Scientific articles

Propuestas para el diseño de estrategias didácticas en entornos digitales a partir de la teoría de autodeterminación y la gamificación

Proposals for designing didactic strategies at digital environments based on Self-Determination Theory and Gamification

Propostas para o desenho de estratégias de ensino em ambientes digitais baseadas na teoria da autodeterminação e na gamificação

Mariana García de la Torre*
Universidad Autónoma de San Luis Potosí
mariana.garcia@uaslp.mx
https://orcid.org/0000-0002-9890-7123

Silvia Romero Contreras
Universidad Autónoma de San Luis Potosí
silvia.romero@uaslp.mx
https://orcid.org/0000-0002-7726-6195

Guillermo Javier Castro Larragoitia
Universidad Autónoma de San Luis Potosí
gcastro@uaslp.mx
https://orcid.org/0000-0003-3756-454X

Mariana Buendía-Oliva
Universidad Autónoma de San Luis Potosí
mariana.buendia@uaslp.mx
https://orcid.org/0000-0002-8830-5954

*Autor de correspondencia

Resumen

Después de la crisis provocada por la pandemia de covid-19, millones de estudiantes han migrado a entornos digitales para continuar con su educación. Esta transición no solo responde a la emergencia sanitaria, sino también a la dinámica que promueven los dispositivos de comunicación y el mercado laboral, lo que ha generado transformaciones significativas en la educación. En este contexto de transformación acelerada y empleo de prácticas educativas digitales, el objetivo de este estudio fue proponer elementos para el diseño de estrategias didácticas mediadas en entornos digitales. Esto se basó en la identificación de tendencias relacionadas con las motivaciones y preferencias de los alumnos de nivel superior al invertir su tiempo en juegos digitales, para lo cual se usó como marco teórico la teoría de la autodeterminación y sus constructos principales: autonomía, competencia y vinculación. En concreto, la investigación adoptó una metodología mixta, ya que combinó enfoques cualitativos y cuantitativos en igual medida, lo cual fue complementado con análisis documental. Asimismo, se llevó a cabo un diagnóstico situacional exploratorio mediante un formulario digital como herramienta de investigación. Para recopilar datos, se diseñó el instrumento Eddreg (Encuesta para el Diseño Digital de un Recurso Educativo Gamificado), el cual fue administrado a estudiantes universitarios, mientras que el análisis de datos se realizó utilizando estadística descriptiva. Los resultados indican que ciertas cualidades de los juegos en entornos digitales satisfacen necesidades psicológicas específicas de los estudiantes. Además, se observó un impacto positivo especialmente notable en los constructos de autonomía, competencia y autoestima, aunque menos significativo en el de vinculación. A partir de estos hallazgos, se proponen diversas estrategias didácticas con el fin de fomentar el aprendizaje efectivo en entornos digitales.

Palabras clave: autodeterminación, diseño educativo digital, educación superior, gamificación.

Abstract

After the crisis triggered by the COVID-19 pandemic, millions of students migrated to digital educational environments. Beyond the health crisis, the dynamics promoted by communication devices and the job market have led to transformations in education. In a context of accelerated transformation and migration of educational practices to digital environments, the objective of this study was to propose elements for designing instructional strategies mediated in digital environments. This was achieved through the identification of trends regarding motivations and preferences of higher education students when investing their time in playing in digital environments, framed within the self-determination theory and its constructs: autonomy,

competence, and relatedness. The research employed a mixed-methods approach with equal status, complemented by literature analysis. The research tool was an exploratory situational diagnosis conducted through a digital form. A data collection instrument was created, named Eddreg (Survey for the Digital Design of a Gamified Educational Resource), and used to survey university students. Data analysis was conducted using descriptive statistics. Results suggest that certain qualities of games in digital environments meet psychological needs of students. The positive impact is more noticeable in the constructs of autonomy, competence, and self-esteem than in relatedness. Based on the findings, proposals are made for designing instructional strategies to promote learning.

Keywords: self–determination, digital educational design, higher education, gamification.

Resumo

Após a crise provocada pela pandemia de covid-19, milhões de estudantes migraram para ambientes digitais para continuarem os seus estudos. Esta transição não responde apenas à emergência sanitária, mas também à dinâmica promovida pelos dispositivos de comunicação e pelo mercado de trabalho, que gerou transformações significativas na educação. Neste contexto de transformação acelerada e utilização de práticas educativas digitais, o objetivo deste estudo foi propor elementos para o desenho de estratégias didáticas mediadas em ambientes digitais. Isto se baseou na identificação de tendências relacionadas às motivações e preferências dos estudantes de nível superior ao investirem seu tempo em jogos digitais, para os quais foi utilizado como referencial teórico a teoria da autodeterminação e seus principais construtos: autonomia, competência e vínculo. Especificamente, a pesquisa adotou uma metodologia mista, pois combinou em igual medida abordagens qualitativas e quantitativas, que foi complementada com análise documental. Da mesma forma, foi realizado um diagnóstico situacional exploratório utilizando um formulário digital como ferramenta de pesquisa. Para a coleta de dados foi elaborado o instrumento Eddreg (Pesquisa para o Design Digital de um Recurso Educacional Gamificado), que foi aplicado a estudantes universitários, enquanto a análise dos dados foi realizada por meio de estatística descritiva. Os resultados indicam que certas qualidades dos jogos em ambientes digitais satisfazem necessidades psicológicas específicas dos alunos. Além disso, observou-se um impacto positivo particularmente notável nos construtos autonomia, competência e autoestima, embora menos significativo no vínculo. Com base nessas descobertas, diversas estratégias de ensino são propostas para promover uma aprendizagem eficaz em ambientes digitais.

Palavras-chave: autodeterminação, design educacional digital, ensino superior, gamificação.

Introduction

Formally or informally, institutionally or personally, technology has invaded classrooms (Apolo *et al.* , 2016). Beyond the educational adaptation driven by the health crisis caused by the arrival of covid-19 on a global scale, the dynamics promoted by communication devices and the labor market have led to constant transformations in education (Donath *et al.* , 2020).

In this emerging context, the field of education has had to advance its process of fortification and consolidation in digital environments, which is why its development has followed an uneven pace in each country. In several places, the way of facing the impossibility of returning to classroom spaces highlighted the lack of technological infrastructure, the lack of expertise in digital pedagogy of teachers and the need to increase the repositories and learning resources available to students (Chiu *et al* ., 2021).

These realities open opportunities to open dialogues and reflect on variables such as a) understanding the motivational process of students, b) promoting the digital competence of teachers, and c) considering the psychological needs of learners in e-learning designs. (Chiu *et al* ., 2021; Blume, 2020). In fact, during this reflection process, it may be pertinent to ask questions such as the following: what motivates students to use digital environments? What can make education mediated by the use of technologies more effective?

From the theory of self-determination, some answers could be proposed, since, from its conception as a theory of human motivation, its objective is to achieve an understanding of behaviors that is generalizable to all the contexts in which individuals can develop (Deci and Flaste , 1996). According to this theory, social factors influence motivation through intermediaries constituted by the basic human psychological needs of autonomy, competence and relatedness (Deci and Ryan, 2000).

Autonomy is defined as the manifestation of the will of an individual who attends an activity out of his or her own desire (Deci and Ryan, 2000), which is why it is associated with an experience of integration and freedom, an essential element for the healthy functioning of the individual. . This is one of the two central elements of learning in digital environments, since it is considered key when students can select the place and time of learning (Coll, 2016).

On the other hand, in the mid-20th century, the concept of *competence* was defined in the field of psychology as the ability of an organism to interact effectively with the environment (White, 1959). Years later, in the field of education and with a relational approach, it was proposed

as the binding element of the attributes of individuals: knowledge, skills, dispositions, values and the demands coming from the tasks and activities they carry out in their lives. (Gonzci , 2003; Kirschner and Merriënboer , 2018; Wiek *et al* ., 2011). The skills —according to Beneitone *et al* . (2007)—are a combination of attributes regarding knowing and understanding (theoretical knowledge of an academic field); knowing how to act (the practical and operational application based on knowledge); and knowing how to be (values as an integral part of the way of perceiving others and living in a context).

In self-determination theory, competence refers to the feelings of effectiveness that are generated when the person takes on optimal challenges and is skillful within the environment in which he or she operates. On the other hand, the attribute of bonding is presented as the feeling that the individual experiences about his or her relatedness with others while participating in a certain activity (Deci and Ryan, 2000). This connection represents the experience of healthy social relationships, where individuals need to experience that they are involved in interactions with others, through bonds of mutual care and affection (Faye and Sharpe, 2008).

The bonding factor has been documented as one of the main reasons why students decide to practice learning in digital environments (Park, 2009) or play in them (Çirak , 2020; Ingram and Cangemi , 2011). This social relatedness and sense of belonging are important elements that influence student motivation and engagement in digital environments.

Autonomy, competence, and relatedness—as psychological needs—can be fully or partially satisfied when playing in digital environments (Çirak and Erol , 2020; Gainsbury , 2016; Ingram and Cangemi , 2011; Park, 2009). Explicitly, it is noted that autonomy is manifested by governing the game, competence is manifested in the level of performance achieved when playing and finally, bonding refers to the interactions that emerge within the game (Çirak and Erol , 2020). If these three needs are linked to the learning process, autonomy is conceived as the ability that the student develops to organize his or her own learning process. This autonomy is intentional, conscious, explicit and analytical, and its practice requires the determination of the learner to be responsible and to make personal decisions about their own process, as well as the willingness to link with their classmates and the teacher, in negotiation. of the following aspects: the identification of one's own needs and learning objectives; planning and organizing learning moments; the selection and choice of content and its sequence; the selection of educational resources; training in the use of methods and techniques, especially learning and metacognitive ones; and, finally, self-assessment of their achievements (Knowles, 1990).

In a complementary way, and following the line of satisfaction of psychological needs of individuals, it has been recognized that playing in virtual environments has positive impacts on self-esteem, defined as the value and respect that the being assigns to itself (Dang , 2019; Ingram and Cangemi , 2011; Park, 2009). In the words of Monteiro *et al.* (2021), is a key element to understanding people's well-being and success. A good level of self-esteem is also favorable for building learning and articulating knowledge, since individuals with low and poor self-perception are prone to have high degrees of inconsistency and instability that are reflected in their academic performance (Ingram and Cangemi , 2011).

Now, globally, it is estimated that the average time people spend on the Internet is almost seven hours a day (Kemp, 2022). On the same scale, virtual games are the focus of attention for about 880 million network users. In the North American region - which includes Canada, the United States and Mexico - a total of 87.3 million virtual game users were registered in 2020 (Statista, 2020). In Mexico alone, it was found that during the same year there were 17.4 million virtual game users, and of this total, 31% were in the age range between 18 and 24 years (Statista, 2020).

It is important to note that at least 77% of the total enrollment of the school population in higher education in Mexico also belonged to that same age range (National Association of Universities and Higher Education Institutions [ANUIES], 2022). Therefore, it can be inferred that in Mexico people between 18 and 24 years old, in addition to being higher education students, could also be part of the virtual game user population. Another relevant example is the case of the United States where, within the same age range, approximately 97% of male students and 80% of female students play in virtual environments regularly (Ingram and Cangemi , 2019).

Taking this described reality as a basis, the objective of this study was (based on the theory of self-determination) to propose elements for the design of teaching didactics mediated in digital environments, based on the identification of trends regarding the motivations and preferences of higher level students when they invest their time in playing in digital environments. To achieve this objective, in the first part of the text an analysis of some qualities of gamification [1]was carried out in order to offer clues about the key elements so that this strategy can be used as an effective pedagogical tool.

Subsequently, reference was made to the need to resort to practices that encourage active learning of students, especially in complex learning areas such as the field of sustainability. In a

---

[1] Gamification consists of incorporating ludic elements into learning processes that occur in contexts that are not games and do not have entertainment as their sole objective (Fischer and Barabasch , 2020).

following section, the methods and techniques used to collect data and generate results were described, followed by a contrast of the information obtained with what is described in the relevant literature. Finally, attributes were proposed to consider when creating teaching strategies for digital learning environments with the goal of optimizing the learning experience of higher-level students in such environments.

It is important to keep in mind that the learning process cannot be replaced by games, since the teaching task does not consist of making education fun, but must focus on causing students to think (Spector, 2016; Díaz-Barriga, 2021), which demands active and participatory methodologies where students acquire a dynamic role in their learning.

In this sense, gamification can be used in both digital and face-to-face contexts as an element to enrich educational practice. Specifically, their proposal is to incorporate playful elements into the learning processes that occur in contexts that are not games and do not have entertainment as their sole objective (Fischer and Barabasch , 2020). In fact, gamification has been shown to be a useful strategy to motivate learning and stimulate the use of virtual environments. Likewise, it has been found to improve performance in terms of efficiency and effectiveness of the human-computer relationship, especially with regard to changes in attitude, behavior, and level of knowledge (Khakpour and Colomo , 2020).

In the practice of digital education, the student is the protagonist and the teacher acts as a companion. Logically, as in any educational practice, this requires that design and planning become a reflective commitment so that learning objectives can be achieved (Cárdenas and Paredes, 2015). For this reason, the importance of games being designed to attract the attention of students, being balanced in terms of the levels of difficulty they propose, and being considered relevant by the learning facilitator is highlighted (Galbis-Córdova et al . . , 2017). In short, within the framework of learning, games are integrated as a pedagogical strategy to understand complex phenomena and processes (Kirschner and Merriënboer , 2018).

For example, games have been used to facilitate learning about sustainability-related topics. Likewise, complex learning is essential to train professionals in this field, since, in addition to disciplinary knowledge, students also need skills, dispositions, values and knowledge, also in relation to other disciplines (Bring and Lyon , 2019). Indeed, in education focused on the development of skills, games are part of its set of active teaching strategies (Nieto-Caraveo, 2020) that are considered effective in developing transferable and replicable skills (Allal-Chérif *et al* ., 2016).

When it comes to online gaming, to meet the preferences of the virtual gaming user population, the market offers a wide range of features. The present study has focused on investigating some of them, on which there was already previous research. For example, in terms of device and Internet connectivity, it has been shown that the mobile phone is the preferred device and that for those who use the Web to play increase their motivation (Çirak and Erol , 2020).

Regarding the time invested in playing, a significant difference has been observed depending on the gender of the player (Park, 2009), since the majority of women play two or less hours a day, while men play between three and six hours a day (Çirak and Erol , 2020). Therefore, gender has also turned out to be a determining factor in the selection of the type of game (Dang , 2019).

The reasons people have for choosing a game include the context of competition, challenge, social communication, rejuvenation effect, and fantasy worlds (Sherry *et al.* , 2006). In fact, it has also been postulated as important to promote the link between players and the game, for which it is proposed that users can identify with the characters that star in it. For example, in the field of education for sustainability, multiple scenarios and actors are presented that require finding consensus when developing, implementing and reviewing environmental policies, roles that can be emulated when designing educational experiences. Finally, it is recommended that the game's difficulty level can be hierarchical and selectable, so that it is neither boring nor overwhelming (Bryant, 2011).

Materials and methods

The research methodology used in this study was documentary and mixed, since qualitative and quantitative approaches were combined with equal relevance. Specifically, a qualitative design was used to ensure a complete and balanced analysis of the data collected. The main research tool was an exploratory situational diagnosis, implemented through a digital form.

The initial objective of the study was to propose elements for the design of teaching strategies mediated in digital environments, based on the identification of trends related to the motivations and preferences of higher level students when investing their time in games in digital environments, all of this. framed in the theory of self-determination.

To collect data and identify trends, two main instruments were used: the standardized Amai questionnaire (used to classify the sample according to their socioeconomic situation) and the survey for the digital design of a gamified educational resource (Eddreg), designed specifically

for this study. The structure and characteristics of Eddreg are described in more detail later in the document.

Regarding the selection of the sample, the main criteria were established that the participants were university students and were enrolled in programs with an explicit link to the concept of sustainability.

For the application of the instruments, a link to the aforementioned digital form was shared with the call. The responses constituted the source of information for the research.

During data processing, first, responses that did not come from undergraduate students were discarded. Subsequently, the responses were grouped based on the correspondence that the items had with the analysis categories: description of the sample, motivations, preferences and relevance. Once grouped, descriptive statistics and interpretive analysis of the data were used to prepare the results.

Definition and characterization of the target audience

The research was carried out with students from the Autonomous University of San Luis Potosí (UASLP), a higher education institution founded in 1851 and recognized nationally and internationally. The UASLP has more than 33,000 students distributed across seven campuses throughout the state of San Luis Potosí, and offers a wide educational offering made up of 102 undergraduate programs and 105 graduate programs.

Specifically for this project, the campuses of the Huasteca Zone Multidisciplinary Academic Unit in Cd. Valles and the Altiplano Region Academic Coordination (OESTE) in the municipality of Salinas were selected. It was decided to work with three degree programs: (1) degree in Management and Public Policies, (2) degree in Sustainable Tourism and (3) degree in Agroindustrial Engineering. The main selection criterion for the programs was the compatibility and link between their educational offer and the concept of *sustainability* .

Methods and techniques for collecting information

First, the Amai framework (Mexican Association of Market and Opinion Intelligence Agencies [AMAI], 2018) was selected as an instrument for the socioeconomic classification of the sample. Simultaneously, the survey-type instrument was designed and built for the digital design of a gamified educational resource (Eddreg) in order to characterize higher education students. This instrument considered three emerging categories based on the theory of self-determination

and the exploration of feasibility: preferences, motivations and relevance, each with their respective constructs and subconstructs according to the conceptual framework of the research.

Then, a documentary exploration was carried out focused on each of the constructs and subconstructs integrated into the instrument. Based on the definition or description of each subconstruct , the survey items were created. The steps for creating the items followed the following logic:

1. Constructs that represented qualities for digital learning or the popularity of digital games were identified. For example, the subconstruct *Autonomy* is mentioned by Coll (2016) as a central quality for digital learning.

2. Each construct was defined or described. For example, autonomy is characterized as the ability of each person to give themselves rules or to make decisions without intervention or external influences.

3. The items for each construct were created or adapted from other instruments. For example, the Likert-type frequency scale item was designed: "I play of my own free will," with response options that include never, rarely, sometimes, almost always, and always.

Amai and Eddreg reagents were entered into a digital form-type instrument with the purpose of being applied simultaneously. The configuration and fundamentals of the instrument are detailed in Table 1. Subsequently, the sample was formed using a convenience and self-nomination method , and the composite instrument was administered to the sample. The call to participate was disseminated through emails sent to students by the academic coordination of each program, as well as through instant messages sent through social networks. The period for receiving responses was available for thirteen days.

The analysis of the responses obtained was carried out using a mixed analytical approach. Specifically, descriptive statistics were used to analyze the quantitative data, while categorical interpretation was used to synthesize the qualitative data.

Revista Iberoamericana para la
Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

Table 1. Characteristics and constructs integrated into the Eddreg instrument for characterization

Category	Construct	Subconstructs	Sources	Question type	Reagent example
Motivations	Self-determination	Autonomy	Deci and Ryan, 2000; Coll, 2016	Frequency Likert Scale	I play of my own free will
		Competence	White, 1959; Gonzci, 2003; Bryant, 2011	Frequency Likert Scale	In general, I feel capable of achieving the challenges that video games pose to me
		Relatedness	Deci and Ryan, 2000; Bryant, 2011, Kim, H.S., 2017	Frequency Likert Scale Multiple choice	I have friends within the world of virtual games
	Self-esteem		Park, 2009; Dang, 2019	Likert scale of agreement	While playing I am inclined to think that I am incompetent
preferences	Instrumental	Device	Cirak, 2020	Multiple choice	What devices do you access virtual games with?
		Connectivity	Cirak, 2020	Frequency Likert Scale	I use the Internet to play
		Time	Park, 2009; Cirak, 2020	Multiple choice	On average, how many hours do you play per week?

	Game Specifics	Genre	Dang , 2019	Multiple choice	Mark your two favorite game genres
		Scenery	Sherry, 2006; Ingram, 2011	Multiple choice	Do you like games set in real or fantasy worlds more?
		Interactivit y -	Sherry, 2006; Ingram, 2011	Frequency Likert Scale	I use the board to compare my performance with that of other players
Relevance		personal disposition	Merriënboe r , 2018; Allal-Chérif *et al* ., 2016	Multiple choice	If you could access a video game to develop knowledge, skills and values, would you play it?
		Conditio ning	Spector, 2016	Open answer	Under what condition(s) would you like to play a digital game that is also an educational resource?

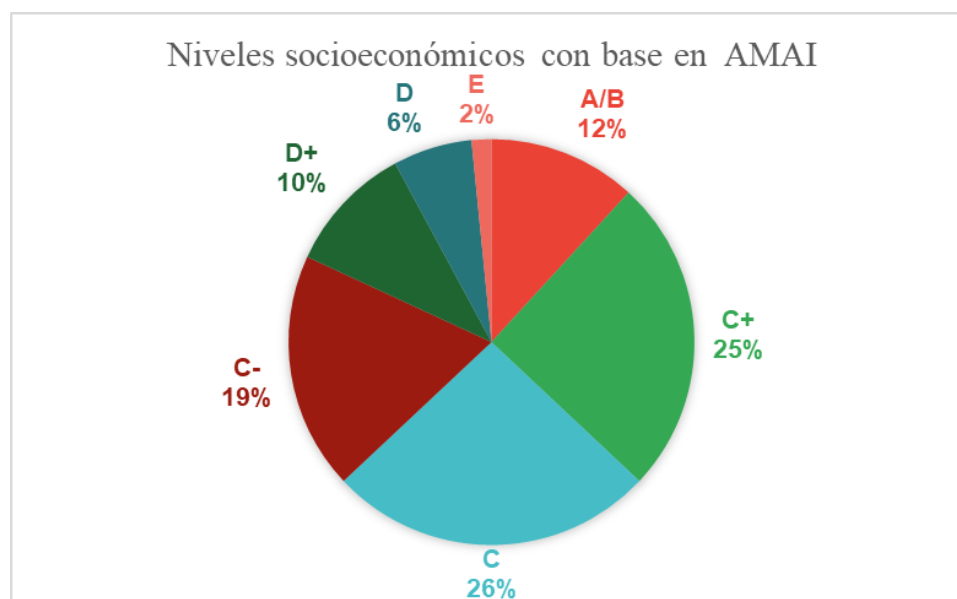Fountain: Own elaboration

Results

After the distribution of the digital form, 137 responses were received. Of the total, ten were invalidated because the respondents indicated that they were not undergraduate students. Considering that in the courses there were an approximate total of 300 students who could have answered the instrument, the response rate was 46%.

The students who were considered for the study are enrolled in the degrees of Agroindustrial Engineering (37 %), bachelor's degree in Management and Public Policies (28%), and bachelor's degree in Sustainable Tourism (35%), in all semesters except the second. .

Regarding the sex of the participants, 43% are male, 56% female, and 1% preferred not to make it explicit. Regarding their age at the time of application of the instrument, 49% were between 17 and 20 years old, 48% were between 21 and 24 years old, and another 3% were over 24 years old.

The distribution of the sample by socioeconomic level is presented in figure 1. The majority (70%) are located in levels C–, C and C+, considered medium. A fifth of the sample (18%) is in levels D+, D and E, while 12% is in level A/B.

Figure 1. Distribution of the socioeconomic level of the participants based on Amai (Mexican Association of Market Intelligence and Opinion Agencies, 2018)

Source: self made

Linked to motivations

Regarding the use of games in virtual environments, 100% of the sample stated that they were users. On the other hand, 64% declared that they do like playing in virtual environments, while 36% responded that they do not like it.

The results regarding students' motivations emerge from their perception regarding their autonomy, competence, relatedness and self-esteem, as mentioned above. The data corresponding to the first three are presented in Table 2, and Table 3 offers those related to self-esteem.

To facilitate reading and interpretation, the Likert frequency scale responses that were applied on a scale from one to five are presented compiled in three groups. The answers given as *always* and *almost always* are compiled in *Alta* ; *sometimes* and *rarely* shown as *Medium* , and *never* shown as *Null* .

Table 2. Results of the Eddreg instrument on self-determination (n = 127)			
Subconstruct	Description	Results [%]	
Autonomy	Play of your own free will	Alta	74
		Medium	17
		Null	9
Competence	He feels capable when he plays	Alta	63
		Medium	29
		Null	8
	The difficulty level you prefer to play with is	Very difficult or difficult	39
		Intermediate	47
		Easy or very easy	14
Bonding	Has friends in the game environment	Yeah	48
		No	52
	It is important for you to identify with the characters in the game	Alta	17
		Medium	48
		Null	35

Source: self made

Questions linked to the subconstruct *Self-esteem* were formulated based on the Rosenberg self-esteem scale (Rojas-Barahona *et al* ., 2009), where four statements are proposed: two positively directed and two negatively directed. In the case of table 3, which shows a Likert scale question and answer section, the answers given as *strongly agree* and *agree* are compiled into *Agree* , and those given as *disagree* or *strongly disagree* are compiled. presented as *Disagree* .

Table 3. Results of the Eddreg instrument regarding self-esteem (n = 127)

Subconstruct	Address	Statement	Results	[%]
Self-esteem	Positive	"While I play I feel like I can do things as well as most people."	Agree	76
			In disagreement	24
		"I feel satisfied with myself when I pass the level or solve problems posed by the video game"	Agree	88
			In disagreement	12
	Negative	"I feel really useless while playing video games"	Agree	25
			In disagreement	75
		"While playing I am inclined to think that I am incompetent"	Agree	13
			In disagreement	87

Source: self made

Regarding preferences

Students' preferences when playing in virtual environments may be instrumental or particular to the game. In the former, the device they use, their use of the Internet and the time they invest in the activity are integrated. The second are the type of game, the setting of the scenario in which the game occurs, and the opportunities for interactivity that the game provides to students. The quantitative responses are compiled in table 4.

Table 4. Results regarding instrumental and particular game preferences (n = 127)

Instrumentals			
Subconstruct	Description	Results	[%]
Device	Device they play with regularly	Cell phone	58
		Console	22
		Computer	18
		Portable console	2
Connectivity	Use the Internet to play	high	57
		Half	31
		Null	12
Time	Hours per week [h/s] used to play	less than 7	69
		7	17
		14	10
		more than 14	4
Game Specifics			
Scenery	Setting of the story that the game tells	real worlds	51
		fantasy worlds	49

Interactivity	Way to interact with other players	Compete	52
		Socialize	48
	Use of dashboards for performance comparison	high	29
		Half	51
		Null	20

Source: self made

To the results presented in table 4 we must add that, regarding the type of game, those that enjoy the greatest popularity are adventure and shooting; while those that are least attractive to them are puzzles and simulation.

On the other hand, regarding what makes a game attractive, students prioritize playability, images and challenges (in that order). In contrast, they give little importance to the musicalization of the game.

About the relevance

The motivations that students consider most important for deciding to play, ordered from highest to lowest frequency, are fun, relaxation, improving skills, social interaction, obtaining knowledge, escaping from reality and increasing their self-esteem.

When asked if they would like to play a digital game if they knew it was also an educational resource, 95% said yes, and 5% said no. Positive responses increased to 98% and negative responses decreased to 2% when asked if they would play a digital game to learn, practice and/or reinforce knowledge, skills and values.

Finally, through an open question, the students were asked what conditions they would set to make it pleasant for them to play a digital game that is at the same time an educational resource. To this question, 99 students responded, which represents 78% of the sample.

Among the conditions they raised include that it does not have a defined schedule or that it is compatible with cell phones. The conditions raised by the students were categorized based on their content in Table 5. It should be noted that a response may have been considered in more than one category when the response warranted it due to length and content. The frequency distribution is shown in table 5.

Table 5. Conditions for use with a gamified digital educational resource .

Constructs	Sub-constructs	Frequency	Example
Self-determination	Autonomy	6	"Do not have a defined schedule"
	Competence	1	"That the levels of learning would be raised"
	Bonding	4	"Interact with more colleagues"
Instrumentals	Device	3	"Let it be on a cell phone"
	Connectivity	3	"With little Internet use"
	Time	1	"That it is related to school schedules"
Game Specifics	Guy	2	"Let it be shots"
	Scenery	22	"Create a good story to capture the student's attention"
	Interactivity	2	"Make competition among my classmates and earn points"

Source: Own elaboration based on Eddreg

In addition to the conditions that coincide with the categories of the Eddreg instrument , other comments regarding the resource point out the following:

1) Be fun.
2) It serves to acquire knowledge, for example, "that is used to better understand and deepen a topic, that is used to understand the political, social and economic functioning."
3) That there are rewards, for example, "that for playing it they would give me extra points in subjects."
4) Multiple languages can be practiced.
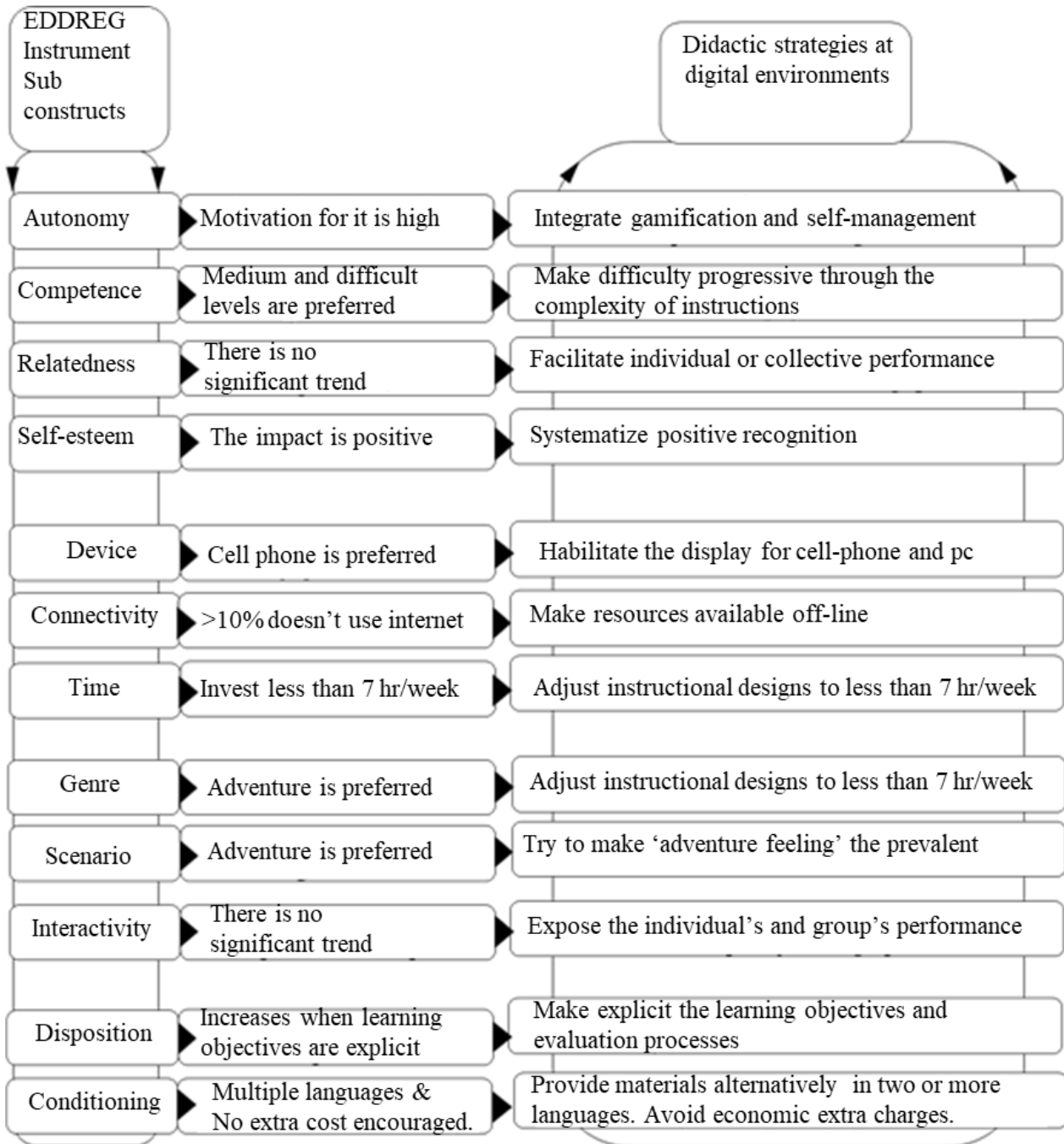5) It can be used without a financial charge.

Critical path and suggestions for teaching strategy

The sequence of steps carried out in the study included:

1) Selection of a sample of students.

2) Creation of an instrument to collect data, based on specialized literature on skills and gamification.

3) Data collection using the instrument in a segment of the target population.

4) Collection, processing and analysis of the data obtained.

5) Proposals for the design of teaching strategies in digital environments, as shown in figure 2.

Reading the diagram in Figure 2 shows (from right to left) how the Eddreg instrument encompasses a variety of constructs, from which results were obtained. These data collected with the instrument were used to suggest elements that could be useful in the creation of teaching strategies mediated in digital environments.

Figure 2. Teaching suggestions based on the results of the Eddreg instrument

Source: self made

Discussion

Although it can be confirmed that playing games in virtual environments can satisfy the psychological needs raised by self-determination theory (Çirak and Erol , 2020; Ingram and Cangemi , 2011; Gainsbury , 2016; Park, 2009), the impact varies for each conceptual object, although in general it can be indicated that the most positive and notable is found in the constructs of autonomy, competence and self-esteem, and not so much in that of relatedness.

In this sense, the results of the present study do not agree with those presented by Park (2009), since this author postulates that the need for bonding is satisfied during virtual game experiences. However, in this study, according to the students' perception, approximately 1 in 2 students consider that virtual games satisfy their need for bonding.

Therefore, if it is considered that just as " the individual is not born a member of society, but is born with a predisposition to sociability and becomes a member of society " (Berger, 1991, p. 149), An individual does not integrate into the university being a professional either. Therefore, the psychological need for bonding could be fundamental for the processes of subjectivation and socialization during university education.

On the other hand, it was found that the device most used to play is the cell phone, which agrees with what was documented by Çirak and Erol (2020), who in their work indicate that 77% of women and 58.4% of men They use cell phones for this purpose.

Likewise, no trend has been found regarding preferences in the narratives of fantasy worlds over real worlds, since the result was a minimal difference in terms of the inclination to compete or socialize. Therefore, it has not been possible to verify what Sherry *et al. proposes.* (2006) when they describe the context of competition and fantasy worlds as priority reasons for playing in virtual environments.

Furthermore, the study participants give importance to the level of difficulty being hierarchical and selectable, in such a way that it is neither boring nor overwhelming, which coincides with what was pointed out by Bryant (2011).

Now, if we consider that the sample is representative of the population of university students and that the socioeconomic levels proposed by Amai (Mexican Association of Market Intelligence and Opinion Agencies, 2018) are valid, creating virtual educational resources dependent on the connection to The Internet would put at risk the accessibility of almost 18% of the school population in higher education in Mexico.

Even so, it can be stated that gamification can facilitate compliance with the need to set sequential learning objectives that vary in level of complexity, as complex learning requires (Kirschner and Merriënboer , 2018), for example, in education. with a focus on the development of competencies.

Conclusions

Some qualities of games in digital environments satisfy the psychological needs of students and maintain their attention, which makes them virtues transferable to educational practice as an innovation strategy to promote learning in digital environments. In this sense, and considering self-determination theory as a guide to address emerging needs in digital education, gamification emerges as a strategy that satisfies these psychological needs, although unevenly for each of them.

Therefore, carrying out a process of characterizing students around their motivations and preferences is essential for making decisions when designing teaching strategies. In other words, integrating reflective exercises of this type or using them as a reference can contribute to improving the competence in digital pedagogy of those who design instruction in higher education, for which it is important that teachers know the motivations, interests and tastes of their students to carry out more effective educational practice.

In conclusion, this study has been consistent with the idea of placing the student as the protagonist of the learning process. However, the importance of having conceptual clarity about one's own pedagogical approaches and strategies is highlighted before implementing a strategy for characterizing students in each educational design, whether daily or aspirational.

Future lines of research

Potentially, a first line of research that emerges from this work is to determine the reliability and validity of the Eddreg instrument . Subsequently, the possibility of delving into the effectiveness of gamification and the theory of self-determination for instructional design in education aimed at the development of competencies opens up.

Another line would be to carry out studies with a gender perspective to identify specific preferences. Likewise, both disciplinary and multidisciplinary trends could be explored in relation to the use of gamification strategies in educational environments.

Finally, it is pertinent to conduct longitudinal studies to investigate the impact on academic performance of the combination of instructional design supported by self-determination theory and

gamification. This approach could be explored in different pedagogical frameworks, including instrumental, emancipatory, transmissive and transformative approaches.

References

Allal-Chérif, O., Bidan, M. and Makhlouf, M. (2016). Using serious games to manage knowledge and competencies: The seven–step development process. *Inf Syst Front, 18*(6),1153-1163.

Apolo, E., Bayés, M. y Hermann, A. (2016). Cambios educativos en los procesos de lectura digital la pedagogía del ciberespacio como estrategia de procesamiento de contenidos en la era de Internet. *Revista de Estudios para el Desarrollo Social de la Comunicación*, (12), 222–249.

Asociación Nacional de Universidades e Instituciones de Educación Superior [ANUIES] (2022). *Anuario Educación Superior – Técnico Superior, Licenciatura y Posgrado 2021–2022,* vol. 1.1.

Asociación Mexicana de Agencias de Inteligencia de Mercado y Opinión [AMAI] (2018). Nivel Socio Económico AMAI 2018.

Beneitone, P., Esquetine, C., González, J. Marty, M. Siufi, G. y Wagennart, R. (eds.) (2007). *Reflexiones y perspectivas de la educación superior en América Latina. Informe final del proyecto Tuning América Latina 2004–2007.* Universidad de Deusto. http://www.deusto–publicaciones.es/deusto/pdfs/tuning/tuning05.pdf

Berger (1991). *The social construction of reality.* Penguin Books.

Blume, C. (2020). German teachers digital habitus and their pandemic pedagogy. *Postdigital Science and Education*, *2*, 879–905.

Bring, A. and Lyon, S. (2019). Role–play simulations as an aid to achieve complex learning outcomes in hydrological science. *Hydrol. Earth Syst. Sci.,* (23), 2369–2378.

Bryant, J. (2011). *Psychology of Entertainment.* Routledge.

Cárdenas, F. y Paredes, W. (2015). *Alfabetización digital de los docentes de EBR en instituciones educativas públicas del nivel secundario de la provincia de Chupaca* (tesis de maestría). Universidad Nacional del Centro del Perú, Perú.

Chiu, T., Tzung–Jin, L. y Kirsti, L. (2021). Motivating online learning: the challenges of COVID–19 and beyond. *Asia–Pacific Edu Res, 30*(3), 187–190.

Çirake, N. and Erol, O. (2020). What are the factors that affect the motivation of digital gamers? *Participatory Educational Research*, *7*(1),184–200.

Coll, S. (2016). Pedagogy for education on sustainability: integrating digital technologies and learning experiences outside school (LEOS). *United Nations University, 1*, 1–25.

Dang, S. (2019). *Exploring the link between motivations and gaming* (ponencia). 12.ª Conferencia Internacional sobre Minería de Datos Educativos. Montreal, julio de 2019.

Deci, E. and Flaste, R. (1996). *Why we do what we do: Understanding self motivation.* Penguin Books.

Deci, E. and Ryan, R. (2000). Self–determination theory and the facilitation of intrinsic motivation, social development, and well–being. *American Psychologist*, *55*(1), 68–78.

Díaz-Barriga, Á. (2021). Repensar la universidad: la didáctica, una opción para ir más allá de la inclusión de tecnologías digitales. *Revista Iberoamericana de Educación Superior*, *12*(34),3–20.

Donath, L., Mircea, G. y Rozman, T. (2020). E–learning platforms as leverage for education for sustainable development. *European Journal of Sustainable Development*, *9*(2), 1–19.

Faye, C. and Sharpe, D. (2008). Academic motivation in university: The role of basic psychological needs and identity formation. *Canadian Journal of Behavioral Science*, *40*(4),189–199.

Fischer, S. and Barabasch, A. (2020). Gamification. A novel didactical approach for 21st century learning. In E. Wuttke (coord.), *Vocational education and training in the age of digitization. Challenges and opportunities* (pp. 89–106)*.* Verlag Barbara Budrich.

Gainsbury, S., Russell, A. King, D. Delfabbro, P. and Hing, N. (2016). Migration from social casino games to gambling: motivations and characteristics of gamers who gamble. *Computers in Human Behavior*, *63*, 59–67.

Galbis-Córdova, A., Marí-Parreño, J. and Currás-Pérez, R. (2017). Higher education students' attitude towards the use of gamification for competencies development. *Journal of E–Learning and Knowledge Society, 13*(1),129–146.

Gonzci, A. (2002). *Teaching and learning of the key competencies* (ponencia). Segundas Contribuciones al Symposium DeSeCo. Ginebra, febrero de 2002.

Ingram, J. and Cangemi, J. (2019). Video games: motivation, effects, and clinical implications on self–esteem. *College Student Journal, 53*(1),1–12.

Kemp, S. (2022). Digital Global Overview. *Data–Reportal*. https://datareportal.com/reports/digital–2022–global–overview–report#:~:text=The%20global%20total%20has%20grown,of%20the%20world's%20total%20population

Khakpour, A. and Colomo, R. (2020). Convergence of gamification and machine learning: a systematic literature review. *Technology, Knowledge and Learning, 26*, 597–636.

Kim, H. S. (2017). Why do young adults gamble online? A qualitative study of motivations to transition from social casino games to online gambling. *Asian Journal of Gambling Issues and Public Health*, *7*(6). https://www.researchgate.net/publication/319237955_Why_do_young_adults_gamble_online_A_qualitative_study_of_motivations_to_transition_from_social_casino_games_to_online_gambling

Kirschner, P. and Merriënboer, J. (2018). *Ten steps to complex learning.* Routledge.

Knowles, M. (1990). *The adult learner: a neglected species*. Gulf.

Monteiro, R., de Holanda Coelho, G., Hanel, P., de Medeiros, E. and Gomes, D. (2021). The efficient assessment of self–esteem: proposing the brief Rosenberg self–esteem scale. *Applied Research in Quality of Life*, *17*,931–947.

Nieto-Caraveo, L. (2020). *Sostenibilidad, adaptación o disrupción en la contingencia global: claves para pensar algunos desafíos de las universidades en México* (ponencia). Ciclo de conferencias: La sostenibilidad. El aprendizaje en la contingencia global. San Luis Potosí, Universidad Autónoma de San Luis Potosí, mayo-junio de 2020.

Park, S. (2009). An analysis of the technology acceptance model in understanding university students' behavioral intention to use e–learning. *Educational Technology & Society, 12*(3), 150-162.

Rojas-Barahona, C., Zegers. B. y Foster, C. (2009). La escala de autoestima de Rosenberg: validación para Chile en una muestra de jóvenes adultos, adultos y adultos mayores. *Revista Médica Chile*, *137*(6), 791–800.

Sherry, J., Greenberg, B., Lucas, K. and Lachlan, K. (2006). Video game uses and gratifications as predictors of use and game preference. *International Journal of Sports Marketing and Sponsorship*, (8), 213–224.

Spector, M., Ifenthaler, D., Kinshuk, P. and Sampson, D. (2016). *Learning and instruction in the digital age*. Springer.

Statista (2020). *Online games – worldwide report*. https://www.statista.com/outlook/dmo/digital–media/video–games/online–games/worldwide

White, R. (1959). Motivation reconsidered: the concept of competence. *Psychological Review, 66*(5), 297–333.

Wiek, A., Withycombe, L. and Redman, C. (2011). Key competencies in sustainability: a reference framework for academic program development. *Sustain Sci, 6*, 203–218.

Contribution Role	Author(s)
Conceptualization	Mariana García de la Torre and Silvia Romero Contreras (same), Guillermo Javier Castro Larragoitia (supports)
Methodology	Mariana García de la Torre and Silvia Romero Contreras (same).
Software	DOES NOT APPLY
Validation	DOES NOT APPLY
Formal Analysis	Mariana García de la Torre (main), Silvia Romero Contreras (support)
Investigation	Mariana García de la Torre
Resources	DOES NOT APPLY
Data curation	Mariana García de la Torre (main), Silvia Romero Contreras (support).
Writing - Preparation of the original draft	Mariana García de la Torre, Silvia Romero Contreras (same), Guillermo Javier Castro Larragoitia
Writing - Review and editing	Silvia Romero Contreras, Mariana García de la Torre (main), Gerardo Morales Jasso and Mariana Buendía-Oliva (support).
Display	Mariana García de la Torre and Silvia Romero Contreras (same).
Supervision	Silvia Romero Contreras (main) and Guillermo Javier Castro Larragoitia (support).
Project management	Mariana Garcia de la Torre, Silvia Romero Contreras, Javier Castro Larragoitia (same).
Fund acquisition	DOES NOT APPLY