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Active and Emerging Methodologies for Ubiquitous Education: Potentials of Flipped Learning and Gamification

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Abstract: Introduction: Nowadays, education is immersed in a process of constant renewal due to the inference of two fundamental facts: The emergence of new technologies and the development of new active methodologies that lead the teaching and learning processes. Methods: A case study was developed to analyze the effects caused in these processes by the implementation of "flipped learning" and "gamification" as teaching models; after the implementation of each one, variables such as learning achievement, learning anxiety, motivation, and autonomy were compared. This work was carried out with secondary school subjects (n = 60) of an educational center of the Autonomous City of Ceuta. A descriptive experimental study was carried out. Gamification and flipped learning effects were compared to analyze both their potentials as educational methodologies. Results: The results show the benefits of both methodologies. All measured dimensions increased positively, in accordance with previous studies on the subject. Conclusion: The implementation of both methodologies in the classroom causes an improvement in the students' learning processes, in their achievements, and in their enthusiasm.

Keywords: ICT; educational innovation; innovative methodologies; methodological contrast; transformative pedagogies; flipped learning; gamification

1. Introduction

It cannot be denied that today's society is in a process of digitalization, derived from the constant influence that continuous advances and technological advances are causing in people's lives. This situation is demonstrated in the projection that it assumes and in the prominent position in which information and communication technologies (ICT) are found in the social, educational, and labor functions of citizens [1].

Specifically, the penetration and expansion of ICT into the field of education has been one of the most prominent [2]. This fact is justified by the transformation experienced by the training processes, which have benefited from the constant innovation produced in the entire educational spectrum, from the changes in the roles of the main agents (teacher–students), to the emergence of new methodologies, resources, means, and places to develop the teaching and learning processes [3,4].

The development of educational technologies and emerging methodologies has been full, as it is the protagonist of the educational renewal that is happening in the learning spaces [5]. The inclusion of these new ways of learning has led to various academic indicators of attitudinal types such as motivation, attitude, and perception of students; these are favored as a result of all the means, tools, and digital resources that are available to boost formative processes [6–8].

ICTs have created an opening of possibilities to carry out formative actions and to provide students with access to the contents and teaching materials [9]. In this sense, the integration of ICTs in everyday instructional actions is essential to adapting the educational system to the conditions, needs, and demands of students in a digital age [10]. All of this has resulted in the creation of both new moments and places to deploy teaching practices [11], in the promotion of the ubiquity of learning, and in the emergence of unique experiences and activities to foster and strengthen the learning structures of students [12]. This transformation has led to an increase in training quality and a greater adaptation of education to the intrinsic characteristics of the information and knowledge society [13].

Following the impact that technology and methodological innovation have had on the educational field and its relevant process of pedagogical renewal, new ways of transmitting information to and generating knowledge in students have emerged. An example of this is the appearance of flipped learning and gamification, understood as new teaching methodologies adapted to the new times and paradigms with which the education of the new millennium concurs [14,15].

1.1. Educational Considerations about Flipped Learning

Flipped learning is presented as a mixed methodology where face-to-face and virtual teaching are combined [16]. This approach has acquired a great projection; it is currently being used at all educational levels due to its effectiveness and its practical and dynamic components that make up the act of training [14,17,18].

The ideology of this methodological approach is based on enhancing the time the student spends in the physical classroom to solve problems, interact with classmates and the teacher, and deepen the contents [19], always based on their previous experiences and knowledge [20–22]. For this, the teacher previously had to create the contents through an audiovisual medium [23] and host them on a digital platform so that students could have access to them before attending the class [24–26]. In addition, flipped learning causes an investment in learning moments, in which a first approach, contact, and assimilation of the contents takes place anywhere first, and ends in the classroom with a deepening of the contents and resolution of the doubts and concerns of the students [27,28].

The change in the traditional teaching and learning schemes and moments involved in the practice of flipped learning has led to a set of potentials at the academic level. This methodology causes an increase in their motivation [29], attitude towards learning [30], commitment to the task [31], interaction [32,33], participation [34], socialization among the agents involved [35–37], autonomy [38,39], and even the regulation of learning at individual rates [29,40].

These improvements positively influence the performance and results obtained by the students, resulting in an increase in the assessment test scores [41,42] and a greater assimilation of skills and achievement of objectives [43–45]. Consequently, several reported studies in impactful scientific literature have verified the effectiveness of flipped learning in contrast to the use of traditional teaching methods, demonstrating the full formative potential of this innovative approach [46–49].

1.2. Particularities about Gamification in Education

Gamification is understood as an active methodology that has made its way in education through the use of structure, elements, and designs of games and recreational environments in formal educational settings [39,50,51]. Although it is cataloged within the group of innovative and emerging methodological approaches that are currently being carried out, its practice has been carried out since the 1960s, when the use of the game to improve student learning began to be promulgated [52,53].

Although there are teachers who apply gamification in their classroom, there are still others who do not know that this learning technique is capable of motivating and teaching students in a playful way. One of the main keys to applying it is for the students to have perfectly assimilated the game dynamics that will be carried out. All of them are intended to involve the student in playing and moving forward in achieving their objectives while the activity is being carried out. In gamified experiences, the main objective is to try to maximize children's abilities through experimentation and

play. This way, it is made easier and more possible to achieve more meaningful and functional learning [54].

At present, due to technological impacts, the games have undergone a transformation towards the digital, being able to carry out the learning of contents from the most traditional games to the most innovative videogames with large digital loads [55–57]. Gamification can be applied at different educational levels, demonstrating its potential at an early age [58], in adolescence [59], and even in university contexts [60].

The use of gamification in formative action is a benefit to the motivation of students, which is increased as a result of this innovative methodology [61,62]. Likewise, other academic indicators—such as the social and interactive components among students, teachers, and content—are increased with the use of games [15]. Gamification also contributes to improving the involvement, interest, and students' attitudes toward learning tasks [63–65], as well as their autonomy as agent builders of their own knowledge [66].

Through gamification, students build their knowledge through a game that does not involve an apparent effort, so it helps to improve their involvement and dedication in educational activities of a playful nature [67]. Unlike traditional methodologies, gamification rewards every effort made in addition to the achievements, so that the attitude, commitment, and motivation of the students towards new learning experiences are benefited [68], which has a greater impact on performance [69] and ease in learning content [70,71].

All of this leads to the reflection that ICTs assume a very important role in gamification, since through technology, one can design different training scenarios through online games, where—thanks to their ubiquity—they can generate learning in any context, whether formal, non-formal, or informal [72].

In this sense, with these dynamics of work in virtual environments, interaction, socialization, and problem solving are favored in a cooperative manner [73]. First, a scientometric study of educational gamification was developed in 2019. Given the recent interest in gamification in education, one of the conclusions that they achieved was to carry out a specific research analyzing gamification by education level; that is what this work is: A research to determine the influence of gamification on secondary education with a specific intervention [72].

2. Materials and Methods

This study was carried out through the experimental design of a descriptive and correlational analysis based on the quantitative perspective, as indicated by the experts [74,75]. First, students, who had not had experiences with gamification or flipped learning, answered a pre-test. Then, some activities were carried out through these active methodologies. Finally, a post-test was given again to the students to measure the different variables after the experience of the before-mentioned active methodologies.

All statistical analysis was carried out with the Statistical Package for the Social Sciences (SPSS) v25 program. In the data analysis, descriptive statistics such as mean (M) and standard deviation (SD) were used. The measurement of the size of the effect caused was obtained by biserial correlation (r). In addition, a $p < 0.05$ is established in the study as a statistically significant difference.

2.1. Participants

The participants who took part in this experiment were 60 secondary school students. Recent studies of relevance and impact in the educational field show that the sample size in this type of investigation does not condition the performance of these experiments [76,77].

The students of this study were selected through a non-probabilistic technique of an intentional type—thanks to the ease of access to the students' educational center—and by conglomerates. The configuration of the conglomerates was not a problem due to the existence of two groups of students of the same level in an educational center of the Autonomous City of Ceuta (Spain).

In particular, students were selected from the third year of Secondary Education (n = 60; M_{age} = 16 years; SD = 1.62). The configuration of the group in relation to sex included 35 boys and 25 girls.

2.2. Instrument

Data collection was done with an ad hoc questionnaire. The design of this instrument was based on other validated instruments obtained from the reviewed scientific literature [78,79]. The questionnaire has 42 items. The dimensions of learning achievement, learning anxiety, motivation, and autonomy compose the questionnaire. To measure the items, a Likert scale with a range of four points was used (from 1 = Strongly disagree to 4 = Strongly agree).

The instrument was validated in a quantitative and qualitative way. First, a Delphi method was carried out to validate it qualitatively. The procedure involved ten experts from several universities, who were involved with emerging technologies and innovation in the educational field. The questionnaire was positively valued by these experts (M = 4.87; SD = 0.21; min = 1; max = 6), who also gave certain recommendations about some items. In the review, the Fleiss's Kappa and Kendall's W were applied to achieve the indexes of concordance and relevance of the observations granted, drawing positive results (K = 0.87; W = 0.89). Subsequently, performing an exploratory factor analysis using the principal components method with Varimax rotation quantitatively validated it. The tests determined the dependence between the delimited variables (Bartlett's test of sphericity = 2647.21; $p < 0.001$) and adequacy of the sample (Kaiser–Meyer–Olkin = 0.86).

In addition, other statistics were used to measure the reliability of the questionnaire, such as Cronbach's alpha (α), Compound Reliability (CR), and Average Variance Extracted (AVE), confirming all of the values achieved for the internal consistency of the questionnaire.

2.3. Procedure

This study was carried out in several phases. Firstly, the instrument was designed and validated. Secondly, participants of the study were selected. Afterwards, the first phase of data collection was done. Then, several activities were carried out using the active methodologies of gamification and flipped learning. Finally, the second phase of data collection was performed. The difference with respect to time between the two tests was one month—before and after developing the sessions with active methodologies (two per week).

To develop the study, teachers were responsible for developing the learning activities through gamification and flipped learning. The mentioned purposes of the use of these active and emerging methodologies were focused on increasing the motivation, participation, attitude, interest, autonomy, and teamwork of students by presenting an innovative training action. Students are the protagonists of the whole process, and the role of the teacher is focused on presenting the activities and problems to be solved and orienting students towards the achievement of learning and knowledge. All of this is carried out in an appropriate class environment generated by the teacher, avoiding situations of stress, noise, and lack of control that can cause distraction and anxiety during the development of the sessions.

The main variables of experimentation were based on global ideas about autonomy involved in fields such as self-determination. Together with motivation, these represent the two main aspects to investigate, which become convergent with those ascertained from the aforementioned studies.

Figure 1 shows a summary of the investigation process followed.

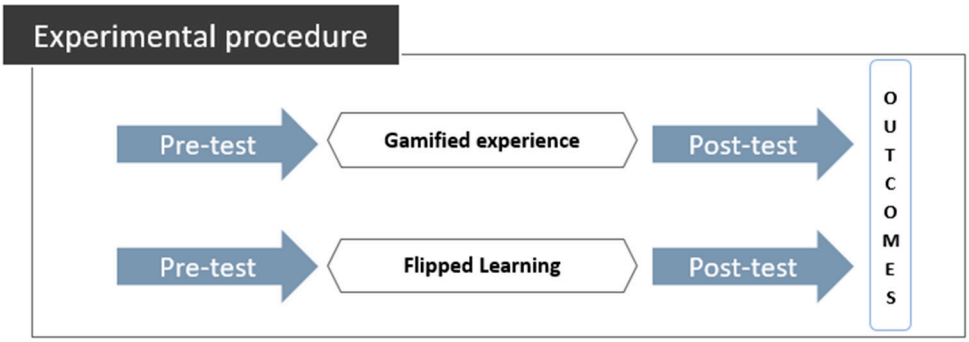

Figure 1. Overview of the experimental procedure of the present research.

3. Results

Initially, it was proposed to resort to traditional parametric statistics to perform analyses. After verifying that data collected for both groups did not follow a normal distribution, the researchers decided to use equivalent non-parametric tests. For this purpose, the Shapiro–Wilk test was used. The *p*-value was 0.01 for the control group, and the *p*-value was 0.03 for the experimental group; both values are below 0.05, evidencing that the participation values were not normally distributed.

In order to prove the validity of the questionnaire used, the classic validation tests proposed by the literature are used: Cronbach's alpha (α), Composite Reliability (CR), and Average Extracted Variance (AVE). The results show (Table 1) reliability indices that can be considered acceptable for all values of $\alpha > 0.79$, CR > 0.60, and AVE > 0.5 [80].

Table 1. Reliability and validity indices.

	Alpha (α)	CR *	AVE **
Learning Achievement	0.81	0.931	0.711
Learning Anxiety	0.79	0.793	0.695
Motivation	0.90	0.837	0.752
Autonomy	0.89	0.815	0.842

Note: * Composite Reliability, ** Average Extracted Variance.

As shown in Table 2, the values obtained for the gamified experience are similar in all analyzed dimensions of both the pre- and post-tests. Learning anxiety showed low levels (2.18 ± 0.52; 2.25 ± 0.71) for the first gamified experience and (4.60 ± 0.77; 4.13 ± 0.91) for the flipped experience. In relation to motivation, two methodologies showed great values in the pre- and post-tests (4.69 ± 0.23; 4.79 ± 0.42 and 4.05 ± 0.81; 4.10 ± 0.90 out of 5).

On the other hand, autonomy values were superior in flipped learning (4.15 ± 0.59 and 4,92 ± 0.32) and low in gamified learning (3.20 ± 0.31; 3.51 ± 0.72).

Table 2. Descriptive analysis of each dimension in the two kinds of learning.

Gamified Experience		
	Pre-Test	**Post-Test**
	Mean (SD)	**Mean (SD)**
Learning Achievement	----	4.80 (0.25)
Learning Anxiety	2.18 (0.52)	2.25 (0.71)
Motivation	4.69 (0.23)	4.79 (0.42)
Autonomy	3.20 (0.31)	3.51 (0.72)
Flipped learning		
	Pre-test	**Post-test**
	Mean (SD)	**Mean (SD)**
Learning Achievement	----	4.85 (0.76)
Learning Anxiety	4.60 (0.77)	4.13 (0.91)
Motivation	4.05 (0.81)	4.10 (0.90)
Autonomy	4.15 (0.59)	4.92 (0.32)

The primary evaluation was done in the measurement of learning achievement (Table 3). For this situation, the attained results in the post-test were analyzed between the two measurements. The outcomes show no significant differences ($Z = -0.985$; $p = 0.087$). For this situation, flipped learning had a higher value for the mean position (MR = 71.32) than that of conventional learning (MR = 69.47).

Table 3. Mann–Whitney U test for the learning achievement dimension.

		Mean Rank	U	Z	*p*	*r*
Post-test	**Gamified**	69.47	163.400	−0.985	0.087	---
	Flipped	71.32				

Note: The following are the intervals for *r*: 0.10: Small effect; 0.30: Intermediate effect; and 0.50 or higher: Strong effect.

Conversely, the learning anxiety measurement was examined for each of the learning types utilized during the research. As shown in Table 4, in the gamified unit, anxiety values had substantial differences (Z = −1.872; $p = 0.040$; r = 0.11). Where the flipped technique was utilized, anxiety values were also significantly diminished (Z = −1.954; $p = 0.045$; r = 0.10). These distinctions show a low affiliation intensity (r < 0.11).

Table 4. Mann–Whitney U test for the learning anxiety dimension.

		Mean Rank	U	Z	*p*	*r*
Gamified	**Pre-test**	41.12	332.000	−1.872	0.040	0.11
	Post-test	57.19				
Flipped	**Pre-test**	39.33	301.800	−1.954	0.045	0.10
	Post-test	55.53				

One of the most significant parts of any groundbreaking involvement in the classroom is the inspiration. The results (Table 5) do not show solitary contrasts between the student's past and subsequent inspiration in a gamified learning model (Z = −1.173; $p = 0.073$). The same applies in the adjustment of students' inspiration when completing the subject dependent on a flipped technique (Z = −1.127; $p = 0.057$).

Table 5. Mann–Whitney U test for the learning motivation dimension.

		Mean Rank	U	Z	*p*	*r*
Gamified	**Pre-test**	33.03	281.500	−1.173	0.073	--
	Post-test	39.15				
Flipped	**Pre-test**	43.61	211.300	−1.127	0.057	--
	Post-test	44.80				

With respect to autonomy—as in past measurements—there is a significant difference (Table 6). Despite the fact that the gamified teaching unit does not cause an upsurge in autonomy (Z = −2.179; $p = 0.071$), this happens in the flipped unit (Z = −2.346; $p = 0.045$). These distinctions show a medium affiliation intensity (r = 0.45).

Table 6. Mann–Whitney U test for the learning autonomy dimension.

		Mean Rank	U	Z	*p*	*r*
Gamified	**Pre-test**	31.47	196.200	−2.179	0.071	--
	Post-test	30.15				
Flipped	**Pre-test**	30.85	205.100	−2.346	0.045	0.15
	Post-test	46.45				

4. Discussion

Current education requires a profound process of transformation that must be supported by two fundamental pillars: On the one hand, the information and communication technologies and, on the other, the innovative methodologies that have emerged because of the implementation of the former

in the future of teaching. This is widely found in a multitude of top-level research, comparing here the results obtained in this study with those that already exist on the subject and the variables studied.

The inclusion of the ICTs already in itself generates multiple advantages in the development of the students [2], as it happens in this study. In addition, in this experimentation, we can realize the benefits that the two methodologies analyzed in the study have for students, like the rest of new methodologies that are usually applied in current education [3].

The two methodologies that were part of the study have shown their benefits for the development of the student learning that was part of it. On the one hand, the application of flipped learning causes a significant improvement of the processes and results, encouraging the restlessness of the students, as demonstrated in previous studies [27]. In addition, during the application of flipped learning, there is an increase in motivation, as in other cases [29], and greater autonomy of the students immersed in the teaching processes with this methodology [38].

On the other hand, the application of gamification as an educational tool in the classroom has also meant an increase in the variables that we might consider to be of special relevance. In addition, as with the previous method, better results are obtained and its potential and effectiveness are demonstrated, as in other studies [58]. Based on other variables, we can also observe how autonomy increases, as in other studies [66]; of course, it also implies a wide increase in student motivation, already outlined in other previous studies [61].

It should be noted that this increase in variables is usually very similar in the application of both methodologies; it should be noted that the most significant increase is the one that occurs in the autonomy variable after the application of flipped learning. This fact is understandable since it is one of the pillars of this methodology.

The discussion of these results is based on the continuity of studies on the subject that have been developed so far, highlighting the benefits of the application of flipped learning in the classroom, demonstrated in several previous studies [81–83] .

On the other hand, the good results obtained after the application of gamification as a methodology are also remarkable, and are consistent with previous studies [51,65,84].

5. Conclusions

The uses of the technologies and the innovative methodologies that derive from their implantation in the classroom happen to be the key tools for the future of educational development due to the multiple benefits that they produce in the students. It is necessary to mention that another benefit is the convenience of using these two methodologies in the daily development of classes.

On the one hand, the implementation of the flipped classroom causes an improvement in the students' learning processes, in their achievements, and in the enthusiasm reflected in the students. In addition, it improves the processes of motivation and, above all, the process of autonomy in the students.

On the other hand, it should be noted that gamification and its application in the classroom is an effective method with which better results and predispositions of students to learn are also achieved. In addition, they cause greater autonomy and, above all, greater motivation in students when dealing with learning.

It should be noted that, once the in-depth study of the scientific literature was carried out, no studies were found that directly relate the variables of this study and mix both methodologies. We can indicate that there is a gap in the relationships and applications of several methodologies, which could cause future studies in relation to that issue. The union of these two methodological innovations embarks on a new path in the field of research.

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