Do we play or gamify? Evaluation of gamification training experience to improve the digital competence of university teaching staff

¿Jugamos o gamificamos? Evaluación de una experiencia formativa sobre gamificación para la mejora de las competencias digitales del profesorado universitario

Lorena Martín-Párraga predoctoral, PhD student, Universidad de Sevilla (Spain) (lorena@grupotecnologiaeducativa.es) (https://orcid.org/0000-0002-2406-0708)

Antonio Palacios-Rodríguez PhD assistant, Universidad de Sevilla (Spain) (aprodriguez@us.es) (https://orcid.org/0000-0002-0689-6317)

Dr. Óscar Manuel Gallego-Pérez is a professor and researcher at Universidad de Sevilla (Spain) (ogallego@us.es) (https://orcid.org/0000-0001-8450-8634)

Abstract

Over the last few decades, studies have been carried out in the field of education that endorse the benefits that gamification offers both for teachers and students. The university is working along these lines, with the aim of developing optimal skills that benefit students, both personally and professionally. Consequently, this training designed and selected for teachers is essential to achieve a successful gamified experience. The main purpose of this research is to present a training experience carried out in a university in Latin America and to verify the perception of this methodological strategy by this educational institution. In other words, the aim is to demonstrate whether gamification is perceived as useful by university teaching staff. To this end, two designs were used: descriptive and validation by means of structural equations (PLS), in order to evaluate the degree of acceptance of gamification as an active methodology based on the Technology Acceptance Model (TAM). The results show that the proposal is suitable for university teaching. All the participants, 114, perceived this strategy as adequate, detailing the dimensions related to the ease of use in the classroom, its integration, the transformation of interest in learning, and the ability to show a positive attitude in its use. At the same time, the level of acceptance regarding the validation of the TAM is high. Finally, the assessment of the replicability of the model in future and similar research, or through so-called emerging technologies, is detailed.

Resumen

En las últimas décadas se han realizado estudios en el ámbito de lo educativo que avalan los beneficios que la gamificación ofrece tanto para docentes como al alumnado. En esta línea se trabaja desde la universidad, con la finalidad de conseguir desarrollar habilidades óptimas que beneficien al alumnado, tanto personal como profesionalmente. En consecuencia, esta formación diseñada y seleccionada para docentes es esencial para conseguir una experiencia gamificada exitosa. El objetivo principal de esta investigación es exponer una experiencia formativa llevada a cabo en una universidad de América Latina y comprobar la percepción de esta estrategia metodológica por parte de la institución educativa. Es decir, la finalidad consistiría en demostrar si la gamificación es percibida como útil por parte del profesorado universitario. Para ello, se han empleado dos diseños: descriptivo y la validación mediante ecuaciones estructurales (PLS), de forma que se pudiese evaluar el grado de aceptación que tiene la gamificación como metodología activa en base con el modelo de Aceptación de la Tecnología (TAM). Los resultados expuestos demuestran que la propuesta es adecuada para la docencia universitaria. Todos los participantes, 114, percibieron esta estrategia como adecuada,

detallando las dimensiones relacionadas con la facilidad de uso en el aula, su integración, la transformación del interés en el aprendizaje, y la capacidad de mostrar una actitud positiva en su uso. Simultáneamente, el nivel de aceptación respecto a la validación del TAM es alto. Por último, detallar la valoración a la hora de replicar el modelo en investigaciones futuras y similares, o a través de las llamadas tecnologías emergentes.

Descriptores: Gamificación, Educación Superior, competencia digital, formación del profesorado, metodologías activas, validación.

1. Introduction

The 21st century society is immersed in constant technological and methodological challenges, transforming its educational practice. The adequacy of the educational environments to these trends, the needs demanded by the system and the changes that have occurred, influence the way we communicate, learn and interact in the so-called information and communication society. It is a hyper-technological society, immersed in continuous and multiple changes, many of them produced by the use and implementation of digital technologies (Tornero & Varis, 2010). There are new media that literate practices, adding importance to interpreting the functioning of the work and recreational contexts of the knowledge community of the 21st century (Mills, 2010)

A new technological era, which is the result of accelerated changes, where information opens up paths promoted by the advances characterized by the use of so-called Information and Communication Technologies (ICT). The possibility of immediate access to each of the sectors that make up this cycle announces the essential elements that generate a great added value to the economic and social development of the knowledge society.

The technology of information is the purpose that impels and generates new alterations in the organization of knowledge, practices and forms of organization, as well as in the shaping

of human cognition, without ignoring the topic that concerns us: education.

It highlights the need for digital teacher transformation and the acquisition of skills, defined, according to the European Union, as "a combination of knowledge, skills and attitudes appropriate to the context" (Consejo de la Unión Europea, 2018, p.7). Therefore, it is essential to acquire skills that respond to the current challenges.

Despite this progression, the fact of incorporating technology does not change learning environments. According to Pelgrum and Voogt (2009), to achieve this purpose, there must be leadership in the centers that can motivate teachers to use new teaching methods in relation to ICT, in order to acquire higher levels of competence in the use of ICT and to develop a collaborative culture that encourages the inclusion of ICT in the teaching and learning process (T-L).

This is where the term "E-Learning" established by the European Commission is important. Virtual education would become one of the most powerful tools whose quality must be measured when designing training plans for this modality.

As detailed in the Istanbul Declaration (2002) and the Alexandria Declaration on Information Literacy (2005), training in digital skills is essential for a citizen to develop adequately in the Knowledge Society (Gutiérrez-Priego & García-Peralta, 2016).

Therefore, online education is a crucial tool for being involved in technological contexts, achieving the increase of key competencies that allow the development and autonomy of good educational practices through virtual environments. It is a type of virtual pedagogy that will promote collaborative work, improve individualized tutoring, and that will be able to include diversity in learning, improving the student's proficiency level and commitment.

To do this, the teacher must be able to develop dynamizing and cooperative methodologies focused on "learning by doing", as a method guided to the improvement of the performance, applicability and motivation of student learning.

Hence, the need to achieve a literacy model that offers a digital culture, which promotes: "Digital literacy, e-learning, e-inclusion, e-health and digital solutions in these fields" (provision 8301 of relations with the courts and equality, 2019). In turn, the importance of providing educational communities with different digital platforms and technological and didactic resources to ensure their correct application in the T-L process (provision 8301 of relations with the courts and equality, 2019).

The importance of using ICT to facilitate our daily work, to improve our professional performance and as lifelong learning is a relevant and substantial aspect of any training program (Cabero-Almenara & Palacios-Rodríguez, 2020). The significant increase in this progression will mean that jobs will require digital skills in the near future (Williamson et al., 2019).

When we talk about including a competency model in a curriculum, we mean that learning activities should not be limited to a single subject, but that the content developed seeks to achieve the same competence that will enable them to cope with any situation. We must be able to achieve a change in methodologies, moving from a type of reproductive methodology to a productive one. Only in this way will students be able to apply knowledge acquired in a problem-solving area in different scenarios. The consolidation of competencies through productive strategies simultaneously enhances different aspects of the teaching-learning process (T-L).

In this sense, with the main purpose of offering solutions to these positions, new ways of interpreting the educational environments are proposed, seeking a transformation that will achieve a better didactic adaptation in this sector. These active methodologies make students to take on a dynamic role in their own learning by transforming rigid and memoristic concepts.

In most of our universities, traditional teacher-centered and not student-centered learning methodologies continue to be used (Lai et al., 2018; Pelger & Nilsson, 2018). Consequently,

gamification emerged, aimed at the search for a better adaptation to current contexts, addressing the diversity and equality of conditions in the classrooms and developing different ways of motivating and energizing the T-L process. This strategy consists of introducing activities in the classroom through the dynamics of games, allowing the construction of dynamic learning, where the increase of the student's participation is enhanced and, therefore, the student acquires the need to "learn". In other words, gamification is a type of strategy that promotes more meaningful learning focused on the interests of students (Kapp, 2012; Herberth-Alexander, 2016; Molina-Álvarez et al. 2017; Corchuelo-Rodríguez, 2018). This rethinking of education brings with it new methodologies and, therefore, the need for digital transformation and the acquisition of key competencies that achieve quality education mediated in today's digital transformation environments.

The fields of application offered by gamification are diverse, the most researched is education (Dominguez-Díaz, 2018), where its implementation arises in e-learning environments, given its digital nature (Muntean, 2011). This means that, in recent times, these gamifying practices are taking on a significant role (Peñalva et al., 2018), especially because of the diversity of possibilities they offer, as shown by the various meta-analyses on the subject (Martínez-García et al., 2020). A study conducted by Çakıro lu et al. (2017), where real evidence was presented, revealed the positive effect that gamification has in education and how education manages to influence, indirectly, academic performance, personal commitment and social relations, generating positive effects and motivational impacts that benefit the T-L process

This type of learning is optimal due to its enjoyment and the good acquisition of contents (Molina-Álvarez et al., 2017). It is understood that in games, the challenges pose the need that the player has in order to exceed his/her expectations, causing this a psychological burden with

the aim of influencing human behavior (De Soto García, 2018).

Many of the studies carried out in this field of study conclude that gamification can offer different advantages for both teachers and students. For example, it allows the teacher to better understand the learning styles and difficulties of the students and to offer more immediate feedback, as well as to take advantage of class time for understanding the contents (Ortiz-Colón et al., 2018). On the other hand, students are more involved than in traditional classes, provoking positive emotions and attitudes towards learning (Gallego-Durán et al., 2014).
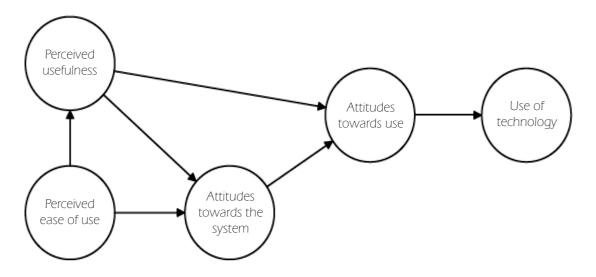
Gamification has proven to be effective in terms of acquiring knowledge and skills for the professional future of students (Villalustre-Martínez & Del Moral, 2015). In turn, other authors claim that it could be used as a motivational mechanism to encourage positive behaviors among students for their training (Kapp, 2012; Smith-Robbins, 2011). Focused on the relationship between learning based on gamified activities, Donoso-Anés and López-Gavira (2010) observe that peer-to-peer instructional opportunities are increased when classroom activities promote active learning. In short, gam-

ification is an active methodology that arises from the teaching interest in improving and motivating the student's commitment to self-learning (Rodríguez-Jiménez et al., 2019).

Although many studies have investigated the specific activities and practices used in gamification (Cortizo-Pérez et al., 2011), little attention has been paid to the final outcome of these activities, nor to the satisfaction of the students or teachers who conduct them.

To analyze the acceptance degree of the gamification methodology in this study, one of the models that has the greatest significance acquired is used to explain the adoption degree of a person towards technology, both general and concrete. This model was originally called the Davis Technology Acceptance Model (TAM) (1989), which states that beliefs, attitudes or willingness on technologies will have an impact on the use of technology. For this purpose, it is determined by two variables: perceived utility and perceived ease of use. The TAM model empirically proposes and demonstrates that Perceived Usefulness (PU) and Perceived ease of use (PFU) are the most critical factors in the process of technology adoption and systems use (Chen & Tan, 2004).

Figure 1. Davis Acceptance Model (1989)

Different transformations have been introduced in different studies (López-Bonilla & López-Bonilla, 2017; Cabero-Almenara et al., 2016; Cabero-Almenara & Llorente, 2020; Cabero-Almenara et al., 2021b) through the incorporation of new dimensions such as, for example, predictive dimensions (gender, degree of compulsory adoption of technology, experience, age, type of users…).

From the model itself it is emphasized that it must be built in each and every situation of acceptance of the technologies that are to be investigated. For this reason, it adapts exceptionally to the study presented, contextualizing and locating the mediating variables considered from the researcher's point of view. In this sense, the model has evolved into other versions, such as the TAM 2 (Venkatesh & Davis, 2000) or the integration model of technology acceptance and user satisfaction (Venkatesh & Bala, 2008).

2. Methodology

Because of the latter, this research presents the design of a training proposal for Latin American teachers in Higher Education. In this sense, the training process is developed and the degree of acceptance by teachers on this methodology is evaluated. Therefore, the proposed objective is to study the level of acceptance of the gamifying methodology of the university faculty involved in the formative action: validation of the gamifying methodology acceptance model (TAM) and analysis of the level of acceptance of the gamifying methodology.

This study uses two types of designs: scale validation and descriptive analysis. The first attempts to validate the scale of acceptance of the gamification methodology by adapting Davis TAM model (1989). Subsequently, the most significant data related to the acceptance of the gamification methodology were provided.

The 114 participants correspond to: male professors (54) and female professors (60) of the Private Technical University of Loja (UTPL),

Ecuador. This faculty is part of the staff of the university responsible for developing classes in the face-to-face and online modality of the different degrees and postgraduate courses that it offers.

UTPL is an autonomous institution with social and public purpose; it offers a teaching-learning process, conducts research with scientific and administrative freedom, and participates in development plans in the country.

The experience with UTPL faculty is presented. The aims and objectives that are pursued with the formative action are as follows:

- Learn basic concepts related to gambling, video games, Game-Based Learning (GBL) and gamification.
- Gamification in Higher Education.
- Know the importance of applying the term in training scenarios.
- Know what different elements of the game are relevant to their application in the areas that are demanded.
- See various examples of gamifying educational applications.
- Acquisition of strategies that make it possible to apply this strategy in teaching.
- Develop skills for the production of gamified resources through free or licensed software.
- Produce gamifying resources for a subject.

The course content will be developed as follows:

- Gamification.
- Theories that underpin gamification: Flow Theory and Fogg Model.
- Techniques and dynamics of gamification.
- Gamification in the T-L process
- Gamification in Higher Education.
- Game-Based Learning (GBL)
- The Game in College Education
- Gamification Tools

1. Edmodo
2. Clase Dojo
3. Quizizz
4. Mentimeter
5. Socrative
6. Kahoot
7. Studio

2.1. Integration of gamifying tools in Canvas

The three trainers in charge belong to Universidad de Sevilla and carry out this activity online. Participants have all the necessary content and resources in the classroom, which are completed with three videoconferencing sessions that discuss theoretical and practical aspects of the topic.

The course materials are different, mainly text fragments, outlines, graphs, and video clips. A series of links are presented that are directed to different documents and are indicated in the text; these are addressed to know more, and are not mandatory for the follow-up of the formative action.

As for the tutors, they have a daily presence in the course, encouraging participation and the solution of doubts collaboratively or to answer them directly. The solution of doubts takes place through a forum of doubts that is opened in the virtual platform for that purpose.

The final assessment of the course will be based on three axes:

• Performing the activities established in the distance learning.
• Participating in video conference sessions.
• Completing the final activity (production of gamified material for one of the subjects).

The TAM model is applied to measure the motivation degree as well as the satisfaction level experienced by university faculty in participating in educational experiences supported in gamification and to be able to investigate the technical, curricular and organizational difficulties arisen (Davies Technology Acceptance Model, 1989). Its application is conducted online using the following address: https: //cutt.ly/8WHa4FS

Prior to the analysis of the data, it is observed that these are not normally distributed through the study of asymmetry and kurtosis. The Kolmogorov-Smirnov goodness-of-fit test confirms it, with significance (p-value) equal to .000 for all items (non-normal distribution).

In order to achieve the main objective, the model of acceptance of the gamifying methodology (TAM-GAM) is validated by an analysis of reliability (Cronbach's Alpha and Composite Reliability), construct validity (AVE) and structural equation modeling (PLS). Descriptive and central trend analyzes are then carried out.

The data obtained are analyzed with the statistical package SPSS 27 (descriptive analysis and contrast), and SmartPLS 3 software (structural equation modeling).

3. Results

The level of acceptance of the gamifying methodology is studied after having presented the training proposal. In this case, an adaptation of the technology acceptance model (TAM) suggested by Davis (1988) is created for the gamification methodology. For this reason, the adaptation is validated before describing the data.

First, the reliability and validity values of the construct are yielded. In the case of validity, the overall result after applying the Cronbach Alpha is 0.912. According To O'Dwyer and Bernauer (2013), this figure implies a high level of reliability. The reliability, composite reliability and construct validity indices are calculated by dimensions. The results are shown in Table 1.

Table 1. Construct reliability and validity values by dimensions

	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
UP	0.914	0.956	0.824
FUP	0.802	0.872	0.821
PD	0.926	0.942	0.865
ACU	0.821	0.926	0.815
IU	0.895	0.985	0.846

As can be verified, all the relative reliability results (Alpha and Composite Reliability) are higher than 0.7, suitable minimum value according to Levy (2006) to indicate acceptable levels. Therefore, it can be stated that the proposed model of acceptance of the gamifying methodology has good internal consistency in its indicator block. For convergent validity, all the average variance extracted (AVE) indices are greater than 0.5. This value is taken as a reference by Bagozzi and Yi (1988) to indicate that more than 50 % of construction variances are due to model indicators. Thus, it can be said that the total amount of variance of the indicators is taken into account by the latent construct.

This is followed by an analysis of the discriminating validity of the model, which allows to know whether each dimension is different from the others. Two techniques are used: Fornell-Larcker criterion and cross-loading analysis.

Fornell-Larcker criterion allows to check whether the one-dimension average variance extracted is higher than the variance of the other dimensions. Table 2 shows the results.

Table 2. Discriminant validity of the model using Fornell-Larcker criterion

	ACU	FU	IU	PD	UP
ACU	0.912				
FU	0.321	0.852			
IU	0.782	0.280	0.941		
PD	0.781	0.291	0.663	0.960	
UP	0.715	0.405	0.700	0.600	0.900

To interpret this table, it should be noted that the elements on the diagonal are the square root of the average extracted variance, and the others are the correlations between dimensions. As can be seen, all values on the left and below the diagonal values are lower. The first criterion of discriminatory validity is therefore confirmed.

Next, the analysis of the cross loads of the model is performed. The results can be seen in Table 3.

Table 3. Load model crosses

	UP	FUP	PD	ACU	IU
UP1	0.902				
UP2	0.802				
UP3	0.905				
UP4	0.901				

	UP	FUP	PD	ACU	IU
FUP1		0.812			
FUP2		0.800			
FUP3		0.910			
PD1			0.963		
PD2			0.921		
PD3			0.854		
ACU1				0.903	
ACU2				0.910	
IU1					0.910
IU2					0.952

The results above 0.7 indicate high correlation levels (O'Dwyer and Bernauer, 2013). Therefore, it ensures that items measure the construct to which they are incorporated. The model formulated by obtaining the standardized regression coefficients (path coefficients), the values of the t student and the R2 (R-square) of the structural diagram are presented. In terms of results, the model explains 73% of the variance in the "Attitude toward Use" dimension, 62% in the "Intent to Use" dimension, 40% in the "Perception of Enjoy" dimension, and 23% in the "Perceived Usefulness" dimension. All relationships in the model are meaningful with a 99% confidence level.

Finally, the goodness of fit of the model is evaluated using the standardized mean square (SRMR), Chi-square, and normalized fit index (NFI). Table 4 shows the values obtained, as well as the reference values according to Hu and Bentler (1999).

Table 4. Model adjustment

Indicator	Result	Reference
SRMR	0.063	<0,08
Squared Chi	225.324	<500
NFI	0.785	>0.7

After the validation of the proposed model, an analysis of the acceptance level of the gamifying methodology is carried out. Table 5 shows the average and standard deviations for each of the items that make up the model. For its interpretation, it should be noted that the scale used has 7 points (1= strongly disagree / 7= strongly agree).

Table 5. Descriptive statistics of the acceptance level of the gamification methodology

Item	Mean	DT
This methodology could improve my learning in the classroom (UP1).	6,43	0,903
The use of this methodology during classes would make it easier for me to understand certain concepts (UP2).	6,50	0,679
I think this methodology is useful when learning (UP3).	6,55	0,597
Using this methodology favors my learning (UP4).	6,30	0,758
I think the methodology is easy to use (FUP1).	5,95	0,815
Learning to use and manage it has not been a problem for me (FUP2).	5,85	1,350
Learning to use and manage this methodology has been clear and understandable to me (FUP3).	6,05	0,959
Using it has been fun for me (PD1).	6,38	0,705
I enjoyed using this methodology (PD2).	6,35	0,802
I think the methodology allows learning by playing (PD3).	6,38	0,774
Using this methodology makes learning more interesting (ACU1).	6,48	0,679
I think it is a good idea to use it in the classroom (ACU2).	5,60	2,521
I would like to use this methodology in the future if I had the opportunity (IU1).	6,50	0,641
I would like to use this methodology to learn both the topics presented to me and other topics (IU2).	6,58	0,594

All items are above 5.6 points, which implies that, in general, the acceptance level of the gamification methodology is high. Specifically, it highlights: usefulness while learning (UP3), learning clarity (FUP3), fun use and playful learning (PD1, PD3), interest in learning (ACU1), and future intent to research other topics (IU2).

To specify the analysis, a descriptive analysis by dimensions is performed. The results can be seen in Table 6.

Table 6. Descriptive statistics on the acceptance level of the gamifying methodology (dimensions and total)

Dimension	Media	DT
Perceived Usefulness (UP)	6.44	0.73
Perceived Ease of Use (FUP)	5.95	1.04
Perception of Enjoyment (PD)	6.37	0.76
Attitude towards Use (ACU)	5.21	1.60
Use Attempt (UI)	6.54	0.62
Total	6.16	0.91

As can be seen, the students emphasize the intention of use (UI) and perceived usefulness (UP).

4. Discussion and conclusion

Gamification methodology is a useful strategy and with a wide variety of possibilities to facilitate the learning of students in different curricular areas and at different educational levels, from children to university students (Juan-Lázaro

& Area-Moreira, 2021). However, it should be noted that considerable efforts are being made to conduct studies and research with the aim of knowing deeply how students learn through it.

This research determines as a significant model the TAM formulated by Davis (1989). This model proposes that the perceived usefulness toward the technologies and the easy management of these technologies will be able to establish values with respect to the attitude of the subject, being able to direct it toward a specific intention of use. In a virtual learning experience, the results lead to the establishment of one of the first conclusions; teachers perceive the incorporation of the gamifying methodology as an appropriate strategy, highlighting other dimensions of it: perceived ease of use in the classroom, the acceptance of its integration, the transformation of interest in learning, and the positive attitude toward its use in the future, with similar results to those presented by Turpo-Gebera et al. (2021), who state that the successful assessment with the training received online indicates not only a relevant adaptation of resources to their needs, but also the acquisition of higher levels of maturity in the domain of digital competence. With all this, it can be said that the training received by teachers who have participated in this learning experience has developed satisfactorily.

On the other hand, another conclusion that can be derived from this study is that the level of acceptance in terms of the validation of the TAM model is high (Teo et al., 2009; Venkatesh & Bala, 2008). This model has adequate internal consistency with regard to the indicator block. Therefore, the TAM model used is presented as a good predictor to explain the attitude toward gamifying methodology in university education. All of this highlights the significance of the model initially formulated by Davis (1989). In this sense, the results obtained are very much in line with those achieved by Arteaga and Duarte (2010), or Cabero et al. (2018).

Gamification is an active methodology presented as useful that facilitates and improves the learning of students, regardless of the educational stage (Rodríguez-García & Arias-Gago, 2020). However, considerable efforts are being made to carry out studies and research that support their effectiveness and thus to have a thorough understanding of the scope of their work.

Throughout the study, the importance of measuring the degree of acceptance of this technology by teachers has been deepened in order to determine its future usefulness. Despite high simplicity and validity, the TAM model shows some limitations. First, this model refers to usage prediction, but not user performance´s increment. Hence, there is no positive relationship between usage and performance. On the other hand, we find the ability to predict the actual use of technology, since this instrument is based on self-report, and finally, the variability of results if the sample is applied to teachers with high proficiency levels.

It can be stated that the model analyzed involves a transformation of traditional methods. It is necessary to rethink the ways in which the competence development of university professors is proposed. All this through different levels and therefore as a constant learning that mobilizes different competitive dimensions ranging from technical domain to ICT innovation (Flores-Lueg & Roig, 2016; He & Zhu, 2017). Even so, it is also necessary to point out different limitations of the study such as the reduced sample number or the specificity of the context where the training proposal is developed. Therefore, it would be interesting to replicate the model in research with the same or different methodology as, for example, the Scape-Room or the Flipped Classroom, since they also have a high educational potential (Cabero-Almenara et al., 2021a, 2021b), or through the incorporation of different technologies, above all, through so-called emerging technologies (Guillén-Gámez et al., 2021; López-Cortés et al., 2021).

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