., 2016). Against this fact, increasing daily PA can be beneficial to improve fitness among college students (Wang, 2019). In fact, the age range between 19 and 24 years old is considered the transition to adulthood and, therefore, a key phase in which to promote more active lifestyles (Rizo-Baeza et al., 2014).

Motivation and engagement are key factors for academic achievement in education (Xerri et al., 2018). Physical education teachers should use motivational teaching methodologies when aiming to promote specific behavioral changes (e.g., a more physically active lifestyle) among their students (González et al., 2016; Huang & Soman, 2013). Specially, gamification (Deterding, Sicart, et al., 2011) has gained interest among physical education teachers as a teaching strategy that favors students' motivation by applying game-based elements (e.g., rankings, levels, scores, lives, missions, and challenges) in nongame contexts, such as the educational setting (Hanus & Fox, 2015; Zichermann & Cunningham, 2011). The essence of gamification resides in the design of a narrative inspired by a theme (e.g., detective, spatial, medieval, etc.) or adapted from an existing one (e.g., STAR WARS™) and in making students the protagonists of this narrative/adventure (Kapp, 2012; Pérez-López, 2020). The narrative justifies and gives meaning to each of the educational challenges proposed throughout the adventure (e.g., to run or cycle a specific number of days and hours to travel between galaxies in STAR WARS™). This type of proposal includes game-based elements, such as rankings, levels, scores, lives, missions, or challenges, that make the adventure (a course) motivational and exciting for students.

There are seven important aspects that must be taken into consideration when designing a gamification-based program in the educational setting (Pérez-López, 2020): (a) To captivate the students: For this purpose, teachers should focus on generating curiosity and emotions during the experience (Chou, 2019; Mora, 2017); (b) To immerse the students in an adventure: Different quests and challenges are proposed for the students to leave their comfort zone (Marczewski, 2018); (c) To enable the students to achieve an educational objective that goes beyond the end of the experience: The objective of the proposal should be ambitious (e.g., to improve fitness and thus health status) and, therefore, fundamental to influence the students' intrinsic motivation (Burke, 2014; Deci & Ryan, 2002; Kapp, 2012); (d) To generate an exciting purpose: Students should have an attractive, challenging objective that moves them to action under the framework of the narrative/adventure proposed (Chou, 2019; Marczewski, 2018); (e) To design and propose educational and learning challenges, adapting their grade of difficulty to the level of students' competence:

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Materials should be developed according to the esthetic of the narrative (Kapp, 2012; Zichermann & Cunningham, 2011); (f) To act as a guide teacher, not a protagonist teacher: The teacher should generate the context necessary for the students to become the protagonists of the adventure and to assume responsibility (Marczewski, 2018); and (g) The students must be coherently integrated into the narrative built by the teacher: The teacher must take care of small details so that the narrative built has internal credibility for the students (Kapp, 2012; Marczewski, 2018).

A review indicated that programs including game elements to promote active behaviors were based mainly on nonmobile "exergames" (i.e., home exercises; Tabak et al., 2015). However, these "exergames" fail to transfer PA to daily life and might, therefore, fail to change physically active behaviors in the long term. In contrast, the implementation of mobile apps has notoriously increased in all educational levels as it favors certain behavioral changes in real life (Vega-Hernandez et al., 2018). Concretely, the use of different mobile apps has yielded positive effects on students' PA and fitness levels (Cotton & Patel, 2019; Lister et al., 2014; Patel et al., 2017). To the best of our knowledge, only two studies analyzed the effects of a game-based mobile app under a gamification-based physical education approach on fitness levels in a university setting (Mora-Gonzalez, Pérez-López, & Delgado-Fernández, 2020; Mora-Gonzalez, Pérez-López, et al., 2020). These two studies found positive effects of gamification on CRF but lacked the measurement of other important fitness components, such as muscular fitness.

The World Health Organization itself called for more strategies aiming to promote PA within health and other sectors, such as the educational setting (Bull et al., 2020). Gamification can be a powerful teaching strategy for physical education teachers to favor motivation and behavioral changes against the actual lack of implication from students and their low fitness levels (Cugelman, 2013; Deterding, Dixon, et al., 2011; Huang & Soman, 2013). Therefore, the aim of this study was to analyze the effects on physical fitness of a 14-week gamification-based physical education teaching program, based on the "STAR WARS™" saga of movies, in undergraduate students of the degree in Physical Education.

Method

Study Design and Participants

The "STAR WARS™: The First Jedi" program is a quasi-experimental cluster-randomized controlled trial designed to examine the effect of a 14-week gamification-based physical education teaching program on fitness levels of college students.

A convenience sample of 112 college students (21.22 ± 2.55 years old; 26% women) agreed to participate in the study. Students belonged to two different class groups from the same academic course called "Fundamentals of Physical Education and Sport" that was taught in the second academic year of the university degree in Physical Education and Sport Sciences (Department of Physical Education and Sports, College of Sport Sciences, University of Granada, Granada, Spain). These 112 college students from the same academic course were asked to choose between two course groups according to their schedule preferences. Of the two natural class groups formed, one constituted the intervention group ($N = 56$, 20.69 ± 1.41 years old; 29% women) and participated in the "STAR WARS™: The First Jedi" gamification-based physical education teaching program, and the other one formed the control group ($N = 56$, 21.75 ± 3.25 years old; 23% women), which followed a traditional teaching methodology. Once the two class groups were formed, the director of the Department of Physical Education and Sports randomly assigned two different teachers to each group, one who monitored the gamification-based experience and another who monitored the traditional teaching methodology (i.e., master lectures).

All participants were given a full and detailed description of the purpose and characteristics of the study, and a written informed consent was obtained from them. The study protocol was approved by the Human Research Ethics Committee of the University of Granada (approval number: 421/CEIH/2017).

The "STAR WARS™: The First Jedi" Gamification-Based Intervention

The "STAR WARS™: The First Jedi" program was designed: (a) to face the generalized lack of motivation among students derived from traditional physical education teaching methodologies (Silva-Quiroz & Maturana-Castillo, 2017; Zepeda et al., 2016) and (b) to improve their quality of life by educating them in active lifestyles. Importantly, STAR WARS™ was used solely with didactic and teaching purposes and, under no circumstances, with commercial purposes. Thus, we simply based the intervention on the STAR WARS™ atmosphere to develop the narrative of the gamification-based program that, as commented before, had only didactic, teaching, and motivational purposes. This program was based on a gamification strategy as an educational prequel of the legendary "STAR WARS™" saga, remarkable and motivational for students. The narrative was tightly built around the need of the students (under the role of *padawan*, i.e., apprentices who required training to improve their skills to become *Jedi Master*) to develop and fulfill their full potential (by doing learning, creative, and physical challenges) to become a *Jedi* (future physical education teachers and promoters of active lifestyles) and take part in the *Rebel Alliance*. This was the only way for *padawans* to succeed and free the *galaxy* and *Jedi Master Yoda* from the clutches of the *Galactic Empire*. The program lasted 14 weeks, and the narrative started with the *Jedi Council* (formed by alumni/former students who collaborated punctually to enrich the experience) recruiting all *padawans* and installing an *ad hoc* mobile app on their phones (Figure 1). This app was designed and developed by an engineer specifically for this gamification-based program and was used by the teacher, under the role of *Master Guidoogway* (an old friend of *Yoda*), to manage the course and provide guidance to all *padawans*. Again, no commercial use was given to this app as it was only used for didactic purposes. In fact, once the program was ended, the app was no longer operational, being removed from the server, making it inaccessible to participants. The app included a countdown timer installed by the *Jedi Council* to determine how well the *padawans* managed their time to learn and complete their *Jedi* training (as future physical education teachers). If the counter reached 0, it meant that the *padawans* had succumbed to the temptations from the *dark side of the Force* (i.e., comfort, conformism, and apathy) that had imposed over the *bright side of the Force* (i.e., passion, compromise, and creativity). Thus, an equivalence was made of the remaining lifetime that each student had in their countdown at the end of the program with a corresponding grade/mark (from 0 to 10) for the course. At the end of the 14-week program, the *padawans* (students) reached the rank of *Jedi*, taking part in the *Rebel Alliance* that fought the *Siths* to free *Master Yoda*.

Figure 1 — Visual interface and main menu with the life countdown of the "STAR WARS™: The First Jedi" app. "Dias" = days; "Horas" = hours; "Minutos" = minutes; "Segundos" = seconds; "Viajes" = travels; "Reto Ciclismo" = cycling challenge; "Reto Running" = running challenge; "Velocidad" = speed; "Ritmo" = pace; and "Duración" = duration.

Through the *ad hoc* app, the *padawans* were able to manage different regular activities in their daily life to complete their training and become future *Jedi*. These activities were: (a) Follow *Jedi Masters* around the world to learn from them. Through the app, the *padawans* could connect to *Twitter* and follow relevant people from the field of education, in general, and physical education, in particular. Thus, they had the opportunity to set up different folders within the app and collect in them all those *tweets* that increased their educational learning, for example, *tweets* on new educational interactive tools or audiovisual materials that could help them build their own sessions as future teachers; (b) Buy "groceries." This was the most common way for *padawans* to add time to their countdowns and, therefore, increase their level of *midiclorianos* (in the "STAR WARS™" saga, this was the unit of measurement of the potential of a *Jedi* and was used in this gamification-based program as the points obtained after the completion of any learning or physical challenge). To do this, they had to show evidence of their learning through the realization of formative challenges (representing the "food" within the adventure) and creative challenges (representing the "water"). First, they had to "buy" in a virtual "supermarket" any formative or creative challenge they wanted to complete, and to do so, they had to use time from their countdown as a bargaining chip. Second, once they had completed the challenge, they had to upload the corresponding files to the app to receive feedback from *Master Guidoogway* (the teacher) and be rewarded with time; and (c) To do *interplanetary travels*. They had the possibility to achieve a special time bonus if they fulfilled weekly a series of kilometers at a certain pace by running or riding a bike. This was possible because the *ad hoc* app was connected with the Runtastic app, and *padawans* could, therefore, upload their PA sessions from the Runtastic app to the course app. Under the narrative of "STAR WARS™," this symbolized the realization of trips by the *padawans* to other planets to make their inhabitants aware of the need to join the *Rebel Alliance* and, in this way, be able to build a hopeful future in the educational galaxy.

The goal of the students as *padawans* was to become those whom "the Force is strong with," as suggested in the original saga. To achieve this, the *padawans* had to increase their level of *midiclorianos* up to a specific level where they would become

Jedi. The *padawans* had to use the app to manage different learning and physical challenges that would make them increase their learning as future *Jedi* (physical education teachers). The main aim of the gamification-based physical education strategy used herein was the motivational approach to encourage college students to change their usual PA patterns (Physical Activity Guidelines Advisory Committee, 2018) during the 14-week program duration. In the context of the narrative, as explained earlier, all *padawans* had to do *interplanetary trips* to raise the awareness of other planets to join the *Rebel Alliance* and build a better and healthier future. To complete these *interplanetary trips*, the *padawans* had to do at least 150 min/week of moderate PA or 75 min/week of vigorous PA (Physical Activity Guidelines Advisory Committee, 2018). Thus, they had to run or cycle 3–5 days/week to gain time and upload their daily PA registers into the Runtastic app (www.runtastic.com). This app allowed real-time GPS tracking of activities such as running or cycling, and the validity of the GPS-enabled app to record PA distance has been previously demonstrated (Benson et al., 2015). *Padawans* had to upload their Runtastic registers into the app, specifically under the "Interplanetary trips" section (translated as "Viajes" in Spanish, see Figure 1). All recordings were downloaded by the teacher to have information of the duration and pace of the physical activities performed by the students. Particularly, having information about the pace allowed for control of the intensity at which each activity was performed, that is, running pace should be >5–8.4 min/km and cycling pace should be >16–25.6 km/hr to meet PA recommendations (Ainsworth et al., 2000). Finally, at the end of every week, those who had uploaded three to five valid PA sessions saw a lifetime bonus increment of 2 and a half days in their countdown.

The *ad hoc* app used for the gamification program included a "Padawan" (student) section where the students could check: (a) the "Individual classification" (based on their *midiclorianos* level); (b) the "Jedi Clan" classification; (c) the "Level" of each *padawan* based on the learning and physical challenges overcome (with the corresponding experience points—XP—that could be expended in different privilege cards); all *padawans* were able to check their level (i.e., *Padawan*, *Jedi Knight*, *Commander of the Rebel Alliance*, and *Jedi Master*), which was established based on their *midiclorianos* level and the number of challenges overcome; and (d) the "History," where *padawans* could check all actions that were performed by them through the app (i.e., time investments and time rewards). Only the first *Jedi* (the top 10 of the classification) would have a protagonist role in the final battle against the *Siths*.

The control group was formed by college students from the same course and degree as the intervention group's participants, but they belonged to the traditional methodology course group. Therefore, the gamification teaching strategy through which active lifestyle was encouraged was not followed in this group. During the 14-week duration of the gamification-based program, the control group was asked to keep their usual lifestyle.

Fitness

CRF was assessed using the 20-m shuttle run test (also called *Course navette*; Léger et al., 1988). Participants had to run as long as possible, back and forth, between two lines set 20 m apart following the pace marked by an audio signal. The initial speed was 8.5 km/hr and increased by 0.5 km/hr every minute of the test. The last stage completed was recorded as an indicator of CRF.

The handgrip strength test and the standing broad jump test were used as indicators of upper and lower body muscular fitness, respectively. The upper body muscular fitness was measured using a digital hand dynamometer with an adjustable grip (TKK 5101 Grip-D, Takei) as described elsewhere (Ruiz-Ruiz et al., 2002). We first measured hand size in women to determine their optimal grip span, whereas for males the optimal grip span has been set at 5.5 cm (Ruiz-Ruiz et al., 2002). Each participant performed the test twice, alternately with both hands, and the maximum scores of each hand were averaged in kilograms. Lower body muscular fitness was measured using a standing broad jump test which had acceptable levels of validity and reliability in young adults (Cooper et al., 2010). Participants were instructed to jump twice as far as possible from a line with both feet together, and the longest jump was recorded in centimeters.

Statistical Analysis

The study sample's characteristics are presented as means and *SD*s or frequency and percentage, as appropriate. One-way analysis of variance was used to analyze the baseline differences between the intervention and control groups for continuous variables and the chi-squared test for categorical variables. SPSS software (version 25.0) and Prism (version 7.0, GraphPad) were used for statistical analyses and design of graphs, respectively.

The effects of the "STAR WARS™: The First Jedi" program on fitness outcomes were tested with analysis of covariance using postintervention outcomes as dependent variables, group (i.e., intervention vs. control) as fixed factor, and baseline outcomes as covariates. Prior to this analysis, the intraclass correlation coefficients were calculated. As intraclass correlation mean values were virtually zero (i.e., intraclass correlation ≤.04), we used regular analysis of covariance to test the effect of the program. The z score of each fitness outcome was computed at baseline (i.e., [individual raw value at baseline − baseline mean]/baseline *SD*) and at postintervention (also called z score of change) by dividing the difference of the postintervention raw value from the baseline mean by the baseline *SD* (i.e., [postintervention individual raw value − baseline mean]/baseline *SD*). The analyses of covariance were performed and are presented herein for both raw and z score outcomes. The computation of z score values to report the effects of an intervention was previously used in a major randomized controlled trial (Sink et al., 2015). The use of these z score values allows comparisons across outcomes of different nature and raw units (e.g., CRF and muscular fitness). Also, the z score of change (i.e., postintervention z score) can be interpreted as standardized effect size as it indicates how many *SD*s the outcomes at postintervention have changed with respect to the baseline mean and *SD* (Sink et al., 2015). For example, a 0.89 z score value in CRF for the intervention group means that the CRF is 0.89 *SD*s higher at postintervention than at baseline for this group. We based our interpretation of these effect sizes on the standard benchmarks proposed elsewhere (i.e., threshold z scores of 0.2, 0.5, and 0.8 were considered small, medium, and large effect sizes, respectively; Sink et al., 2015). Significant effects are reported according to a $p < .05$. We performed multiple comparisons correction using the Benjamini–Hochberg method ($q < .05$; Benjamini & Hochberg, 1995) to further investigate whether the significant effects persisted after this adjustment.

Results

Table 1 shows the baseline characteristics of the study sample as well as the baseline differences between groups. Significant baseline mean differences between intervention and control group were

Table 1 Descriptive Baseline Characteristics of the Participants of the "STAR WARS™: The First Jedi" Program

	All		Intervention group		Control group		
	N	**Mean ± *SD***	***N***	**Mean ± *SD***	***N***	**Mean ± *SD***	***p***
Age (years)	112	21.22 ± 2.55	56	20.69 ± 1.41	56	21.75 ± 3.25	**.028**
Sex	112		56		56		.667
Male (*n* %)	83	74%	40	71%	43	77%	
Female (*n* %)	29	26%	16	29%	13	23%	
Cardiorespiratory fitness (stages)	112	7.37 ± 1.98	56	7.79 ± 2.03	56	6.96 ± 1.86	**.026**
Upper body muscular fitness (kg)	112	38.56 ± 8.36	56	37.82 ± 8.04	56	39.3 ± 8.69	.352
Lower body muscular fitness (cm)	112	201.66 ± 28.57	56	204.00 ± 29.63	56	199.32 ± 27.54	.389

Note. Values are expressed as mean ± *SD* unless otherwise indicated. Baseline differences were analyzed by one-way analysis of variance and chi-squared tests. Bold font indicates significant differences at $p < .05$. Significant differences disappeared after correction for multiple comparisons.

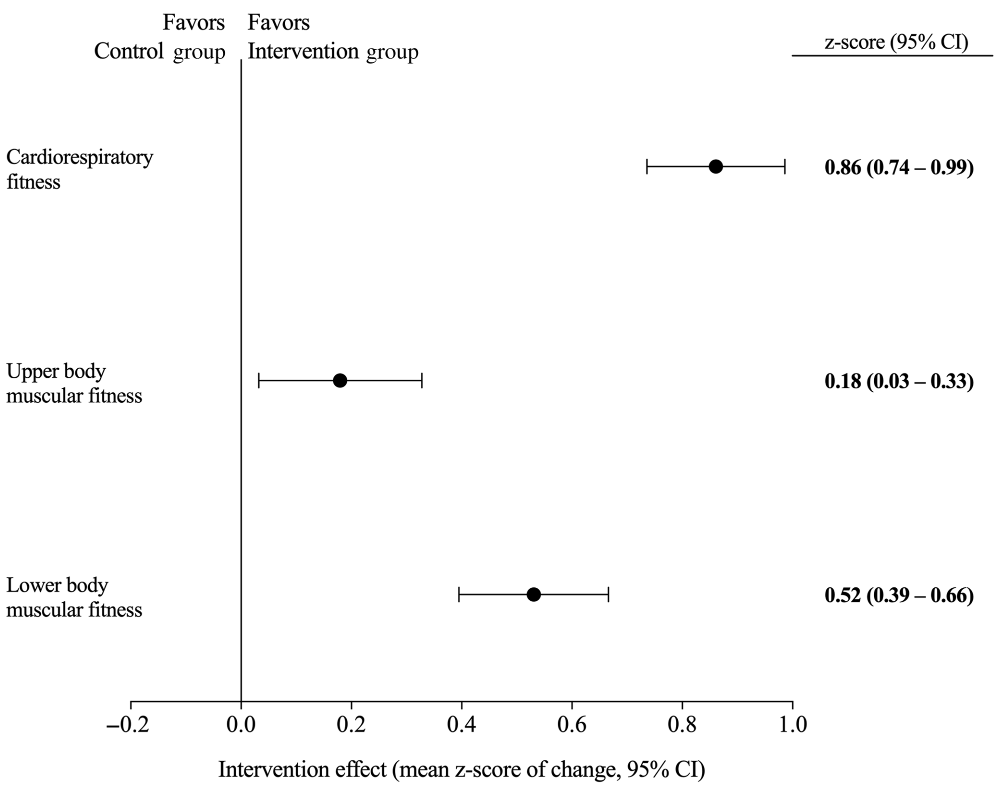

Figure 2 — Effects of the "STAR WARS™: The First Jedi" program on fitness outcomes. "Spaceships" represent the between-groups difference (intervention vs. control) in fitness gains (i.e., *z* score values of change, black dots), that is, change of each postintervention outcome with respect to the baseline mean and *SD*. Bars of the "spaceships" represent 95% confidence intervals (CIs). Bold font indicates significant effect at $p < .05$ after correction for multiple comparisons.

observed for age (−1.06 years, $p = .028$) and CRF (0.83 stages, $p = .026$). However, these baseline differences did not remain significant after correction for multiple comparisons.

The main effects of the "STAR WARS™: The First Jedi" program on fitness outcomes are presented in Figure 2. Also, the corresponding effects on raw and *z* score postintervention outcomes for the intervention and control groups separately are shown in Table 2. The largest effect size from the "STAR WARS™: The First Jedi" program was observed in CRF with the intervention group improving from baseline to postintervention 0.86 *SD*s ($p < 0.001$) more than the control group (Figure 2, Table 2). In regards to the muscular fitness outcomes, the largest improvement from baseline to postintervention was observed for the lower body muscular fitness with the intervention group improving 0.52 *SD*s (i.e., medium effect size) more than the control group ($p < .001$). The upper body muscular fitness was also improved significantly more in the intervention group in comparison with the control group (0.18 *SD*s, $p = .018$), although this effect size was of small magnitude. All the effects observed on fitness outcomes persisted after correction for multiple comparisons using Benjamini–Hochberg method (Benjamini & Hochberg, 1995).

Discussion

The findings of this study indicate that college students who participated in the "STAR WARS™: The First Jedi" gamification

Table 2 Effects of the "STAR WARS™: The First Jedi" Program on Raw and z Score Mean Fitness Gain Scores

		Mean [95% confidence interval]					
	N_{all}	N	Intervention group	N	Control group	Difference between groups	p
Cardiorespiratory fitness (stages)	112	56		56			
Raw score (kg)			9.14 [8.96, 9.31]		7.43 [7.26, 7.60]	1.71 [1.46, 1.95]	**<.001***
z score			0.89 [0.80, 0.98]		0.03 [−0.06, 0.12]	0.86 [0.74, 0.99]	
Upper body muscular fitness (kg)	112	56		56			
Raw score (kg)			41.43 [40.55, 42.30]		39.92 [39.05, 40.80]	1.51 [0.27, 2.74]	**.018***
z score			0.34 [0.24, 0.45]		0.16 [0.06, 0.27]	0.18 [0.03, 0.33]	
Lower body muscular fitness (cm)	112	56		56			
Raw score (kg)			214.74 [212.01, 217.48]		199.58 [196.84, 202.32]	15.16 [11.28, 19.04]	**<.001***
z score			0.45 [0.36, 0.55]		−0.07 [−0.16, 0.02]	0.52 [0.39, 0.66]	

Note. Values are postintervention fitness scores adjusted by baseline values. Bold font indicates significant effect at $p < .05$. The *z* score data show how many *SD*s the postintervention values have changed with respect to the mean and *SD* at baseline. For example, a 0.89 *z* score means that the cardiorespiratory fitness postintervention mean value is 0.89 *SD* higher than the baseline mean value.
*Indicates whether the significant effect persisted after correction for multiple comparisons.

program improved their CRF significantly more than the control group. This finding confirms prior research on the effects of gamification on CRF that used different science fiction narratives (Mora-Gonzalez, Pérez-López, & Delgado-Fernández, 2020; Mora-Gonzalez, Pérez-López, et al., 2020). This study also extended the field by revealing, for the first time, a positive effect of a gamification-based physical education teaching program on muscular fitness in college students. Our findings suggest that implementing gamification and its elements, such as a science fiction narrative, missions, levels, or rankings, in the educational setting is useful to encourage students to meet PA recommendations and result in health-related fitness improvements. We also believe that, by living a gamification experience and learning about its main elements and mechanics explained earlier, college students who are called to be physical education teachers in high schools can make use of this kind of innovative and motivational teaching strategies in the future.

The present gamification-based investigation emerged as a response to the general unhealthy habits presented among college students (Cabanas-Sanchez et al., 2018; Chacón et al., 2016) and as a way for them to implement it as future physical education teachers. More concretely, our gamification program arose to face the high levels of sedentary time and low levels of PA among college students, which may have a negative impact on their health-related fitness levels (Cabanas-Sanchez et al., 2018; Chacón et al., 2016). We chose gamification given its evidenced potential to transform repetitive activities into more attractive and active activities for the students (Deterding, Dixon, et al., 2011; Deterding, Sicart, et al., 2011). There exist previous gamification-based physical education teaching programs carried out in higher education with benefits on fitness (Mora-Gonzalez, Pérez-López, & Delgado-Fernández, 2020; Mora-Gonzalez, Pérez-López, et al., 2020). In a similar sample to ours, college students participating in a gamification program based on "The Matrix" movies improved their CRF by 1.7 stages in the 20-m shuttle run test more than the control group (Mora-Gonzalez, Pérez-López, et al., 2020). Another study implemented a similar mobile app to the one presented herein, also allowing college students to manage their lifetime and encouraging them to meet PA recommendations through game challenges (Mora-Gonzalez, Pérez-López, & Delgado-Fernández, 2020). In that study, gamification was based on the "In Time" movie and yielded positive effects on CRF as well, showing an improvement of 1.2 stages by the gamification group compared with the control group (Mora-Gonzalez, Pérez-López, & Delgado-Fernández, 2020). Our study confirms these two previous investigations by also yielding a beneficial effect of the gamification program on CRF, indicated by a difference of 1.7 stages at postintervention between the gamification group and the control group. Not only CRF but also muscular fitness benefited from the "STAR WARS™: The First Jedi" gamification program, with college students from the gamification group reporting higher upper and lower body muscular fitness at postintervention than the control group. To the best of our knowledge, there is no evidence concerning effects of gamification on muscular fitness in any educational level, which hampers comparisons with previous studies.

Importantly, the implication of gamification to change lifestyle behavior toward a more physically active lifestyle was evidenced in the two studies presented before (Mora-Gonzalez, Pérez-López, & Delgado-Fernández, 2020; Mora-Gonzalez, Pérez-López, et al., 2020). In these two studies, there were college students from the gamification groups who followed and met PA recommendations regularly throughout the program (i.e., 3–5 days of moderate PA every week), whereas there were college students also from the gamification groups that did not follow and meet the PA recommendations regularly (i.e., not every week). Interestingly, college students who followed and met PA recommendations regularly throughout the program showed a higher improvement of CRF than those not following and meeting PA recommendations regularly (i.e., every week). Thus, the beneficial findings on fitness presented herein could be explained by the idea that using gamification in physical education has the potential to promote active lifestyles that, consequently, have a beneficial impact on fitness. This is justified because, when it comes to physically active lifestyle habits, the majority of young adults are not predisposed to acquire a continuity in the practice of PA (Zuckerman & Gal-Oz, 2014). Therefore, including game elements in their routine or contexts (e.g., in the university) can generate changes in their attitude and behaviors. The distinguishing element in these cases could be the inclusion of a mobile app that includes game elements that motivate the student by allowing them to have continuous feedback of their progress in the gamification experience. Also, fitness-based mobile apps have been demonstrated to be viable tools to help people meet PA recommendations (Molina & Myrick, 2021). For example, an intervention carried out in college students that included an app with personally oriented functionalities (like the one used herein) significantly improved PA adherence and social engagement (Hu & He, 2020). We consider it crucial to promote innovative and motivational physical education teaching strategies, such as gamification, in higher education and any other educational level given their power to motivate students to change their lifestyle behaviors toward a healthier status.

Another key factor in education is to educate the students about the benefits of the activities that they are going to perform (Mokmin & Jamiat, 2021). A study wherein students showed fitness benefits through the use of a game-based app reported an awareness of the positive effects of increasing PA levels on the students' fitness status (Mokmin & Jamiat, 2021). But the benefits obtained go beyond the use of an app as it is also crucial to introduce a gamification narrative in any (physical) education proposal (Li et al., 2021). In the present study, the narrative revolved around the well-known saga of "STAR WARS™," and as evidenced previously, it had the potential to draw the participants of the gamification group in and encouraged them to develop stronger motivations to achieve their real-world goals and higher persistent usage intentions of the mobile fitness app (Li et al., 2021). All this evidence may explain our findings by confirming that a mobile app that is constructed under an attractive gamification narrative can increase motivation and encouragement of college students toward a healthier status.

Limitations and Strengths

The present study has several limitations that must be acknowledged. First, the sample was one of convenience under the quasi-experimental design of the study. Therefore, participants were not randomly selected but formed part of two class groups before the study commenced. Second, the sample size was relatively small, and this limited the statistical power. Third, we lacked an objective measurement of participants' PA and other important components of fitness (e.g., speed, agility). Despite these limitations, we also had several strengths that must be recognized. To the best of our knowledge, this is the first study investigating the effects of a gamification teaching program based on the "STAR WARS™" saga of movies on indicators of muscular fitness in higher education. Other strengths include the objective and standardized assessments of fitness components (i.e., CRF and muscular fitness).

Conclusion

Our results provide initial evidence to suggest that a gamification-based physical education teaching program can have a beneficial effect not only on CRF but also on muscular fitness in college students. Thus, using a game-based mobile app under the narrative of a gamification program ("STAR WARS™") showed a positive effect on CRF and muscular fitness in comparison with following a traditional teaching methodology in higher education. The implementation in all educational levels of innovative and active teaching strategies, such as gamification, can have an impact on students' motivation and compromise and, consequently, favor the acquisition of physically active lifestyle behaviors with benefits for health. Future studies in higher education should use gamification as a way to attract students and motivate them toward healthier lifestyles behaviors. Furthermore, these studies should investigate whether gamification has a positive effect on other dimensions of human health, such as mental or cardiometabolic health.

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