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Research article

Gamification and flipped learning and their influence on aspects related to the teaching-learning process

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ABSTRACT

Nowadays, education is going through a moment of methodological transformation. Two of the active methodologies with excellent projection within the educational field are gamification and flipped learning. This study analyzed the methodological contrast between gamification and flipped learning in the subject of Physical Education in three different educational stages to determine the most influential methodology in the training process. Research design was a quasi-experimental research with a sample of 356 students in Spain. Data collection took place with a questionnaire. The results show that gamification as a teaching and learning methodology is better valued at an early stage, while the more aged participants better value the flipped learning methodology. Both methodologies have shown great potential in the development of educational processes in Physical Education. Gamification indeed seems to have positive effects on students from the lower stages. On the other hand, flipped learning produces positive effects on the group stages, pre-university students.

1. Introduction

Teachers are responsible for selecting the teaching methodologies they use in their classes. The role that these professionals play in the learning process is essential, especially if some of these methodologies use technology (Gil-Flores et al., 2017). Today's active methodologies have broken into the educational system with significant impact (Bernal-Gonzalez and Martinez-Dueñas, 2017). According to the methodology, this type of design provides students with content in a motivating way, where students have to actively build their own learning. This provokes meaningful learning that is remembered and excites the students, producing real learning (Ayén, 2017). All of this is impossible if teachers do not have sufficient training and mastery of the methodology they want to use (Oliveira et al., 2019).

Beyond motivation, the use of this type of methodology in the classroom has different benefits, such as the development of creative thinking (Bezanilla et al., 2019), fostering interactions between students (Flores-Fonseca and Gomez, 2017), cooperation development (Sein-Echaluce et al., 2019), or increased student engagement with their learning process (Montrezor, 2016). Within this scenario, the most commonly used active methodologies nowadays are gamification and flipped learning (Sein-Echaluce et al., 2019).

Gamification applies different learning elements, such as game designs or structures (Attali and Arieli-Attali, 2015). This methodology is based on the fact that learning and retaining information through different activities increases when students have fun during their development (Molina et al., 2017). As an active methodology, gamification has shown to foster a high incrementation in the motivation and development of cooperative work (Lopez-Quintero, Pontes-Pedrajas and Varo-Martínez, 2019), so necessary in the teaching-learning processes, for both the students and the teachers in their teaching work (Lee and Hammer, 2011). These elements, together with the development of a classroom climate (Perez-López and Rivera, 2017), are part of Physical Education classes, according to current trends (Ferriz-Valero et al., 2020; López-Belmonte et al., 2020).

This issue is relevant and is reflected in current studies, which show the positive effects of gamified experiences within the field of physical education (González et al., 2018; Quintas et al., 2020), whose application covers a wide range of possibilities. Gamification can be developed, utilizing various technological resources or didactic resources. This

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means that the range of gamification possibilities is broad and has various application forms (White Shellenbarger, 2018).

On the other hand, flipped learning consists of a mixed-method, which alternates digital and face-to-face training as indicated by Lee et al. (2017), where the teacher and student roles are exchanged (Mortensen and Nicholson, 2015). Through technology (Froehlich, 2018), teachers can create audiovisual material that students have to watch before the lesson (Turan and Akdag-Cimen, 2020), and afterward, in class, they work on the content from a different perspective than a traditional one (Long et al., 2017).

Flipped learning methodology can ease the teacher's work because the student can plan and self-regulate their learning (Chaves-Barboza et al., 2016). Due to this, the teacher can allocate more time in the classroom to guide the student, resolve doubts, and attend to the students' educational needs in a more individualized way. This is favored as explaining the content has been carried out in other learning spaces beforehand (Santiago and Bergmann, 2018). Therefore, this type of active methodology allows the student to work autonomously and actively during their learning (Molina-Aventosa et al., 2015). It also improves all of the associated educational processes, such as motivation, time in class, or the collaboration between students (Awidi and Paynter, 2019; Moreno-Guerrero et al., 2020). This set of possibilities makes the flipped classroom a methodology with great potential for physical education teachers (Sargent and Casey, 2020).

These new methodological trends have increased innovative practice in Physical Education, as it has been recommended by several studies on the matter, where the different academic indicators analyzed are favored (Wyant and Baek, 2019). For this reason, in relation to innovation, Physical Education is a subject that is being studied due to the improvements and potential it produces in student's formative development.

There are also studies where the teaching and learning processes have been developed and applied using a mix of the flipped learning method and gamification (Huang and Guo, 2019; Kwan and Foon, 2020; Segura-Robles et al., 2020). These studies agree that those students who have received a game-based teaching method utilizing invested learning improved their academic performance, besides obtaining better benefits in several dimensions of studies, such as motivation, the interaction between members of the pedagogical act, and problem-solving.

2. Study objective and research questions

Gamification and flipped learning and, what has been exposed in the scientific literature of recent years, have proven to be adequate instructional mechanisms to improve teaching and learning environments. In this sense, the scientific community that has developed studies on both training methodologies has revealed how these training methods, from their idiosyncrasy and their way of imparting and working on the contents, have turned out to be successful and influential in improving learning. An improvement occurs in different academic processes and factors, such as attitudinal, psychosocial, and student performance (Gómez-Carrasco et al., 2020; Parra-Gonzalez et al., 2020).

This study aimed to make a methodological contrast between gamification and flipped learning in the subject of Physical Education in three different educational stages (Primary Education, Secondary Education, and Baccalaureate), with the main aim of determining the most incidental training methodologies in the teaching and learning process. This general objective was broken down into different RQ (Research Questions):

- RQ1: Does the training methodology influence the student's motivation?
- RQ2: Does the training methodology influence the interaction between the students and the teacher?
- RQ3: Does the training methodology used in the interaction with the students influence the didactic contents?
- RQ4: Does the training methodology influence the interaction between students?
- RQ5: Does the training methodology influence the autonomy of the students?
- RQ6: Does the training methodology aid in the collaboration of the student's influence?
- RQ7: Does the training methodology deepen the level of the content influence?
- RQ8: Does the training methodology aid with the problem-solving of the student's influence?
- RQ9: Does the training methodology have an influence on class-time with the students?
- RQ10: Does the training methodology influence the ratings obtained by the students?

3. Materials and methods

3.1. Research design

The study has been developed using a quantitative methodology through a quasi-experimental research design, based on the experts' research premises in this type of study (Hernández-Sampieri et al., 2014; Privitera, 2020). This kind of design involved obtaining a pre-test measure of prior interests, followed by a post-test measure after treatment occurs (Knapp, 2016; Salkind, 2010).

The nature of this type of research required the articulation of two study groups (control and experimental). The control group (CG) carried out a formative action through gamification, while the experimental group (EG) used flipped learning for this purpose (Figure 1). Thus, two study variables were established, an independent one that focused on the type of methodology used in students' training and a dependent variable that focused on the impact obtained in the different dimensions established in the research. When the methodological experimentation commenced, only post-test measurement was obtained to the end of the instruction. The selected groups were homogeneous regarding the sex of the students and the number of students. The two teachers who participated in the experience have training in teaching innovation and are specialists in the methodology they carry out.

Similarly, other published studies have been taken as a reference when carrying out a research process validated by the scientific community (Corujo-Vélez, Gómez del Castillo and Merla-González, 2020; Marín-Marín et al., 2020).

3.2. Participants

The sample obtained in this study was 356 Spanish students, coming from different educational stages (fourth level of Primary Education, aged between 9 and 10 = 100; first level of Secondary Education, aged between 12 and 13 = 118; first level of Baccalaureate, aged between 16 and 17 = 138). Four classes were chosen from both Primary and Secondary Education and from Baccalaureate, five classes were chosen. These students, as a whole, made up the groups presented in Table 1. Intentional sampling was used to select participants, justified in the ease of access to the sample, and collaboration of the teachers who carried out the training phase.

Although this type of sampling may not represent large populations, it is useful to provide the authors with previous results (Etikan, 2016). The sample size was adequate for this type of study in the field of education, as it is exposed in other reported studies, and does not suppose a limitation for its approach (Chou and Feng, 2019).

The sample is comprised of men (42.98%) and women (57.02%), with an average age of between 13 and 14 years (SD = 3.21). Two groups of students was created (Experimental gropup and control group), and the methodological treatment (gamification and flipped learning) was determined randomly; the control group was associated with gamification and the experimental group with flipped learning.

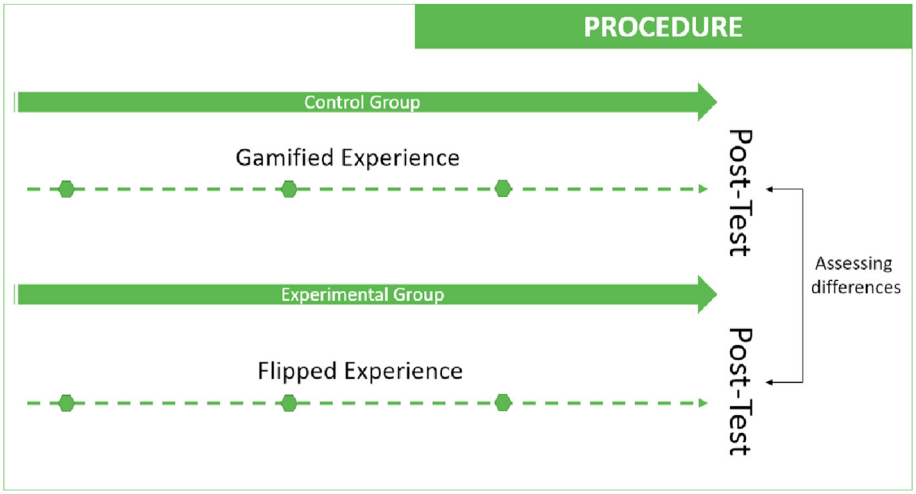

Figure 1. Research design.

Table 1. Two group used.

Group	n	Composition	Pretest	Treatment	Post-test
1- Control	50	Natural	-	G	O_1
2- Experimental	50	Natural	-	FL	O_2
3- Control	59	Natural	-	G	O_3
4- Experimental	59	Natural	-	FL	O_4
5- Control	70	Natural	-	G	O_5
6- Experimental	68	Natural	-	FL	O_6

Note: Gamification (G); Flipped learning (FL).

3.3. Study dimensions

To better understand this study's results, different dimensions were established in the research, which has been analyzed and presented (Santiago and Bergmann, 2018). These dimensions were selected from studies presented in this work, and methodological contrasts were carried out where the approaches, such as inverted learning and gamification, have intervened:

- **Socio-Educational**: Caters socio educational variables as age, course, teaching methodology.
- **Motivation**: Denotes the motivation levels from the students during the formative action.
- **Interactions**: Denotes the students' interactions and may be of different types (with the teacher, with the content, and between the different students).
- **Autonomy**: Addresses the level of autonomy developed by the students during the instructional process.
- **Collaboration**: Addresses the level of collaboration and teamwork carried out by the students during the teaching and learning phase.
- **Deepening In The Contents**: Attends to the level of treatment and the projection of the content in the teaching and learning process.
- **Problem-Solving**: Attends to the students' decisive competence when faced with different problems in the training practice.
- **Class Time**: Attends to the time used by the students during the development of the training action.
- **Ratings**: Attends to the ratings reached by the students in the different tasks and assessment tests.
- **Teacher Ratings**: Attends to the teacher's ratings to compare with the ratings reported by the student.

3.4. Instrument

Data collection was carried out through an ad hoc questionnaire. This questionnaire was derived from other instruments that report on the matter's state (Discroll, 2012; Santiago and Bergmann, 2018). Eight experts group in innovative methodologies analyzed the questionnaire through Delphi method. These judges offered feedback to optimize the questionnaire and revealed a positive opinion of it ($M = 4.82$; $SD = 0.36$; $min = 1$; $max = 6$). All of these observations were analyzed using the Kappa of Fleiss (K) and W of Kendall (W) statistics, which revealed agreement and adequacy of the guidelines and comments from the specialists ($K = 0.84$; $W = 0.87$). The instrument was then subjected to quantitative validation by exploratory factor analysis with the principal component's method. The sphericity Bartlett's test revealed dependency between the study variables (2148.25; $p < 0.001$), and the KMO (0.83) test reflected adequate adequacy of the sample. Furthermore, the designed questionnaire turned out to be reliable after the tests were carried out (Cronbach's alpha $= 0.86$; Composite reliability $= 0.84$; Average variance extracted $= 0.82$). Because the sample exceeded 50 participants, normality was assumed (Ghasemi &and Zahediasl, 2012; Pallant, 2003).

3.5. Procedure

In this study, as a treatment to determine the previously discussed models' effectiveness, a didactic unit of eight sessions was developed. This unit was carried out in the subject of Physical Education, as this subject is assuming a fundamental role for the students' integral development (Sargent and Casey, 2020; Wyant and Baek, 2019). In this sense, Physical Education has undergone a methodological change in recent

years. This is verified by the different active methodologies that are being carried out to deliver the content (Hinojo-Lucena et al., 2018). In turn, this subject is leaving behind traditional methods characterized by individual and purely physical work (Segura-Robles et al., 2020; Xiang et al., 2020).

Specifically, the didactic unit carried out encompassed corporal expression contents (the body, the movement, the rhythm, the dance, choreographic compositions). Regarding the activities carried out, each control group performed collaborative games based on problem-solving through different escape room-type dynamics.

This was based on a story told by a teacher in order to involve the students. This story had a series of challenges and missions that needed to be carried out to achieve badges, which would allow them to pass through various phases of the game and reach the final test. Passing the final test would mean reaching the didactic objectives formulated in the unit and, therefore, winning the challenge.

On the other hand, the experimental group's training activities had a hybrid character based on flipped learning. This was developed both in the digital environment, through a content management platform, and in-person in the educational center's different learning spaces. Previously, the students viewed the audiovisual material provided by the teacher. This material contained dances with different rhythms and musical styles. Then, the students carried out the activities and dynamics already shown in the videos in the classroom. In both cases, the teacher's role in question was focused on guiding and orienting the students during the different training tasks carried out and providing timely feedback that helped facilitate the students learning process. All of this was thanks to the autonomous work developed by the students. In the case of gamification, by solving problems by themselves. In flipped learning, thanks to the visualization of the contents before the face-to-face session, it allowed the students to come to class with familiar contents. Once the didactic unit was completed, the students filled out the questionnaire, and the collected data was then statistically analyzed to achieve and answer both the objective formulated in the research and the different questions derived.

3.6. Ethical considerations

Within this research, all of the principles and criteria were established using the Code of Good Research Practices, as established by the Declaration of Helsinki. Similarly, all participants were aware of the study objectives, informed consent was obtained, and their anonymity was preserved. Likewise, a regional Ethics Committee (BDS-ABL-20) made up of researchers external to the research approved the study.

3.7. Data analysis

For statistical analysis, SPSS (v.25) package was utilized. This tool is the most used software in Social Sciences, which provides a good interface to calculate some basic stadistics as Mean (M), standard deviation (SD), skewness (Skw) and kurtosis (Kme) to know the distribution of a data matrix. Student-t test (tn1 + n2-2), test was carried out to compare means between experimental and control group. To detect size of effect of significant results Cohen's d was applied. A cut-off standar of $p < 0.05$ was used to stablish significate differences.

4. Results

On the basis of the descriptive analysis carried out, it can be determined that there is a disparity in the responses, depending on the stage of development, and showing in all dimensions a normal distribution of response (Jöreskog and Moustaki, 2001). In Primary Education, the results obtained by pupils within the control group showed higher values for most dimensions than those obtained by pupils within the experimental group. Specifically, the best-valued dimensions, especially in the control group, are those of motivation, student-student, autonomy, resolutions, and ratings, where they exceeded in all cases the 3 points of average. Although the ratings are medium-high in the rest of the dimensions, they do not exceed the 3 points of average, both in the control and experimental groups. The standard deviation shows an equal response distribution by the students in all dimensions of the research. Kurtosis in the control group is variable since, in most dimensions, a platykurtic distribution is shown, except in autonomy and ratings, where the distribution is leptokurtic, and in collaboration and motivation, where the distribution is mesokurtic. In experimental group, kurtosis is platykurtic(Table 2).

In the Secondary Education students, the means presented were, in general, slightly lower than those shown by the Primary Education students. In this case, the evaluations' mean is located in both the experimental and control groups, over 2.5. The difference is marked by the control group's dimensions, specifically motivation, student-student, autonomy, collaboration, and resolution, and where they are located, approximately, in the mean line of 3. Kurtosis, in all dimensions of the study, is platykurtic (Table 3).

In the Baccalaureate stage, the response trend changes substantially compared to the secondary and primary education stages. In this case, the responses offered by the control group were lower, in most dimensions, than those given by the experimental group. The mean was approximately 2.7 points in the control group, while in the experimental group, the mean was above 3.1 points, except in resolution and teacher-ratings, whose mean was below 3. Kurtosis varies substantially between the CG and the EG. In the control group, the kurtosis is platykurtic. The kurtosis is mainly leptokurtic in the experimental group, except in motivation, resolution, ratings, and teacher-ratings, which are platykurtic, and in teacher-student, student-content, student-student, and class-time, which are mesokurtic (Table 4).

Comparing the means between the stages analyzed shows how the measures of the control groups of the stages of Secondary and Primary Education are higher than those given by the experimental group. This fact is alternated in the High School stage, where the experimental group reflected averages higher than those of the control group (Figures 2, 3, and 4).

According to the results obtained from these tests, the stage where there were differences that are more significant was the Baccalaureate stage, followed by the Secondary Education stage and finally, the Primary Education stage. Regarding the Primary Education stage, where the mean differences were positive, the control group showed higher scores than the EG, the most significant dimensions were motivation, student-student, autonomy, collaboration, resolution, and ratings. In the Secondary Education stage, something similar to the Primary Education stage occurs, although in this case, the differences in means were smaller, and there were also negative differences in the two dimensions, teacher-student, and student-content. The most significant dimensions were the same as those obtained in Primary Education, except for the rating dimension, which shows no significant differences at this education stage.

In the Baccalaureate stage, the results turned around concerning the other two stages, having negative differences in all dimensions; that is, the EG showed higher values than those shown by the CG. In this case, all of the dimensions turned out to be significant, except for resolution and teacher-ratings. In those cases where the difference turned out to be significant, the force of association is negative in the stages of Primary and Secondary Education. This indicates that the force is indirectly proportional; that is, the control group showed a higher force than the experimental group. In the High School stage, the force of association was positive. In all cases, the partnership strength was medium-low. The magnitude of the effect was low in all cases, with even negative values or absolute zeros (Table 5). Negative values are directly related to non-significant values and have no direct interpretation. Positive values close to zero indicate that the strength of association is low.

Table 2. Basic statistics of research in CG and EG of Primary Education.

	Dimensions	Likert Scale *n (%)*				Parameters			
		None	Few	Enough	Completely	M	SD	S_{kw}	K_{me}
Control group	Motivation	2(4)	8(16)	16(32)	24(48)	3.24	.870	-.884	-.085
	Teacher-student	5(10)	14(28)	16(32)	15(30)	2.82	.983	-.293	-.965
	Student-content	3(6)	14(28)	17(34)	16(32)	2.92	.922	-.324	-.879
	Student-student	3(6)	8(16)	18(36)	21(42)	3.14	.904	-.805	-.152
	Autonomy	2(4)	7(14)	21(42)	20(40)	3.18	.825	-.806	.178
	Collaboration	3(6)	7(14)	17(34)	23(40)	3.20	.904	-.934	.069
	Deepening	2(4)	12(24)	24(48)	12(24)	2.92	.804	-.342	-.317
	Resolution	1(2)	8(16)	14(28)	27(54)	3.34	.823	-.946	-.127
	Classtime	2(4)	14(28)	22(44)	12(24)	2.88	.824	-.225	-.579
	Ratings[a]	2(4)	7(14)	16(32)	25(50)	3.28	.858	-.989	.196
	Teacher-ratings[a]	3(6)	11(22)	21(42)	15(30)	2.96	.880	-.482	-.452
Experimental group	Motivation	4(8)	15(30)	17(34)	14(28)	2.82	.941	-.237	-.902
	Teacher-student	6(12)	16(32)	16(32)	12(24)	2.68	.978	-.122	-.980
	Student-content	6(12)	14(28)	19(38)	11(22)	2.70	.953	-.236	-.814
	Student-student	6(12)	14(28)	20(40)	10(20)	2.68	.935	-.239	-.742
	Autonomy	5(10)	14(28)	19(38)	12(24)	2.76	.938	-.264	-.778
	Collaboration	5(10)	14(28)	19(38)	12(24)	2.76	.938	-.264	-.778
	Deepening	5(10)	11(22)	24(48)	10(20)	2.78	.887	-.457	-.374
	Resolution	5(10)	12(24)	22(44)	11(22)	2.78	.910	-.386	-.534
	Classtime	4(8)	16(32)	20(40)	10(20)	2.72	.882	-.153	-.661
	Ratings[a]	5(10)	13(26)	20(40)	12(24)	2.78	.932	-.324	-.669
	Teacher-ratings[a]	4(8)	14(28)	21(42)	11(22)	2.78	.887	-.274	-.597

[a] $p < 0.05$ was used (None: 1–4.9; Few: 5–5.9; Enough: 6–8.9; Completely: 9–10).

Table 3. Basic statistics of research dimensions in CG and EG of Secondary Education.

	Dimensions	Likert Scale *n (%)*				Parameters			
		None	Few	Enough	Completely	M	SD	S_{kw}	K_{me}
Control group	Motivation	3(5.1)	19(32.2)	20(33.9)	17(28.8)	2.86	.899	-.166	-.966
	Teacher-student	7(11.9)	21(35.6)	24(40.7)	7(11.9)	2.53	.858	-.081	-.559
	Student-content	5(8.5)	24(40.7)	21(35.6)	9(15.3)	2.58	.855	.097	-.616
	Student-student	3(5.1)	17(28.8)	19(32.2)	20(33.9)	2.95	.918	-.313	-.965
	Autonomy	3(5.1)	15(5.4)	20(33.9)	21(35.6)	3.00	.910	-.427	-.817
	Collaboration	3(5.1)	13(22)	22(37.7)	21(35.6)	3.03	.890	-.524	-.586
	Deepening	6(10.2)	25(42.4)	17(28.8)	11(18.6)	2.56	.915	.168	-.815
	Resolution	2(3.4)	15(25.4)	22(37.3)	20(33.9)	3.02	.861	-.369	-.800
	Classtime	3(5.1)	27(45.8)	21(35.6)	8(13.6)	2.58	.792	.279	-.490
	Ratings[a]	4(6.8)	24(40.7)	24(40.7)	7(11.9)	2.58	.792	.063	-.402
	Teacher-ratings[a]	6(10.2)	18(30.5)	25(42.4)	10(16.9)	2.66	.883	-.200	-.595
Experimental group	Motivation	4(6.8)	28(47.5)	18(30.5)	9(15.3)	2.54	.837	.318	-.573
	Teacher-student	3(5.1)	27(45.8)	22(37.3)	7(11.9)	2.56	.772	.261	-.393
	Student-content	5(8.5)	25(42.4)	18(30.5)	11(18.6)	2.59	.893	.160	-.788
	Student-student	5(8.5)	27(45.8)	17(28.8)	10(16.9)	2.54	.877	.263	-.692
	Autonomy	6(10.2)	25(42.4)	20(33.9)	8(13.6)	2.51	.858	.142	-.574
	Collaboration	4(6.8)	25(42.4)	20(33.9)	10(16.9)	2.61	.851	.164	-.681
	Deepening	6(10.2)	25(42.4)	18(30.5)	10(16.9)	2.54	.897	.166	-.736
	Resolution	7(11.9)	22(37.3)	21(35.6)	9(15.3)	2.54	.897	.017	-.706
	Classtime	5(8.5)	26(44.1)	20(33.9)	8(13.6)	2.53	.838	.190	-.527
	Ratings[a]	7(11.9)	23(39)	19(32.2)	10(16.9)	2.54	.916	.080	-.781
	Teacher-ratings[a]	7(11.9)	21(35.6)	22(37.3)	9(15.3)	2.56	.896	-.035	-.696

[a] Grade groups utilized (None: 1–4.9; Few: 5–5.9; Enough: 6–8.9; Completely: 9–10).

5. Discussion and conclusions

This study aimed to contrast the efficacy of two innovative methodologies, such as gamification and flipped learning in the area of Physical Education. This study shows that it is at the stages of Primary Education and Secondary Education where the active gamification methodology tends to be of better value. In contrast, in the Baccalaureate stage, the flipped learning active methodology was better valued (Martin-

Table 4. Data obtained for the dimensions of research in CG and EG of Baccalaureate level.

	Dimensions	Likert Scale n (%)				Parameters			
		None	Few	Enough	Completely	M	SD	Skw	Kme
Control group	Motivation	7(10)	21(30)	27(38.6)	15(2.4)	2.71	.919	-.200	-.762
	Teacher-student	8(11.4)	19(27.1)	24(34.3)	19(27.1)	2.77	.981	-.280	-.931
	Student-content	9(12.9)	21(30)	24(34.3)	16(22.9)	2.67	.974	-.162	-.944
	Student-student	8(11.4)	19(27.1)	26(37.1)	17(24.3)	2.74	.958	-.270	-.845
	Autonomy	7(10)	19(27.1)	26(37.1)	18(25.7)	2.79	.946	-.292	-.816
	Collaboration	9(12.9)	21(30)	26(37.1)	14(20)	2.64	.948	-.163	-.848
	Deepening	8(11.4)	23(32.9)	22(31.4)	17(24.3)	2.69	.971	-.105	-.992
	Resolution	8(11.4)	21(30)	25(35.7)	16(22.9)	2.70	.953	-.184	-.880
	Classtime	6(8.6)	20(28.6)	30(42.9)	14(20)	2.74	.879	-.255	-.584
	Ratings[a]	8(11.4)	21(30)	24(34.3)	17(24.3)	2.71	.965	-.187	-.928
	Teacher-ratings[a]	7(10)	20(28.6)	27(38.6)	16(22.9)	2.74	.928	-.243	-.770
Experimental group	Motivation	3(4.4)	12(17.6)	20(29.4)	33(48.5)	3.22	.859	-.842	-.297
	Teacher-student	3(4.4)	10(14.7)	23(33.8)	32(47.1)	3.24	.866	-.908	.032
	Student-content	2(2.9)	10(14.7)	24(35.3)	32(47.1)	3.26	.822	-.864	.000
	Student-student	3(4.4)	10(14.7)	22(32.4)	33(48.5)	3.25	.870	-.936	.043
	Autonomy	3(4.4)	7(10.3)	29(42.6)	29(42.6)	3.24	.813	-.978	.651
	Collaboration	3(4.4)	8(11.8)	29(42.6)	28(41.2)	3.21	.821	-.903	.430
	Deepening	2(2.9)	8(11.8)	28(41.2)	30(44.1)	3.26	.785	-.892	.394
	Resolution	3(4.4)	20(39.4)	25(36.8)	20(29.4)	2.91	.876	-.236	-.873
	Classtime	5(7.4)	9(13.2)	23(33.8)	31(45.6)	3.18	.929	-.939	.004
	Ratings[a]	4(5.9)	11(16.2)	18(26.5)	35(51.5)	3.24	.932	-.949	-.168
	Teacher-ratings[a]	2(2.9)	21(30.9)	28(41.2)	17(25)	2.88	.820	-.111	-.816

[a] Established grade group (None: 1–4.9; Few: 5–5.9; Enough: 6–8.9; Completely: 9–10).

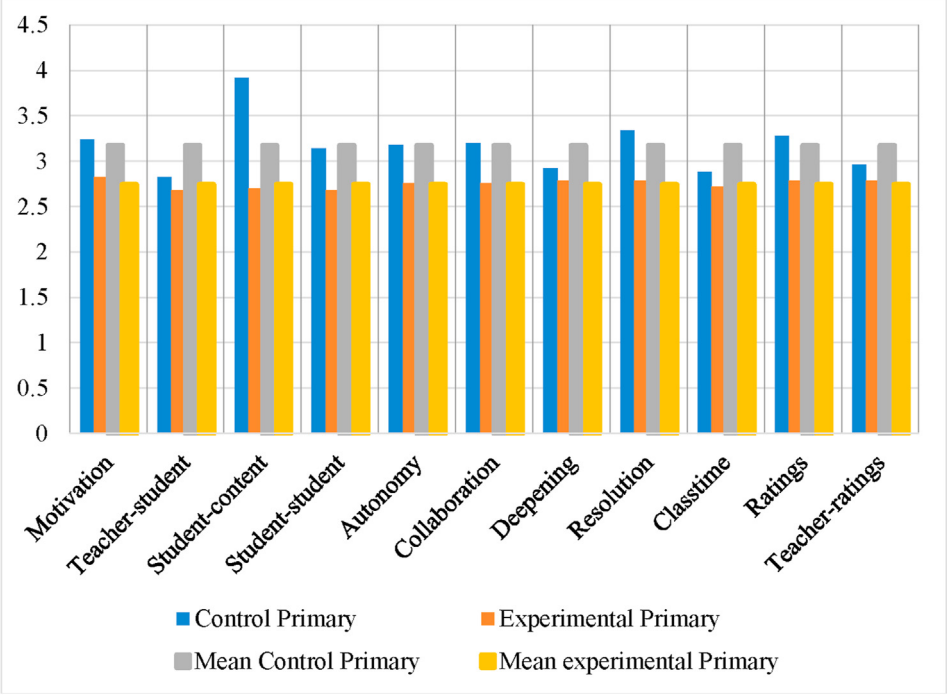

Figure 2. Comparison between the different groups of analysis in Primary.

Rodríguez et al., 2016). Although greater autonomy associated with age could be a correct response, it has not been shown that there is a significant relationship between them (Kashefian-Naeeini and Riazi, 2011). The technological capacity or competence can better explain the students' results (Zainuddin and Perera, 2017).

The response trend in each of the stages is similar to the study dimensions. Both in the control group and the experimental group, except for those dimensions that have been identified as significant differences. Thus, motivation is one of the highlights. These results are not consistent with the scientific literature where various studies show significant increases in student motivation, both for gamified experiences and an inverted methodology (Zainuddin, 2018; Zainuddin et al., 2019).

The primary and secondary stages highlighted that gamification showed better results in the student-student, autonomy, collaboration,

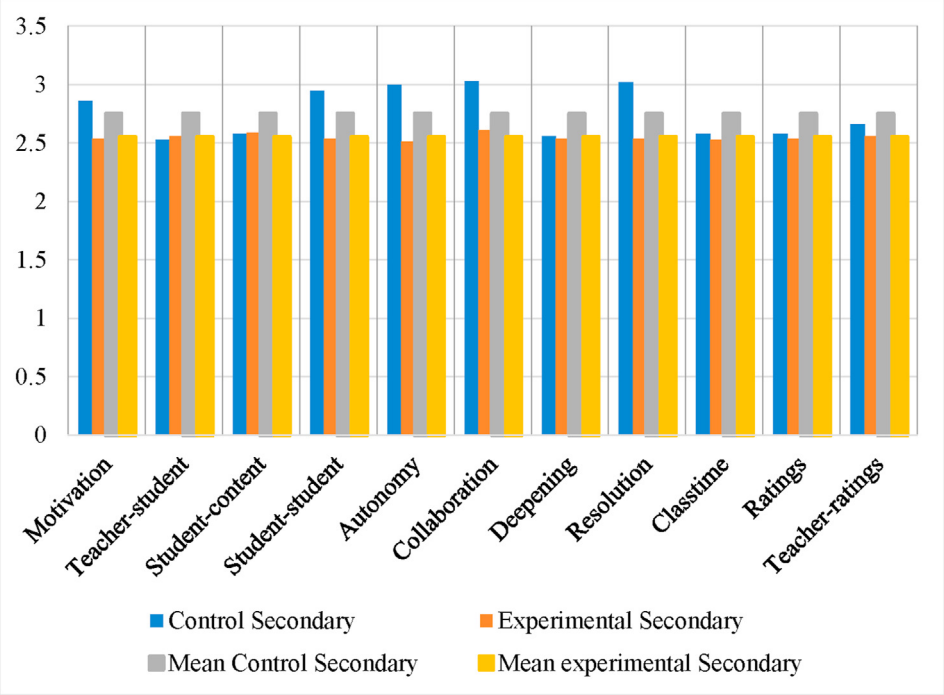

Figure 3. Comparison between the different groups of analysis in Secondary.

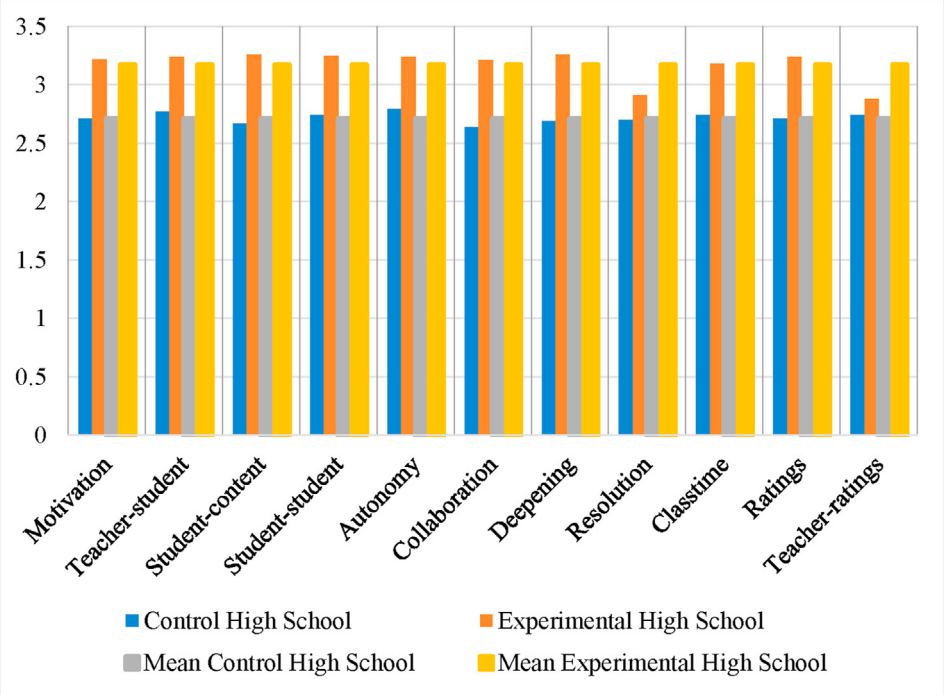

Figure 4. Comparison between the different groups of analysis in Baccalaureate.

and resolution dimensions. These results agree with other studies in which the ability of gamification to develop different abilities has been shown (Banfield and Wilkerson, 2014; Parra-Gonzalez et al., 2020; Quintas et al., 2020; Tan and Hew, 2016). This is probably due to an increase in the students' intrinsic motivation (Ryan and Deci, 2002).

Contrastingly, the dimensions motivation, teacher-student, student-content, student-student, autonomy, collaboration, deepening, classtime, and ratings are significant for high school students concerning the flipped learning methodology. Although it may seem that these results may be influenced by age, they may, instead, be due to a different biological stage (Navarro et al., 2015).

To answer, in general, each of the research questions that have been carried out, it can be shown as:

- Does the training methodology influence the motivation of the students? This research has shown that the methodology does influence the motivation of students. Furthermore, all of the educational stages were analyzed, but from different perspectives. In Primary and

Table 5. Study of the value of independence between groups.

Dimensions	μ(X1-X2)	tn1+n2-2	df	d	rxy
Motivation	.420(3.24-2.82)	2.317*	98	.029	-.228
Teacher-student	.140(2.82-2.68)	n.s.	98	.006	-.072
Student-content	.220(2.92-2.70)	n.s.	98	-.018	-.118
Student-student	.460(3.14-2.68)	2.501*	98	.018	-.245
Autonomy	.420(3.18-2.76)	2.377*	98	.023	-.233
Collaboration	.440(3.20-2.76)	2.389*	98	.029	-.235
Deepening	.140(2.92-2.78)	n.s.	98	-.024	-.083
Resolution	.560(3.34-2.78)	2.227**	98	.000	-.310
Classtime	.160(2.88-2.72)	n.s.	98	.000	-.094
Ratings[a]	.500(3.28-2.78)	2.790**	98	.017	-.271
Teacher-ratings[a]	.180(2.96-2.78)	n.s.	98	.012	-.102
Motivation	.322(2.86-2.54)	2.013*	116	.044	-.184
Teacher-student	-.034(2.53–2.56)	n.s.	116	.056	.021
Student-content	-.017(2.58–2.59)	n.s.	116	.006	.010
Student-student	.407(2.95-2.54)	2.461*	116	.043	-.223
Autonomy	.492(3.00-2.51)	3.018**	116	.037	-.270
Collaboration	.424(3.03-2.61)	2.643**	116	.058	-.238
Deepening	.017(2.56-2.54)	n.s.	116	.000	-.009
Resolution	.475(3.02-2.54)	2.932**	116	.011	-.263
Classtime	.051(2.58-2.53)	n.s.	116	-.017	-.031
Ratings[a]	.034(2.58-2.54)	n.s.	116	-.022	-.020
Teacher-ratings[a]	.102(2.66-2.56)	n.s.	116	.011	-.058
Motivation	-.506(2.71–3.22)	-3.277**	136	-.020	.271
Teacher-student	-.464(2.77–3.24)	-2.943**	136	-.016	.245
Student-content	-.593(2.67–3.26)	-3.862**	136	-.016	.314
Student-student	-.507(2.74–3.25)	-3.251**	136	-.016	.269
Autonomy	-.450(2.79–3.24)	-2.991**	136	-.032	.248
Collaboration	-.563(2.64–3.21)	-3.725**	136	-.029	.304
Deepening	-.579(2.69–3.26)	-3.846**	136	-.037	.313
Resolution	-.212(2.70–2.91)	n.s.	136	.020	.116
Classtime	-.434(2.74–3.18)	-2.816**	136	-.041	.235
Ratings[a]	-.521(2.71–3.24)	-3.224**	136	-.025	.266
Teacher-ratings[a]	-.139(2.74–2.88)	n.s.	136	.029	.080

**. The correlation is significant at the 0.01 level.
*. Correlation is significant at the 0.05 level.
n.s. Not significant.
[a] Established grade group (None: 1–4.9; Few: 5–5.9; Enough: 6–8.9; Completely: 9–10).

Secondary Education, gamification has an influence. In contrast, in Higher Education, it is flipped learning.

- Does the training methodology influence the students' interaction with the teacher? In this case, it has only influenced higher education; it has not in the other stages. Specifically, in the development of flipped learning.
- Does the training methodology influence the interaction of students with the content of the teaching? As with the previous question, this aspect only influenced higher education. Specifically, in the development of flipped learning.
- Does the training methodology influence the interaction of students? Although it is more significant in higher education than in the primary and secondary stages, this aspect influences all education stages. In Higher Education, flipped learning has influence. In the other two educational stages, gamification has influence.
- Does the training methodology influence student autonomy? Although it is more significant in higher and secondary education than in primary education, it has a positive influence. As in the previous cases, gamification influences secondary and primary education. In higher education, it is influenced by flipped learning.
- Does the training methodology influence student collaboration? In this case, it is the same as in the previous question. It is significant at all stages, but more so in secondary and higher education. In Primary and Secondary Education, it is influenced by gamification. In Higher Education, flipped learning.
- Does the training methodology influence the level of depth of the content? It only influences higher education. In the rest of the stages, there is no relationship of importance. In this case, flipped learning has an influence.
- Does the training methodology influence the degree of problem-solving by students? Yes, it affects and is very significant for primary and secondary education stages, but it has no relation to higher education. In this case, gamification has influenced two educational stages.
- Does the training methodology have an influence on class-time with students? Only in higher education. It does not influence the primary and secondary stages of education. In this case, only flipped learning has an influence.
- Does the training methodology influence the degree of qualification of the students? The qualifications only influence, in a very significant way, the primary and higher education stages. It has no apparent influence on the secondary education stage. In Primary Education, gamification has an influence. In Higher Education, it is influenced by flipped learning.

To conclude, it has been shown that the use of two active methodologies, such as gamification and flipped learning, cause different improvements in the teaching and learning processes of Physical Education students. Most studies focus on comparing these types of methodologies with the traditional methodology, but few seek to detect the different advantages and possible applications of the different available methodologies.

It has been shown that, at least in the context where this research has been carried out, both methodologies are equally crucial for Physical Education students' learning processes. It is gamification that seems to have a better predisposition to be used by younger students or in the early stages of the educational system, such as primary and secondary education. At the same time, flipped learning is the one that obtains the best results in more advanced stages, such as secondary education.

As an extension of this study in the future, studying the proposed dimensions from a joint perspective is raised, where gamification and flipped learning are combined and compared with traditional teaching. On the other hand, it would be interesting to know the opinion, through interviews, of the teachers who develop the intervention to obtain qualitative information about the process carried out. Furthermore, this study can be extrapolated to other subjects, such as mathematics or language teaching. Similarly, it appears that there are undetected external or sociodemographic factors that may be affecting the results. Therefore, the study of different sociodemographic variables could guide future research.

Different implications derive from this research. At a theoretical level, the study has made it possible to expand the existing literature on active methodologies in the educational field, in this case, gamification and flipped learning. This has made it possible to bring together the most recent and impact studies to understand and analyze its state.

On a practical level, this research has revealed the most significant and conclusive results achieved to date. Especially regarding the application of gamification and flipped learning in the Physical Education subject. This study has reflected its potentialities with the prospect that other teachers can carry out training practices through these emerging methodologies. On the other hand, the scientific community is encouraged to continue investigating these training actions and contrast and discuss the findings presented here with future works.

Declarations

Author contribution statement

J. López Belmonte, E. Parra-González: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

A. Segura-Robles: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

A. J. Moreno-Guerrero: Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

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Data availability statement

The data that has been used is confidential.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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