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Revisión sistemática de literatura para gamificación en cursos en línea

Systematic Literature Review for Gamification in online courses

Revisão sistemática da literatura sobre gamificação em cursos on-line

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Resumen

El objetivo de esta investigación fue mejorar la comprensión del fenómeno de la gamificación dentro del ámbito de los cursos en línea. Con el fin de alcanzar este objetivo, se llevó a cabo una revisión exhaustiva de la literatura en tres grandes bases de datos utilizando la metodología PRISMA, con el propósito de identificar los elementos de gamificación más empleados en cursos en línea, así como las buenas prácticas en la aplicación de este enfoque didáctico en los cursos en línea.

Los resultados obtenidos de esta investigación representan un recurso valioso en los ámbitos de la educación a distancia, el aprendizaje en línea y la creación de tecnología educativa, ya que ofrecen una perspectiva completa que podría fomentar mejoras concretas en la aplicación de la gamificación en programas de aprendizaje que implementen cursos en línea. Esto se logra al proporcionar una visión objetiva de las mejores prácticas implementadas a nivel mundial. Los resultados permitieron identificar los desafíos, reglas, insignias y tableros de liderazgo como los elementos con mayor relevancia utilizados en los cursos en línea en los

años recientes; y se identificaron tres marcos de trabajo para programadores (Octalysis, MDA y Game-Based Learning Design) como los que más se utilizan al implementar la gamificación en proyectos tecnológicos centrados en la enseñanza y el aprendizaje a distancia. Se destacó el impacto significativo de las estrategias de gamificación en el aprendizaje en línea y en la motivación de los estudiantes.

Palabras clave: Gamificación, elementos clave de gamificación, cursos en línea, motivación, marco conceptual de gamificación.

Abstract

The objective of this research was to improve the understanding of the phenomenon of gamification within the field of online courses. In order to achieve this objective, an exhaustive review of the literature was carried out in three large databases using the PRISMA methodology, with the purpose of identifying the most used gamification elements in online courses, as well as good practices in the application of this didactic approach in online courses.

The results obtained from this research represent a valuable resource in the fields of distance education, online learning and the creation of educational technology, since they offer a complete perspective that could foster concrete improvements in the application of gamification in educational programs. learning that implement online courses. This is achieved by providing an objective view of best practices implemented globally. The results allowed us to identify challenges, rules, badges and leaderboards as the most relevant elements used in online courses in recent years; and three frameworks (Octalysis, MDA and Game-Based Learning Design) were identified as the most used when implementing gamification in technological projects focused on distance teaching and learning. The significant impact of gamification strategies enhancing online learning and student motivation was highlighted.

Keywords: Gamification, Key elements in gamification, Online courses, motivation, gamification frameworks.

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Resumo

O objetivo desta pesquisa foi melhorar a compreensão do fenômeno da gamificação no campo dos cursos on-line. Para atingir esse objetivo, foi realizada uma revisão abrangente da literatura em três grandes bancos de dados usando a metodologia PRISMA, com o objetivo de identificar os elementos de gamificação mais comumente empregados em cursos on-line, bem como as boas práticas na aplicação dessa abordagem didática em cursos on-line. Os resultados obtidos com esta pesquisa representam um recurso valioso para as áreas de educação a distância, aprendizagem on-line e desenvolvimento de tecnologia educacional, pois oferecem uma perspectiva abrangente que pode promover melhorias concretas na aplicação da gamificação em programas de aprendizagem que implementam cursos on-line. Isso é feito por meio do fornecimento de uma visão geral objetiva das melhores práticas implementadas em todo o mundo. Os resultados identificaram desafios, regras, emblemas e placares de líderes como os elementos mais relevantes usados em cursos on-line nos últimos anos; e três estruturas (Estrutura Octalysis, Estrutura MDA e Design de Aprendizagem Baseado em Jogos) foram identificadas como as mais comumente usadas na implementação da gamificação em projetos de tecnologia voltados para o ensino e a aprendizagem a distância. Foi destacado o impacto significativo das estratégias de gamificação no aprimoramento do aprendizado on-line e na melhoria da motivação dos alunos.

Palavras chave: Gamificação, elementos-chave da gamificação, cursos on-line, motivação, estrutura de gamificação.

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Introduction

A literature review, also known as a systematic literature review (SLR), is a critical or integrative analysis that examines and synthesizes information collected from various representative sources (Zamiri and Esmaeili, 2024) . It aims to generate new perspectives on the topic in question, allowing scientific research to progress by offering a summary of what has already been studied. In addition, it contributes to the consolidation of fundamental concepts by reviewing previous research, influencing the formation or consolidation of schools of thought on the topic. It also facilitates the identification of gaps in the existing literature and suggests new research directions for future studies in the selected area.

Considering that the central theme of this study is gamification in the educational field, we are particularly interested in collecting the articles published in the databases that host indexed journals, and, after analyzing these articles, the purpose was to recognize the gamification elements most used in distance courses and, if this method is developed and applied, with the purpose of generating an improvement in student motivation.

According to the research carried out and in consensus with the authors of the analyzed articles, gamification is the application of typical game elements to other areas of activity (Zeybek and Saygı, 2024) , in this case, online education. Its objective is to make non-game activities more attractive and motivating with immediate application in education, corporate training, personal development, in the health sector, as well as in the implementation of marketing and sales strategies (Sheetal *et al.* , 2023) .

Motivation and Self-Determination Theory

According to Rengifo-Millán (2017), gamification is a way to cover the motivation needs towards a task and according to the self-determination theory (Deci and Ryan, 2008), by covering three fundamental psychological aspects (autonomy, social relationships and competence), a continuous level of motivation is maintained.

Accordingly, Self-Determination Theory states that humans possess three basic psychological needs that allow them to motivate themselves to participate or not in a task: autonomy, relatedness, and competence (Ryan & Deci , 2000). The need for autonomy is met in students whose gamified activities allow them to decide which activities they want to participate in, therefore, having autonomy can support increased behavioral and emotional engagement of students (Skinner *et al.* , 2008).

The second psychological need is relatedness, which refers to people's need to interact with others (Ryan and Deci , 2000).

The third psychological need is competence, which refers to the need to control one's own activities or learning itself.

In social relationships, using gamification can increase the level of motivation of students, as they tend to feel better if their learning process includes collaborative work between peers, in addition to the work assigned by the teacher.

Likewise, the self-determination theory (Ryan and Deci , 2000), defines motivation as *that which stimulates man to perform certain actions, it is produced by internal or external factors of the person* and divides it into two types, which are: Intrinsic and extrinsic. Intrinsic

motivation is the individual and natural impulse to seek new possibilities that benefit social and cognitive development, for example, comments on work, rewards, positive feedback, generate feelings of competence, increasing the internal motivations of the individual (Ryan and Deci , 1985). For its part, extrinsic motivation comes from sources external to the person, that is, it leads an individual to perform tasks that reward them or allow them to achieve other objectives, properly the performance is the instrument to reach another end (Deci and Ryan, 1985; Eccles and Wigfield , 2002).

It is essential to consider the above when designing a gamified application , since the use of motivational tools must be planned in advance, with the aim of encouraging the desired behavior in students (Ryan and Deci , 2000). Therefore, it is necessary to configure game elements that encourage student motivation, guiding them towards effort and feedback, elements that they perceive as achievements and opportunities for personal improvement compared to their peers (Zichermann and Cunningham, 2011).

When designing a gamified application , it is crucial to consider the assignment of scores to activities. According to England et al. (2017), this practice can increase classroom anxiety, especially among university students (Khanna , 2015). In this context, Cooper et al. (2018) suggest that activities without an associated value tend to be less stressful. However, based on Eccles and Wigfield ’s (2002) expectancy-value theory, the absence of a scoring system can reduce students’ effort, negatively impacting their learning.

About gamification

The taxonomy of gamification elements classifies the components of a gamified system into three main categories (Boel et al., 2023), described below: 1.- Dynamic elements: referring to the aspects that are related to the narrative and the psychology of the user. In this category we can observe the narrative that refers to the context that gives meaning to the activities that have been gamified , the progression of actions that is the structure that allows to know the user's progress throughout the system; the feedback that works by providing information to the user about their performance; time restrictions to complete the objectives and assigned tasks; also, considering the challenges that users must meet through goals and objectives and finally the competition that drives participation through competitive social interactions (Shanshan and Wenfei, 2024) .

2.- Mechanical elements: these are the defined systems that dictate what the rules of the game are and the way in which users Users progress or interact in the system. This category

includes rewards, where we can see points that support the measurement of progress, badges that are visual symbols obtained for specific achievements, and trophies that represent achievements of high significance. Additionally, we can find levels that stratify the user's progress and easily visualize the level of advancement. Challenges are also part of this category, representing specific tasks that users must complete. Leaderboards allow the position of users to be shown in comparison to others, and finally, the ability to unlock elements or content that becomes accessible when certain objectives are achieved (Zichermann and Cunningham, 2011) .

3.- The component elements: are those that are implemented in the user interface and that are specific and concrete within which we can find: the use of avatars that are graphic representations of the user highlighting physical characteristics in the face, body and use of striking clothing or accessories. Secondly, there is the creation of a user profile where the visualization of the user's achievements and statistics is involved. The use of a collection board where the rewards and objects they have collected are visible to the user. The use of progress markers allows the progress of the game to be visualized and finally a game economy can be implemented that defines a system of exchange of virtual goods within the application (Dereli and Kahraman, 2024) .

Materials and methods

This section describes the resources and procedures used in the study. First, the materials used are detailed, followed by an explanation of the methods applied.

Materials

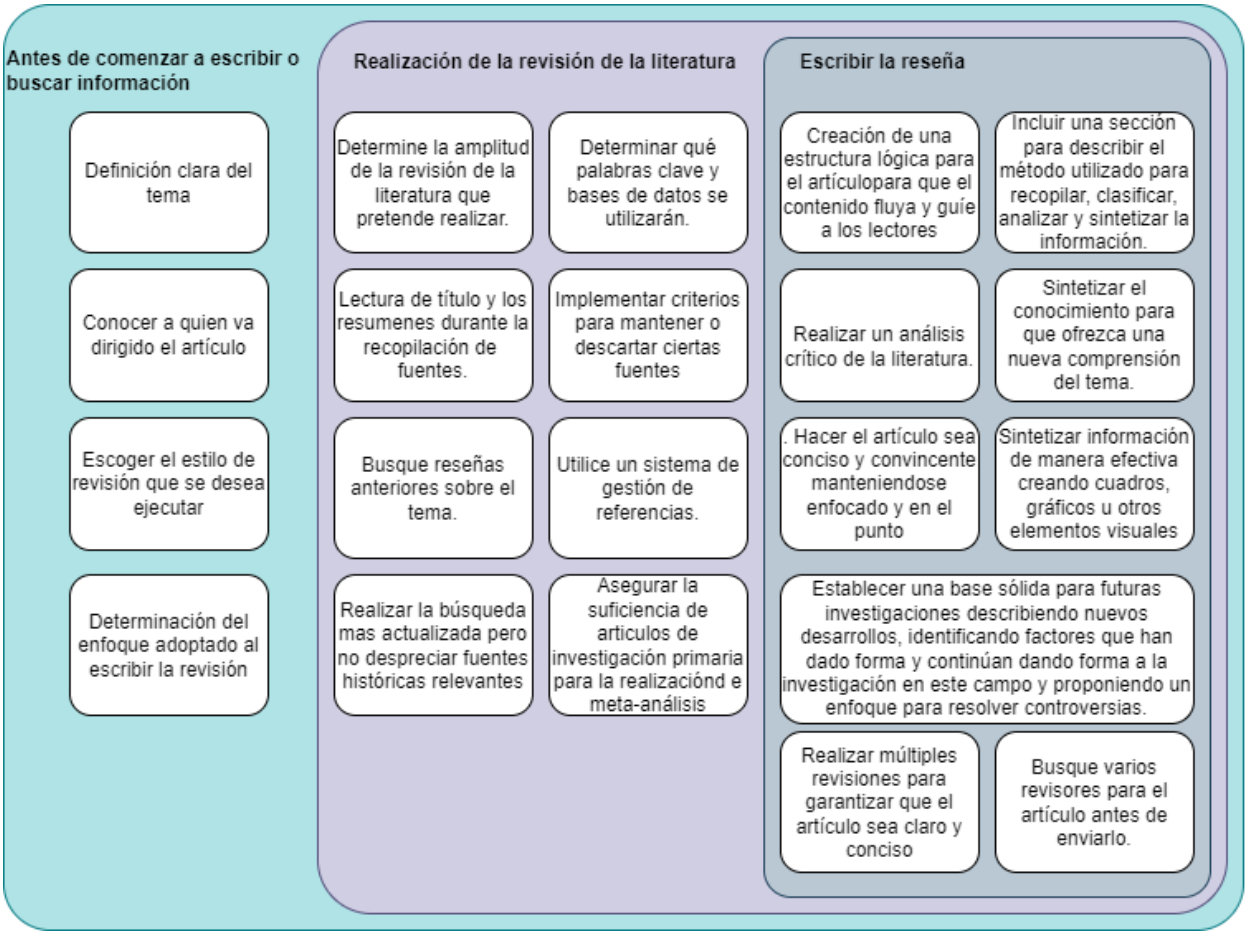
Articles were carefully selected to distinguish between databases recognized for their informative quality and accessibility. The databases consulted included IEEE Xplore, SpringerLink and Web of Science. The publications analyzed had to be written in English and published between 2021 and 2024, in order to ensure an up-to-date and diverse perspective.

Methods

The literature review allows for an adequate understanding and offers a general interpretation of a specific topic, without exhaustively addressing all the details. This approach facilitates the synthesis of existing knowledge and provides diverse perspectives on concepts possibly not explored in previous research. In addition, it allows for a critical

evaluation that identifies the current state of knowledge and areas yet to be investigated, guiding future scientific inquiries. In this study, the systematic literature review was developed in three main stages, as presented in Figure 1.

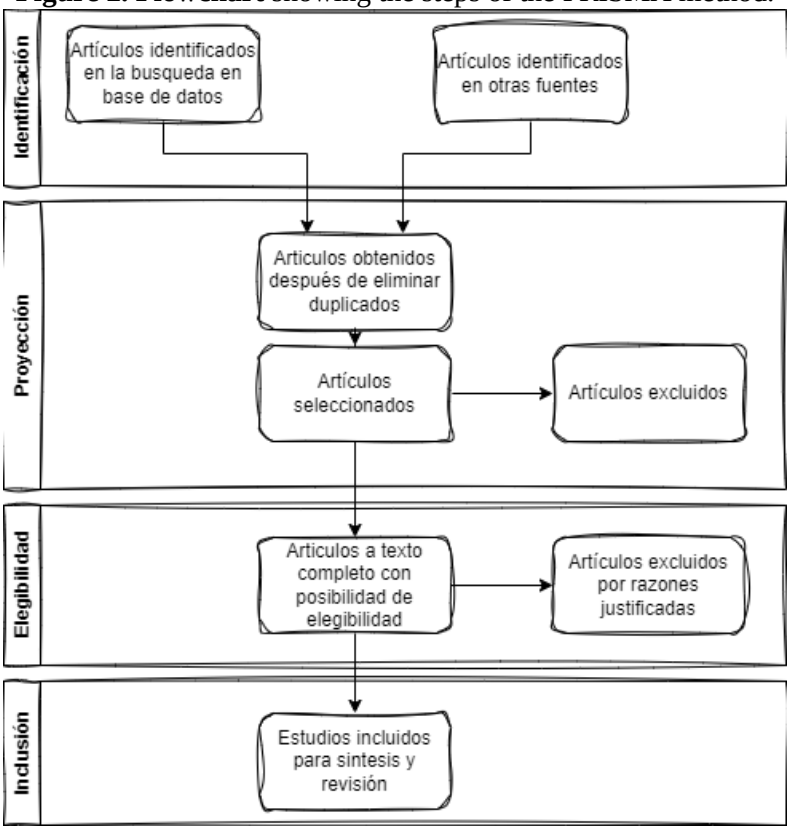
Figure 1. Stages of creating a literature review.



Fountain: (Gregorich, 2019).

Preferred model was applied. Reporting Items for Systematic the PRISMA model is a systematic review and meta- analysis model that provides a sequential approach to data collection, selection, exclusion, and analysis (Page *et al.,* 2021). This model aims to improve the quality of systematic review and meta-analysis reporting and proposes the following components: determining the research question, reviewing specialized databases with established search terms, establishing exclusion criteria, filtering the articles identified in the initial search, analyzing the articles, extracting data to construct information tables, summarizing the research findings, and writing the report. These phases of the PRISMA model are presented in Figure 2.

Figure 2. Flowchart showing the steps of the PRISMA method.



Source: Own elaboration.

Determining the research question

To conduct a systematic literature review (SLR) on the collected literature, it is essential to formulate a research question to guide the analysis. In this article, the following review questions are posed:

1. What are the most commonly used elements of gamification in research?
2. What are the programming frameworks, software or programming languages used in distance learning projects with gamification elements?

Results

Search in specialized databases

The evaluation parameters for the search phase for published articles were established. During this stage, key search terms related to the research topic and the specific question were integrated. In this situation, the following terms were used:

- Best Practices in Gamification
- Gamification in Online Courses.

Additional considerations in the search:

- Articles written in English or Spanish
- Publications from 2021 to 2024.

The following sources were incorporated into the systematic search procedure:

- SpringerLink
- IEEE Xplore
- Web of Science.

Table 1 shows the articles considered in this study after applying the search criteria.

Table 1. Number of articles considered in the first search.

Progressive number	Database	Counting
1	IEEE Xplore	8
2	SpringerLink	196
3	Web of Science	14
	Grand total	218

Source: Own elaboration

Application of exclusion criteria

The following exclusion criteria were applied:

1. The article does not address the topic of interest: gamification, its elements or frameworks for programmers.
2. The article lacks focus on distance or online learning systems.
3. The article does not explicitly include gamification elements.

The procedure for applying the exclusion criteria was as follows:

1) Enter the following data for each article in the Excel file: database, article title, DOI, authors, publication journal , abstract, key words (a maximum of 10 were considered), objectives and relevant aspects of the methodology.
2) Filter in both the title and summary columns of each article: the topic of interest which is gamification, its elements and frameworks for programmers, as well as distance or online course.

3) Review both the objectives and methodological aspects columns for the gamification elements that were intended to be identified or used, the way in which they were used, as well as the type of application or frameworks for programmers that were used.

Table 2 shows the number of articles selected after applying the exclusion criteria. Annex 1 shows the table exported from Excel, in which a check mark indicates if each of the criteria mentioned above is met and a cross indicates if it does not meet them. In the same table, it can be observed that of the total of 219 articles that were reviewed, 66 were reduced, since these are the ones that meet the criteria. Table 2 shows only the number of articles that were selected by each database.

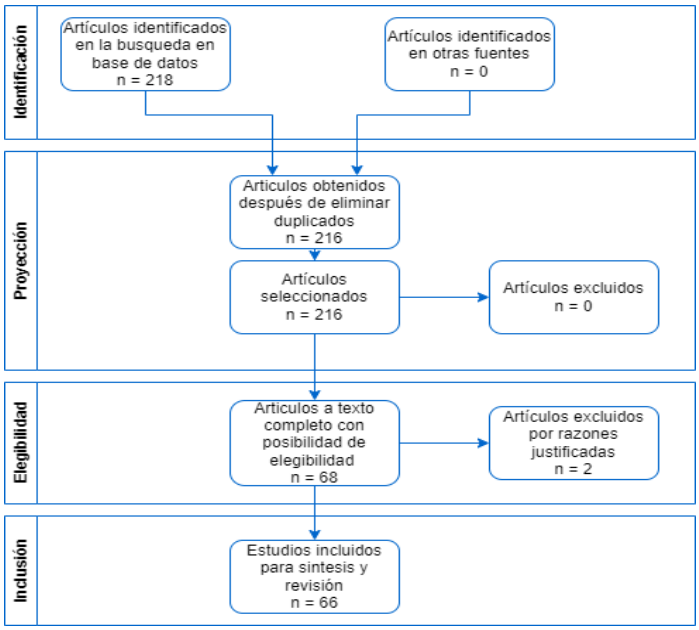
Table 2. Number of articles applying exclusion criteria.

Progressive number	Search source	Counting
1	IEEE Xplore	6
2	SpringerLink	52
3	Web of Science	8
	Grand total	66

Source: Own elaboration

Figure 3 presents the flow diagram of the PRISMA method, with the data obtained in the process.

Figure 3. PRISMA method applied.



Source: Own elaboration

Information obtained from the scientific articles reviewed

As a first step in the data collection, the keywords provided by the authors of the 66 studies were obtained, with the aim of identifying the topics addressed by the researchers. The analysis revealed a total of 339 keywords, with 272 mentions in total, as some appeared in more than one article. Among them, Gamification was mentioned 22 times, Higher Education was mentioned 11 times, and the more complex the keywords were mentioned 10 times. Education 8 times, and Motivation and Online Learning 4 times each.

The keywords were organized into three dimensions:

1. Gamification. This dimension included the term gamification, its elements (mechanics, dynamics and components), as well as programmers' gamified software or frameworks .

2. Educational aspect. Here, teaching and learning strategies, courses (online or in-person), stages of the teaching-learning process (beginning, development, evaluation and feedback) and motivation (intrinsic and extrinsic) were considered.

3. Educational level. The levels into which education is divided were considered: Basic, which includes preschool, primary and secondary, high school, higher education, postgraduate and adult education.

Of the 273 keywords analyzed, 189 were classified in at least one of the proposed dimensions, while 84 were excluded. Among those classified, 170 were assigned to a single dimension, 17 to two dimensions and 2 to all three dimensions, resulting in a total of 210 classifications, as detailed in Table 3.

Table 3. Classification of keywords according to the proposed dimensions.

Dimension	Mentions
Gamification	74
Educational aspect	107
Educational level	29
Total	210

Source: Own elaboration

66 scientific articles were reviewed with the aim of identifying the gamification elements used in distance learning courses. The results are summarized in Table 3, classified as mechanics, dynamics or gamification components.

This information was organized in Table 4, as follows: It was made up of 3 columns, the first containing the progressive number of the article that was selected. The second

column included the author or authors of the publication and the year, and the third column contained the gamification elements identified in each investigation, which were then classified into one of the gamification categories: mechanics, dynamics or components.

Table 4. Gamification elements used in distance learning courses

Item No.	Authors and year	Gamification elements
1	(Hooda *et al.*, 2022)	Avatars, Narrative, Rules, Badges, Personalization
2	(Spielhofer and Haselberger, 2021)	Narrative, Story, Rules
3	(Aly Mogier *et al.* , 2023)	Rules
4	(Gunavaddho *et al.* , 2022)	Avatars, Challenges, Narrative, Rules, Levels
5	(Pirttinen *et al.* , 2023)	Rules
6	(Hethesia and Gandhi, 2023)	Feedback , Point Scales, Achievements, Rules, Levels, Customization
7	(Rebelo and Isaias, 2020)	Score Scales, Narrative, Rules, Badges, Leadership Charts, Customization
8	(Mena *et al.*, 2019)	Challenges, Point Ladders, Rules, Levels, Badges, Leaderboards
9	(Dicheva *et al.*, 2019)	Achievements, Rules, Badges, Leaderboards
10	(Ros *et al.* , 2020)	Narrative, Story, Rules, Customization
11	(Jones *et al.*, 2020)	Feedback , Challenges, Point Tracks, Achievements, Narrative, Story, Rules, Awards, Badges, Leaderboards
12	(De Juana-Espinosa et *al.* , 2023)	Point Scales, Rules, Badges, Leadership Charts
13	(Dick and Akbulut, 2020)	Narrative, Story, Rules, Levels
14	(Dabbous *et al.*, 2023)	Feedback , Point Scales, Rules, Leaderboards
15	(Nordby *et al.*, 2024)	Challenges, Point Scales, Rules
16	(Dereli and Kahraman, 2024)	Feedback , Challenges, Point Tracks, Achievements, Narrative, Story, Rules, Awards, Badges, Leaderboards.
17	(Zainuddin *et al.* , 2024)	Feedback , Achievements, Rules, Awards, Badges, Leaderboards.
18	(Mohanty and Christopher, 2023)	Avatars, Challenges, Scoreboards, Achievements, Narrative, Story, Rules, Levels, Awards, Badges, Leaderboards.
19	(Bai *et al.* , 2022)	Feedback , Rules
20	(Chan and Lo, 2022)	Challenges, Narrative, Rules, Levels

21	(Hsiao *et al* ., 2023)	Feedback , Challenges, Point Scales, Achievements, History, Rules, Awards, Badges, Leaderboards.
22	(Do *et al.* , 2023)	Score Scales, Narrative, Story, Rules, Action Progression, Badges, Customization
23	(Saleem *et al* ., 2022)	Feedback , Challenges, Point Scales, Rules, Awards, Badges, Leaderboards.
24	(Wang *et al.*, 2023)	Personalization
25	(Zahedi *et al.* , 2021)	Point scales, Leadership charts.
26	(Yang *et al.* , 2023)	Feedback , Challenges
27	(Balci *et al.* , 2022)	Badges, Leaderboards.
28	(North *et al.* , 2023)	Challenges, Achievements, Narrative, History
29	(Solmaz *et al* ., 2024)	Avatars, Challenges, Levels
30	(Bucchiarone *et al* ., 2023)	Challenges, Point Ladders, Achievements, Levels, Badges, Leaderboards.
31	(Lim *et al* ., 2023)	Feedback Point Scales, Badges, Leadership Charts.
32	(Balon and Baggili, 2023)	Challenges, Score Tracks, Narrative, Story, Levels, Badges, Leaderboards.
33	(Marnewick and Chetty, 2021)	Challenges, Point Tracks, Narrative, Story, Badges, Leaderboards.
34	(Chen *et al* ., 2021)	Challenges, Narrative, History
35	(Ng *et al.* , 2023)	Challenges, Narrative, History
36	(Kerimbayev *et al* ., 2023)	Challenges, Achievements, Rules
37	(Singh and Meena, 2024)	Point scales, Badges, Leadership charts.
38	(Barbosa *et al.* , 2023)	Point scales, Levels, Badges, Leadership charts.
39	(Harter and Mendez-Carbajo, 2024)	Point scales, Levels, Badges, Leadership charts.
40	(Habeeb, 2023)	Avatars, Challenges, Achievements, Rules, Personalization
41	(Rueda-Gómez *et al.* , 2024)	Awards, Badges
42	(Engelbrecht and Borba, 2023)	Feedback , Narrative, Story, Rules, Levels, Customization
43	(Boel *et al.*, 2023)	Challenges, Point Ladders, Achievements, Badges, Leaderboards.
44	(Varghese and Renumol, 2023)	Feedback , Challenges, Achievements, Rules, Levels
45	(Kaimara *et al.* , 2021)	Point scales, Levels, Badges, Leadership charts.
46	(Snelson, 2022)	Challenges, Rules, Levels
47	(Beaudoin and Avanthey, 2023)	Feedback , Challenges, Rules, Levels
48	(Badali *et al* ., 2022)	Achievements, Awards, Badges, Leaderboards.

49	(Tlili *et al.* , 2022)	Feedback , Avatars, Challenges, Personalization
50	(North *et al.* , 2021)	Awards, Badges, Leaderboards.
51	(Zhong et al., 2024)	Avatars, Challenges, Scoreboards, Achievements, Narrative, Story, Rules, Levels, Awards, Badges, Leaderboards.
52	(Ahsan *et al.* , 2023)	Levels, Badges
53	(Kee *et al.* , 2023)	Feedback , Levels
54	(Khan *et al.* , 2021)	Challenges, Point Scales, Achievements, Leadership Boards.
55	(Bónus *et al.* , 2024)	Feedback , Challenges, Point Scales, Narrative, Story, Rules
56	(Wu *et al.* , 2022)	Challenges, Achievements, Rules, Awards
57	(Caratozzolo *et al.* , 2022)	Narrative, Story, Action progression
58	(Tlili *et al.* , 2021)	Feedback , Badges, Leaderboards.
59	(Oliveira Moreira *et al.*, 2023)	Challenges, Point scales, Narrative, Action progression, Rewards, Leaderboards.
60	(Glaser *et al.* , 2024)	Awards, Badges, Leaderboards.
61	(Chen *et al.* , 2024)	Challenges, Achievements, Narrative, Story Rules, Action Progression
62	(Alawadhi and Abu-Ayyash, 2021)	Feedback , Point Scales, Awards, Badges, Leadership Boards.
63	(Shafiee *et al* ., 2023)	Awards, Badges, Leaderboards, Personalization
64	(Agbo *et al.* , 2023)	Avatars, Challenges
65	(Riivari *et al.* , 2021)	Challenges, Rules, Progression of actions
66	(Weinhandl *et al.*, 2023)	Feedback , Personalization

Fountain: Own elaboration.

The review revealed that the most common elements in the reviewed studies are rules, badges and leaderboards, while elements such as avatars or personalization are less frequent. This suggests a preference for standard gamification mechanisms in distance learning environments.

In 18 of the 66 articles reviewed, the implementation of frameworks for programmers, software or programming languages specific to gamification is mentioned, as detailed in Table 5.

Table 5. Authors mentioning frameworks for gamification implementation programmers and /or supporting software, implementation.

Item No.	Authors and year	Frameworks for programmers / Software or programming language according to its purpose: theoretical design, methodology, implementation and evaluation
1	(Hooda *et al* ., 2022)	*Hexad Player Type :* theoretical design.
2	(Spielhofer and Haselberger, 2021)	*Self-Organized-Learning* (SOL) and *The Container Differences Exchange* (CDE): Implementation practice and evaluation .
3	(Aly Mogier *et al.* , 2023)	Metaverse : practical implementation.
4	(Ros *et al* ., 2020)	*Cognitive constructivism learning theory:* design theoretical .
5	(Jones *et al.* , 2020)	*Kaizen-Education Platform :* practical implementation.
6	(Dick and Akbulut, 2020)	*ERPsim games* , *Association to Advance Collegiate Schools of Business* (AACSB): implementation practice and evaluation .
7	(Nordby *et al.* , 2024)	System thinking : methodology for developing gamification. ARCS: assesses attention, relevance, trust and satisfaction.
8	(Zainuddin *et al.* , 2024)	Gamification for Adult Questionnaires (GAQ): evaluation .
9	(Mohanty and Christopher, 2023)	Gamification Octalysis : practical implementation.
10	(Chan and Lo, 2022)	Gamification Octalysis : practical implementation.
11	(Hsiao *et al.*, 2023)	6E model : methodology.
12	(Yang *et al* ., 2023)	GAFCC model : theoretical design.
13	(Balon and Baggili, 2023)	*Model Driven Architecture* (MDA): practical implementation.
14	(Marnewick and Chetty, 2021)	MinecraftEDU : practical implementation .
15	(Snelson, 2022)	Quest-based learning (QBL): assessment .
16	(North *et al.* , 2021)	Talent Development Capability Model: Implementation practice .
17	(Ahsan *et al* ., 2023)	Micro-credential (MC): practical implementation.
18	(Kee *et al.* , 2023)	Kolb's experiential learning framework: design theoretical .

Source: Own elaboration

The most frequently mentioned frameworks for programmers are related to learning theories (Kolb's experiential learning , Cognitive constructivism learning theory) and specific methodologies (ARCS, Hexad Player Type Framework). This reflects a mixed approach between theoretical foundations and practical applications in gamification.

Data interpretation and summary

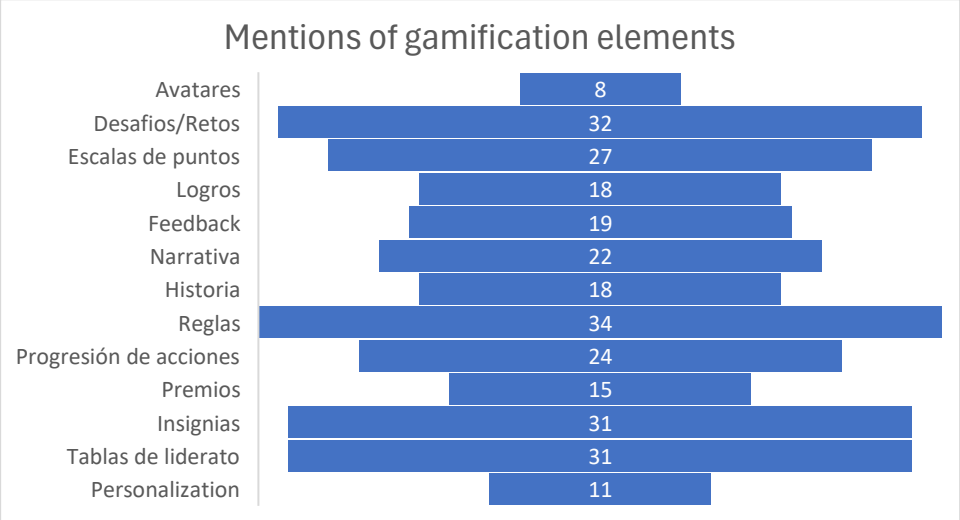
Once the gamification elements used in the 66 studies were identified, they were classified into three categories: mechanics, dynamics and components. This classification is organized in Table 6, and Figure 2 shows the number of gamification elements present in the 66 articles.

Table 6. Analysis of gamification elements by category

Category	Gamification element	Mentions
Mechanics	Avatars	8
	Challenges	32
	Point scales	27
	Achievements	18
	Total	88
Dynamics	Feedback	19
	Narrative	22
	History	18
	Rules	34
	Progression of actions	24
	Total	117
Components	Awards	15
	Insignia	31
	Leaderboards.	31
	Personalization	11
	Total	85

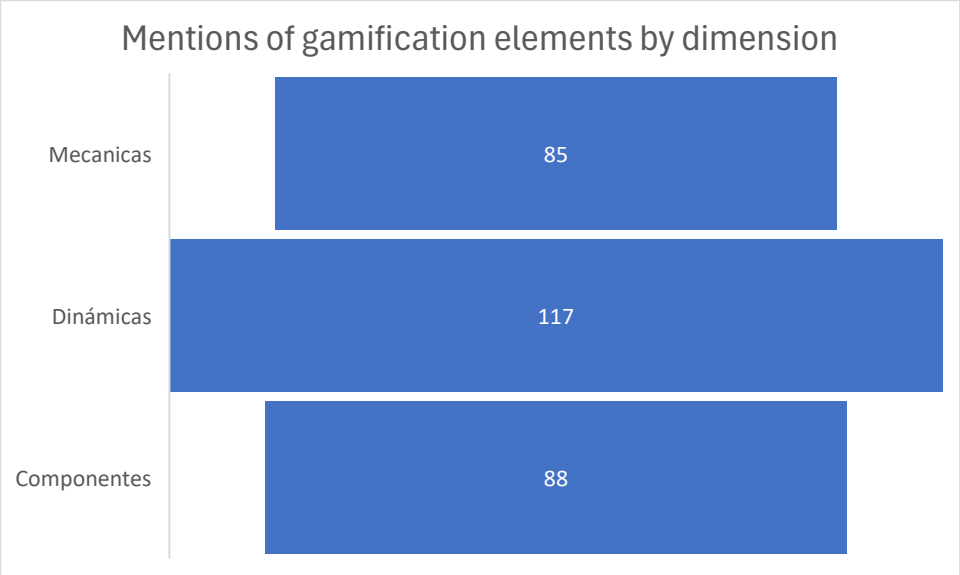
Source: Own elaboration

Figure 4. Number of mentions per gamification element.



Source: Own elaboration

Figure 5. Number of mentions per category



Source: Own elaboration

Another aspect of interest was the educational level used in the study, which was explicitly reported in the article. Table 8 shows the classification by level.

Table 8. Grouping the educational levels explicitly mentioned in the article

Educational Level	Counting
College	3
Highschool	11
Kindergarten	1
Languages Learning	2
Medical Learners	7
NO	30
Secondary School	1
Technical Learners	10
Training	1
Total	60

Source: Own elaboration

Discussion

In the current context in which we live, where speed and information overload, as well as the constant presence of technologies, are dominant characteristics, it becomes an increasingly important challenge for teachers to encourage students to develop cognitive skills and learning strategies. More personalized and contextualized learning experiences are

now promoted to develop relevant skills in the daily and professional life of the student (Adell, 2020). Gamification offers an excellent opportunity to help reflect on this controversial change in the pedagogical culture of teachers. Therefore, the question that guided the systematic review carried out revolved around identifying which mechanics, dynamics and components are the most used in recent research studies using educational software and frameworks for programmers, as well as finding the reason why they are the most used in the educational field.

Regarding the mechanics, it was found that challenges are the most used elements both in the frameworks for programmers and in the software used, followed by the scoring scales defined in them.

Regarding the dynamics, both the established rules and the progression of actions presented in the frameworks for programmers and in the software were identified. Regarding the components, the most used were badges and leadership boards.

Analyzing the reason why these are the most used elements in software and frameworks and reviewing the theories presented at the beginning of this article, the following was found.

Through gamification, the student can be seen as a player who must complete a level, which, according to Ames (1990) and Pintrich (2003), allows the student to advance after successfully completing a unit, module or activity, while learning is assessed through a series of games and experiences.

Students are motivated by earning badges, prizes, points and competitiveness as indicated by Prensky (2005), since rewards represent a fundamental aspect of gamification, since for a long time the only rewards that students acquired were grades, so gamification has facilitated the obtaining of rewards.

One of the theories that support the fact that the assignment of points and rewards is one of the elements that predominated in the studies reviewed is the expectancy value theory of Eccles and Wigfield (2002). It is very important for students to feel valued and one way to show this is by assigning points to the task performed. When the student has made an effort, he wants the teacher to recognize his effort and one way is with the points obtained, or the rewards won in the game, as well as the leadership tables. Thus, if there is no value assigned to the student's effort, it is possible that he will reduce his commitment to his learning (Cooper *et al.*, 2018; Covington, 1992; Wigfield and Eccles, 2000).

Decy and Ryan 's Self-Determination Theory (2008) also explains how students can satisfy key psychological needs, the relatedness *and* the *competence needs* . The first can be satisfied by feeling connected with others and being part of a community with common interests and goals. The competence need can be fostered when the student is offered progress indicators such as levels and immediate feedback such as the score and level obtained in the leadership table, which can support the promotion of the sense of competence and also that of belonging (Sailer *et al.,* 2017).

Gamified activities that encourage students to compete or collaborate cover the needs referred to in this theory, which generates feelings of enjoyment and motivates students to continue developing a certain activity (Skinner *et al.,* 2008).

Now, in relation to the theoretical support on the predominance found in the use of challenges, this is also related to this theory, since another of the basic needs that human beings have is autonomy . Precisely this need is fostered through the choice of attractive tasks and challenges, which promotes the motivation to complete the task.

Studies such as that of De-Marcos *et al.* (2014) support these results, concluding that the inclusion of game elements in the educational context benefits the acquisition of knowledge and promotes greater learning. Hernández-Horta *et al.* (2018) highlight the importance of considering gamification principles in the design of educational activities due to their ability to increase interest in the subject. Furthermore, Ortiz-Colón *et al.* (2018) indicate that it reduces the dropout rate and improves engagement in the teaching process, favoring the development of skills.

In this regard (Badali *et al.,* 2022) They comment that nowadays it is very important for students that their opinions are respected and valued, and that their interests and needs are taken into account in their classes, in addition to being considered in the activities that the teacher plans. Students need to feel that the education they receive is real, that it has value. In this way, gamification is a strategy that allows the interests of students to be satisfied through the different mechanics, dynamics and components that comprise it. According to Castellón and Jaramillo (2013) , the challenges or challenges that are going to be used as part of the selected mechanics must be chosen very carefully, since being too easy can produce boredom in the student or being too difficult would cause frustration, which would prevent the objective of increasing motivation in students from being met.

Tekinbaş and Zimmerman (2003) emphasize that activities carried out through gamification must have an interactive design, which requires teachers to analyze those activities that take into account the interests of students.

With this systematic review, it was also of interest to know whether the elements of gamification used had managed to improve student motivation. It was found that 100% of the studies reviewed stated that the use of gamification mechanics, dynamics and components was beneficial in increasing the motivation of the students they worked with, which coincides with what was pointed out by Barata et al. (2013), González and Mora (2014) and Moreira and González (2015), who comment that the main use of gamification in the educational field is to attract the interest of students. In more than 50% of the studies reviewed, the authors comment that it is essential not to fall into overstimulation of the student, but rather to have a balance between the gamification strategies used and the student's learning process.

Regarding the second research question, on the increased use of frameworks for programmers and gamified software, the following three were identified: Octalysis , MDA and Game-Based. Learning Design , as the most used when implementing gamification in technological projects focused on distance teaching and learning.

Octalysis is a model developed by Yu-kai Chou to analyze and design gamified experiences , focusing on human motivation. This framework is based on eight fundamental factors that drive human behavior: 1) Meaning and epic calling, 2) Development and achievement, 3) Creativity empowerment and feedback, 4) Ownership and possession, 5) Social influence and relatedness, 6) Scarcity and impatience, 7) Unpredictability and curiosity, and 8) Loss and avoidance. Each of these factors is used to identify and optimize the elements of a gamified experience , ensuring that various motivations are addressed and user engagement is maintained. Octalysis is widely used in various fields to create more engaging and effective experiences, in the fields of education, marketing, and product design.

MDA (Mechanics , Dynamics, and Aesthetics) is a theoretical approach to game design and analysis developed by Hunicke *et al* . (2004). This framework breaks down games into three components: Mechanics, which are the basic rules and systems of the game; Dynamics, which are the emergent interactions and behaviors of players within those rules; and Aesthetics , which are the emotional responses and subjective experiences of players as they interact with the game. ADM helped designers understand how decisions in mechanics design can influence game dynamics and the player's aesthetic experience, providing a structured tool that makes it easier to create and evaluate games more effectively.

Game-Based Design Learning Design) is an educational approach that integrates game principles and mechanics into the teaching and learning process, with the aim of improving motivation, student engagement, and learning effectiveness. This design uses elements such as narrative, immediate feedback, progressive challenges, and reward to create immersive and engaging learning experiences. In implementing it, we sought to leverage the intrinsically motivating qualities of games to facilitate the acquisition of knowledge and skills, promoting deeper participation and learning by students.

Conclusion

This paper analyzed the contributions of gamification in the educational field, considering the importance of carrying out adequate planning to select the gamified activities to be used. Regarding the scientific production from 2019 to 2024 on gamification, the review of the studies carried out allowed us to identify that badges and leaderboards are the most used components in gamified activities , addressing the need of students to receive rewards for their work done. Challenges are well received by students, as they broaden their reasoning and allow them to develop critical thinking and make decisions.

The analysis confirmed that the most common dynamics are those related to rules and the progression of actions.

The results of the review of the 66 scientific articles allowed us to understand the types of motivation proposed through the gamified activities implemented in the classroom or in the frameworks for programmers and software used. We concluded that in all cases the students managed to have motivating experiences in support of the commitment they had to show in their learning process, as well as the influence that gamification managed to have on the cognitive development of the students, as well as on the affective and social aspects.

It is also concluded that gamification is a more complex process than just applying a game in the group. This process starts with the establishment of objectives that have to do with teaching and learning, followed by the establishment of rules that will govern the activities, and the inclusion of other elements that will allow the student to have interest in solving what is proposed, thus increasing their motivation and commitment to learning. We agree with some authors in considering gamification as a tool whose purpose is to create commitment in the student with their learning process.

Among the findings of the study are the most commonly used frameworks and software in distance learning courses, which are frequently implemented in corporate

training, students in technical or health-focused areas and in the workplace and focused on implementation and execution projects at the higher education level; of which SOL, ARCS model , QBL, Micro-credential , Kolb's were identified . experiential learning framework , GAFCC model , being Gamification Octalysis Framework and MDA framework are the most implemented.

Future lines of research

Regarding the effectiveness of specific gamification components, it is possible to explore new forms of reward and recognition that could be more effective or complementary to badges and leaderboards and to advance strategies to support the development of critical thinking through challenges. Evaluate how different types of challenges (individual versus group, competitive versus collaborative, etc.) affect students' cognitive and affective development.

It is also possible to analyse the impact of gamification on different demographic groups and additionally investigate how it affects different groups of students, considering variables such as age, gender, cultural background and educational level; as well as evaluate the effectiveness of gamification on students with special educational needs or at different skill levels. As well as investigate how gamification influences soft skills . skills) such as collaboration, communication and resilience. In addition to determining the impact of gamification on socio-emotional development, including aspects such as self-esteem, empathy and emotional regulation.

It is also possible to delve into the analysis and design of educational policies that can incorporate gamification effectively and equitably in different educational contexts and additionally evaluate the impact of gamified policies on improving educational performance at the institutional and governmental level.

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ANNEX 1.

Table 9. Compliance with the criteria by the 219 articles

#	Database	Article	CE4	CE1	CE2	CE3	Include
1	IEEE Xplore	School of Digital Wizards: Exploring the Gamification User Types in a Blended IT Course	✓	✓	✓	✓	✓
2	IEEE Xplore	Framing self-organized online team collaboration in a higher education course on Informatics and Society	✓	✓	✓	✓	✓
3	IEEE Xplore	A Proposed Metaverse Framework Implementing Gamification for Training Teaching Staff	✓	✓	✓	✓	✓
4	IEEE Xplore	From Classroom to Online Environment — The Comparison Analysis of the E-Learning Standards Before and during the COVID-19 Pandemic	✓	✓	✓	×	×
5	IEEE Xplore	What Vadis? - Comprehensive Viewpoint on German Educational Research in Engineering	✓	×	×	✓	×
6	IEEE Xplore	A Life-Development Game for Thai First-Year Engineering Students	✓	✓	✓	✓	✓
7	IEEE Xplore	Lessons Learned From Four Computing Education Crowdsourcing Systems	✓	✓	✓	✓	✓
8	IEEE Xplore	Acquiring Metacognitive Reading Technique through Web 2.0 Application – An Empirical study with ESL Learners	✓	✓	✓	✓	✓
9	Web of Science	Gamification tailored for novelty effect in distance learning during COVID-19	✓	✓	✓	×	×
10	Web of Science	GAMIFICATION AS AN ENGAGEMENT TOOL IN E-LEARNING WEBSITES	✓	✓	✓	✓	✓
11	Web of Science	The Use of Gamification as a Teaching Methodology in a MOOC About the Strategic Energy Reform in Mexico	✓	✓	✓	✓	✓
12	Web of Science	OneUp : Engaging Students in a Gamified Data Structures Course	✓	✓	✓	✓	✓
13	Web of Science	Analyzing Students' Self-Perception of Success and Learning Effectiveness Using Gamification in an Online Cybersecurity Course	✓	✓	✓	✓	✓
14	Web of Science	The Impact of Gamification on the Time-Limited Writing Performance of English Majors	✓	✓	×	✓	×
15	Web of Science	Creating and testing a GCP game in an asynchronous course environment: The game and future plans	✓	✓	✓	✓	✓
16	Web of Science	An analysis of best practices to enhance higher education teaching staff digital and multimedia skills	✓	✓	✓	✓	✓
17	Web of Science	Intentionality and Players of Effective Online Courses in Mathematics	✓	×	✓	✓	×
18	Web of Science	Keeping education fresh-not just in microbiology	✓	×	✓	✓	×
19	Web of Science	Protocol Design Contests	✓	×	✓	×	×
20	Web of Science	A synthesis of systematic review research on emerging learning environments and technologies	✓	✓	×	✓	×
21	Web of Science	INNOVATIVE USE OF THE ERPSIM GAME IN A MANAGEMENT DECISION MAKING CLASS: AN EMPIRICAL STUDY	✓	✓	✓	✓	✓
22	Web of Science	Instructional educational games in pharmacy experiential education: a quasi-experimental assessment of learning outcomes, students' engagement and motivation	✓	✓	✓	✓	✓
23	Springer link	Gamification and customer experience in online retail: a qualitative study focusing on ethical perspective	✓	✓	×	✓	×
24	Springer link	System Thinking in Gamification	✓	✓	✓	✓	✓
25	Springer link	Gamification in physiotherapy and rehabilitation education: a narrative review	✓	✓	✓	✓	✓
26	Springer link	The evaluation of gamification implementation for adult learners: A scale development study based on andragogical principles	✓	✓	✓	✓	✓
27	Springer link	Unlocking potential: Systematic review the use of gamification in leadership curriculum	✓	✓	×	✓	×
28	Springer link	A bibliometric analysis of the use of the Gamification Octalysis Framework in training: evidence from Web of Science	✓	✓	✓	✓	✓
29	Springer link	Incorporating fantasy into gamification promotes student learning and quality of online interaction	✓	✓	✓	✓	✓
30	Springer link	Gamification and open learner model: An experimental study on the effects on self-regulatory learning characteristics	✓	✓	×	✓	×
31	Springer link	Teachers' and Students' Perception of Gamification in Online Tertiary Education Classrooms During the Pandemic	✓	✓	✓	✓	✓

32	Springer link	A study on the effects of using gamification with the 6E model on high school students' computer programming self-efficacy, IoT knowledge, hands-on skills, and behavioral patterns	✓	✓	✓	✓	✓
33	Springer link	Gamified versus non-gamified online educational modules for teaching clinical laboratory medicine to first-year medical students at a large allopathic medical school in the United States	✓	✓	✓	✓	✓
34	Springer link	Gamification Applications in E-learning: A Literature Review	✓	✓	✓	✓	✓
35	Springer link	Gamified versus non-gamified online educational modules for teaching clinical laboratory medicine to first-year medical students at a large allopathic medical school in the United States	✗	✓	✓	✓	✗
36	Springer link	Gamification in education: a mixed-methods study of gender on computer science students' academic performance and identity development	✓	✓	✓	✓	✓
37	Springer link	Towards design principles for an online learning platform providing reflective practices for developing employability competencies	✓	✓	✗	✗	✗
38	Springer link	Developing a gamified artificial intelligence educational robot to promote learning effectiveness and behavior in laboratory safety courses for undergraduate students	✓	✓	✓	✓	✓
39	Springer link	Comparing the effectiveness of badges and leaderboards on academic performance and motivation of students in fully versus partially gamified online physics classes	✓	✓	✓	✓	✓
40	Springer link	Using gamification and IoT-based educational tools towards energy savings - some experiences from two schools in Italy and Greece	✓	✓	✓	✓	✓
41	Springer link	Instructional educational games in pharmacy experiential education: a quasi-experimental assessment of learning outcomes, students' engagement and motivation	✗	✓	✓	✓	✗
42	Springer link	Gamifying model-based engineering: the PapyGame experience	✓	✓	✓	✓	✓
43	Springer link	Analytics-enabled authentic assessment design approach for digital education	✓	✓	✓	✓	✓
44	Springer link	From crisis to opportunity: practices and technologies for a more effective post-COVID classroom	✓	✗	✗	✗	✗
45	Springer link	Research on the development and innovation of online education based on digital knowledge sharing community	✓	✓	✗	✗	✗
46	Springer link	A conceptual model of what programming affords secondary school courses in mathematics and technology	✓	✓	✗	✗	✗
47	Springer link	Cybercompetitions : A survey of competitions, tools, and systems to support cybersecurity education	✓	✓	✓	✓	✓
48	Springer link	Teaching Behavior Analysts to Address Unethical Behavior: Developing Evidence-Based Ethics Instructional Methods	✓	✗	✗	✓	✗
49	Springer link	Data science pedagogical tools and practices: A systematic literature review	✓	✗	✗	✗	✗
50	Springer link	Estimation of sustainability aspects of MOOC platforms in higher education in India using the PLS-SEM approach	✓	✓	✓	✗	✗
51	Springer link	Mining and crafting a game to teach research methodology	✓	✓	✓	✓	✓
52	Springer link	How can primary care benefit from digital health applications? – a quantitative, explorative survey on attitudes and experiences of general practitioners in Germany	✓	✓	✓	✗	✗
53	Springer link	Learning analytics in programming courses: Review and implications	✓	✗	✓	✗	✗
54	Springer link	Harnessing the power of technology: a systematic analysis of challenges, theoretical frameworks, and recommendations for K-12 online learning	✓	✓	✓	✗	✗
55	Springer link	Online and blended entrepreneurship education: a systematic review of applied educational technologies	✓	✓	✓	✓	✓
56	Springer link	Flipped classroom in higher education: a systematic literature review and research challenges	✓	✗	✗	✗	✗
57	Springer link	COVID-19: Making the Best out of a Forced Transition to Online Medical Teaching—a Mixed Methods Study	✓	✓	✓	✗	✗
58	Springer link	Learning technologies for adult literacy: a scoping review and analysis of the current state of evidence	✓	✓	✓	✗	✗
59	Springer link	Fostering non-aviation undergraduates' aviation literacy in an online aviation laboratory: effects on students' perceptions, motivation, industry optimism	✓	✓	✓	✓	✓
60	Springer link	Active learning and education 4.0 for complex thinking training: analysis of two case studies in open education	✓	✓	✗	✗	✗
61	Springer link	Influence of teachers on student motivation: Opportunities to increase motivational factors during mobile learning	✓	✓	✗	✗	✗
62	Springer link	The Process of Developing a Digital Repository for Online Teaching Using Design-Based Research	✓	✓	✗	✗	✗
63	Springer link	A student-centered approach using modern technologies in distance learning: a systematic review of the literature	✓	✓	✓	✓	✓
64	Springer link	Emerging Digital Practices Supporting Student-Centered Learning Environments in Higher Education: A Review of Literature and Lessons Learned from the Covid-19 Pandemic	✓	✓	✗	✗	✗
65	Springer link	Online teaching in Indian higher education institutions during the pandemic time	✓	✓	✓	✓	✓
66	Springer link	Adaptive learning in computer science education: A scoping review	✓	✓	✓	✓	✓
67	Springer link	Digital learning and the ESL online classroom in higher education: teachers' perspectives	✓	✓	✓	✗	✗

68	Springer link	On enhancing students' cognitive abilities in online learning using brain activity and eye movements	✓	✓	✓	×	×
69	Springer link	Diving into the Gap: Recognizing Gender Differences in an Online Learning Activity	✓	✓	✓	✓	✓
70	Springer link	Green IT Meaning in Energy Monitoring Practices: The Case of Danish Households	✓	×	×	×	×
71	Springer link	Kuwaiti parents' and teachers' perceptions of online learning in kindergarten	✓	✓	✓	✓	✓
72	Springer link	Illuminating humanist nature in teaching translation and interpreting studies: Devising an online customizable AI-driven subtitling course	✓	×	✓	✓	×
73	Springer link	Educational inequality in prolonged online learning among young learners: A two-year longitudinal study of Chinese cross-border education	✓	✓	✓	×	×
74	Springer link	Multidisciplinary expert panel report on fluid stewardship: perspectives and practice	✓	×	✓	×	×
75	Springer link	Health promotion in physical education through digital media: a systematic literature review	✓	✓	✓	×	×
76	Springer link	Factors that mediate the success of the use of online platforms to support learning: the view of university teachers	✓	✓	✓	✓	✓
77	Springer link	Development and evaluation of granular simulation for integrating computational thinking into computational physics courses	✓	✓	×	×	×
78	Springer link	A board game to improve freshmen on computer networks: Beyond layers abstraction	✓	×	✓	✓	×
79	Springer link	Restructuring education activities for full online learning: findings from a qualitative study with Malaysian nursing students during Covid-19 pandemic	✓	✓	×	×	×
80	Springer link	Constructing radical community: an ecological model for shifting from an EdD to a We- dD in online doctoral programs	✓	✓	✓	×	×
81	Springer link	Recent developments in using digital technology in mathematics education	✓	✓	✓	✓	✓
82	Springer link	Research Priorities to Increase Confidence in and Acceptance of Health Preference Research: What Questions Should be Prioritized Now?	✓	×	×	×	×
83	Springer link	Academic engagement and management of personalized active learning in higher education digital ecosystems	✓	✓	×	×	×
84	Springer link	The effect of social media interventions on physical activity and dietary behaviors in young people and adults: a systematic review	✓	×	✓	✓	×
85	Springer link	Academic integrity and copyright literacy policy and instruction in K-12 schools: a global study from the perspective of school library professionals	✓	×	✓	×	×
86	Springer link	Understanding the Functional Components of Technology-Enhanced Learning Environment in Medical Education: A Scoping Review	✓	✓	✓	×	×
87	Springer link	Health literacy competency requirements for health professionals: a Delphi consensus study in Taiwan	✓	×	×	×	×
88	Springer link	Attitudes and experiences of registered diabetes specialists in using health apps for managing type 2 diabetes: results from a mixed-methods study in Germany 2021/2022	✓	×	✓	×	×
89	Springer link	Comprehensive evaluation of the use of technology in education – validation with a cohort of global open online learners	✓	✓	✓	×	×
90	Springer link	Effect of flipped classroom and automatic source code evaluation in a CS1 programming course according to the Kirkpatrick evaluation model	✓	×	✓	×	×
91	Springer link	Developing a Context- and Subject-Specific Professional Digital Competence Framework for Beginning English Language Teachers in Hong Kong	✓	✓	✓	×	×
92	Springer link	Muva physical activity intervention to improve social functioning in people with a severe mental illness: study protocol of a pragmatic stepped wedge cluster randomized trial	✓	×	×	×	×
93	Springer link	Educate to transform: An innovative experience for faculty training	✓	✓	✓	×	×
94	Springer link	Why non-technical skills matter in surgery. New paradigms for surgical leaders	✓	×	×	×	×
95	Springer link	mHealth interventions to reduce stress in healthcare workers (fitcor): study protocol for a randomized controlled trial	✓	✓	✓	×	×
96	Springer link	Interactive notebooks for achieving learning outcomes in a graduate course: a pedagogical approach	✓	✓	✓	×	×
97	Springer link	Development and Evaluation of an e-Learning Module for Low- and Middle-Income Countries on the Safe Handling of Chemotherapy Drugs	✓	✓	✓	×	×
98	Springer link	Debiasing Strategies for Conversational AI: Improving Privacy and Security Decision-Making	✓	×	×	×	×
99	Springer link	Digital transformation towards sustainability in higher education: state-of-the-art and future research insights	✓	✓	×	×	×
100	Springer link	Applying educational design research to develop a low-cost, mobile immersive virtual reality serious game teaching safety in secondary vocational education	✓	✓	✓	✓	✓
101	Springer link	Escape rooms technology as a way of teaching mathematics to secondary school students	✓	✓	×	×	×
102	Springer link	Embracing the future of Artificial Intelligence in the classroom: the relevance of AI literacy, prompt engineering, and critical thinking in modern education	✓	✓	×	×	×
103	Springer link	Continuance Intention to use MOOCs: The Effects of Psychological Stimuli and Emotions	✓	✓	✓	×	×

104	Springer link	Industry perceptions of the competencies needed by novice software tester	✓	×	×	×	×
105	Springer link	Sentiment analysis for formative assessment in higher education: a systematic literature review	✓	✓	✓	×	×
106	Springer link	A Validation of AI-Enabled Discussion Platform Metrics and Relationships to Student Efforts	✓	✓	✓	×	×
107	Springer link	Computer games and the study of terminology: An application to national accounts	✓	×	×	×	×
108	Springer link	A bibliometric review on latent topics and trends of the empirical MOOC literature (2008–2019)	✓	✓	×	×	×
109	Springer link	Recent trends in computational intelligence for educational big data analysis	✓	×	×	×	×
110	Springer link	Improving teaching in different disciplines of natural science and mathematics with innovative technologies	✓	✓	✓	×	×
111	Springer link	The View from Below: How the Neoliberal Academy Is Shaping Contemporary Political Theory	✓	×	✓	✓	×
112	Springer link	Video games for assessing computational thinking: a systematic literature review	✓	✓	✓	✓	✓
113	Springer link	Technology-Enhanced Learning in the Education of Oncology Medical Professionals: A Systematic Literature Review	✓	✓	✓	×	×
114	Springer link	Advances in Game-Like Personality Assessment	✓	✓	×	✓	×
115	Springer link	Contextualized game-based intervention for digital literacy for the Pacific Islands	✓	✓	×	×	×
116	Springer link	The Effects of Microlearning: A Scoping Review	✓	✓	✓	×	×
117	Springer link	Potential Barriers to the Implementation of Digital Game-Based Learning in the Classroom: Pre-service Teachers' Views	✓	✓	✓	✓	✓
118	Springer link	A framework for designing interactive mobile training course content using augmented reality	✓	✓	✓	×	×
119	Springer link	Quo vadis higher education? Post-pandemic success digital competencies of the higher educators – a Hungarian university case and actions	✓	✓	×	×	×
120	Springer link	The perceptions of lecturers about blended learning at a particular higher institution in South Africa	✓	×	×	×	×
121	Springer link	Ranking of problems and solutions in the teaching and learning of object-oriented programming	✓	×	×	×	×
122	Springer link	Surviving Covid-19: what museums and cultural institutions can do to attract cultural tourists and get through the pandemic	✓	✓	×	×	×
123	Springer link	Enhancing workplace competence acquisition through a persuasive system	✓	×	✓	×	×
124	Springer link	Understanding the psycho-social context for a new early intervention for resistance to change that aims to strike a beneficial balance between structure and flexibility	✓	×	×	✓	×
125	Springer link	Exploring the characteristics of an optimal design of non-programming plugged learning for developing primary school students' computational thinking in mathematics	✓	✓	×	×	×
126	Springer link	Quest-Based Learning: A Scoping Review of the Research Literature	✓	✓	✓	✓	✓
127	Springer link	Emotional Contagion in Collaborative Virtual Reality Learning Experiences: An eSports Approach	✓	✓	✓	×	×
128	Springer link	Prediction of the acceptance of telemedicine among rheumatic patients: a machine learning-powered secondary analysis of German survey data	✓	×	×	✓	×
129	Springer link	Towards an intelligent blended system of learning activities model for New Zealand institutions: an investigative approach	✓	✓	×	×	×
130	Springer link	Examining the role of computing identity in the computing experiences of women and racially minoritized undergraduates: a literature review	✓	×	✓	✓	×
131	Springer link	Design principles for internet skills education: results from a design-based research study in higher education	✓	✓	×	×	×
132	Springer link	How to help digital-native students to successfully take control of their learning: A return of 8 years of experience on a computer science e-learning platform in higher education	✓	✓	✓	✓	✓
133	Springer link	Contract cheating: an increasing challenge for global academic community arising from COVID-19	✓	×	✓	×	×
134	Springer link	“It's making me think outside the box at times”: a qualitative study of dynamic capabilities in surgical training	✓	×	✓	✓	×
135	Springer link	Points of Interest (POI): a commentary on the state of the art, challenges, and prospects for the future	✓	×	×	×	×
136	Springer link	How are we doing with student-centered learning facilitated by educational technologies? A systematic review of literature reviews	✓	✓	×	✓	×
137	Springer link	The role of motivation in MOOCs' retention rates: a systematic literature review	✓	✓	✓	✓	✓
138	Springer link	Empowering Medical Educators: A UTAUT Analysis of Technology Adoption in Inquiry-Based Learning	✓	×	✓	×	×
139	Springer link	ZeusAR : a process and an architecture to automate the development of augmented reality serious games	✓	×	×	✓	×

140	Springer link	Twenty years of research on technology in mathematics education at CERME: a literature review based on a data science approach	✓	✓	×	×	×
141	Springer link	Impact of the COVID-19 Pandemic on Students' Motivation in Relation to Asynchronous Anatomy Video Lectures	✓	✓	×	×	×
142	Springer link	Design of a future scenarios toolkit for an ethical implementation of artificial intelligence in education	✓	✓	×	×	×
143	Springer link	A Proposed Curricular Framework for an Interprofessional Approach to Deprescribing	✓	×	×	×	×
144	Springer link	Is Metaverse in education a blessing or a curse: a combined content and bibliometric analysis	✓	✓	✓	✓	✓
145	Springer link	How Instructional Design Is Operationalized in Various Industries for job-Seeking Learning Designers: Engaging the Talent Development Capability Model	✓	✓	✓	✓	✓
146	Springer link	Learning English with electronic textbooks on mobile devices: Impacts on university students' vocabulary development	✓	×	×	×	×
147	Springer link	Affordances and constraints of integrating esports into higher education from the perspectives of students and teachers: An ecological systems approach	✓	✓	✓	✓	✓
148	Springer link	A Competency Framework for Participatory Modeling	✓	×	×	×	×
149	Springer link	An interpretive analysis of the 2030 Sustainable Development Goals in Hong Kong public universities	✓	✓	×	×	×
150	Springer link	How should we change teaching and assessment in response to increasingly powerful generative Artificial Intelligence? Outcomes of the ChatGPT teacher survey	✓	×	×	×	×
151	Springer link	Implementation of micro-credentials in higher education: A systematic literature review	✓	✓	✓	✓	✓
152	Springer link	Impact assessment of e-trainings in occupational safety and health: a literature review	✓	✓	✓	×	×
153	Springer link	Exploring contributors, collaborations, and research topics in educational technology: A joint analysis of mainstream conferences	✓	×	✓	✓	×
154	Springer link	An empirical study on immersive technology in synchronous hybrid learning in design education	✓	✓	✓	✓	✓
155	Springer link	'e'-thinking teaching and assessment to uphold academic integrity: lessons learned from emergency distance learning	✓	✓	✓	✓	✓
156	Springer link	South African health sciences students' perspectives on utilization , constraints and future possibilities of mHealth and e-Learning	✓	✓	×	×	×
157	Springer link	Leveraging the Power of Peer Groups for Refugee Integration	✓	×	×	×	×
158	Springer link	Comparative analysis of chemistry teaching in city center and suburban public schools in Brazil: how school reputation and social profile influence chemistry teaching and high school students' performance in science	✓	×	×	×	×
159	Springer link	A Strategic Approach to Onsite Learning in the Era of SARS-Cov-2	✓	×	×	×	×
160	Springer link	Making Mindfulness Meditation a Healthy Habit	✓	×	×	×	×
161	Springer link	Effectiveness of an escape room for undergraduate interprofessional learning: a mixed methods single group pre-post evaluation	✓	✓	×	×	×
162	Springer link	Digital Game-Based Inquiry Learning to Improve Eighth Graders' Inquiry Skills in Biology	✓	✓	✓	✓	✓
163	Springer link	Usability and transparency in the design of a tool for automatic support for web accessibility validation	✓	×	×	×	×
164	Springer link	A meta-analysis to gauge the impact of pedagogies employed in mixed-ability high school biology classrooms	✓	✓	×	×	×
165	Springer link	How to prevent technostress at the digital workplace: a Delphi study	✓	×	×	×	×
166	Springer link	Aligning with Practice: Examining the Effects of a Practice-Based Educational Technology Course on Preservice Teachers' Potential to Teach with Technology	✓	✓	×	×	×
167	Springer link	Attitudes of an international student cohort to the Quizlet study system employed in an advanced clinical health care review course	✓	×	✓	✓	×
168	Springer link	The exploration of continuous learning intention in STEAM education through attitude, motivation, and cognitive load	✓	✓	✓	✓	✓
169	Springer link	The use of video essays and podcasts to enhance creativity and critical thinking in engineering	✓	✓	✓	✓	✓
170	Springer link	Learning analytics to develop future competences in higher education: a case study	✓	✓	×	×	×
171	Springer link	A systematic review of teaching and learning machine learning in K-12 education	✓	✓	×	×	×
172	Springer link	A BPM-based approach for ensuring an agile and adaptive learning process	✓	✓	×	×	×
173	Springer link	Learning analytics for enhancing the usability of serious games in formal education: A systematic literature review and research agenda	✓	✓	×	×	×
174	Springer link	Brain-imaging techniques in educational technologies: A systematic literature review	✓	×	×	×	×
175	Springer link	Towards intelligent E-learning systems	✓	✓	✓	×	×

176	Springer link	The experiences of preparation and engagement of educators in teaching e-portfolio	✓	✓	×	×	×
177	Springer link	Towards utilizing emerging technologies to address the challenges of using Open Educational Resources: a vision of the future	✓	✓	✓	✓	✓
178	Springer link	Whether to flip Extreme Apprenticeship: which is more effective in programming instruction?	✓	×	×	×	×
179	Springer link	Perceptions, Experiences, and Needs of Adolescents About School-Based Sexual Health Education: Qualitative Systematic Review	✓	×	×	×	×
180	Springer link	JEDi - a digital educational game to support student training in identifying Portuguese -written fake news: Case studies in high school, undergraduate and graduate scenarios	✓	✓	✓	✓	✓
181	Springer link	Towards a taxonomy of Roxygen documentation in R packages	✓	×	×	×	×
182	Springer link	Fostering computational thinking through unplugged activities: A systematic literature review and meta-analysis	✓	×	×	×	×
183	Springer link	Chatbots and messaging platforms in the classroom: An analysis from the teacher's perspective	✓	×	×	×	×
184	Springer link	Implementation and Evaluation of an Adaptive Learning Environment Designed According to Learner Characteristics: A Study on Primary School Social Studies Teaching	✓	✓	×	×	×
185	Springer link	AI literacy in K-12: a systematic literature review	✓	×	×	×	×
186	Springer link	The Museum of Instructional Design: an Examination of Learner Experiences & Usability in a Collaborative 3D Virtual Learning Environment	✓	✓	✓	✓	✓
187	Springer link	Transprofessional competences of school teachers in the digital environment: education employers' perspective	✓	✓	×	×	×
188	Springer link	A systematic literature review of requirements engineering education	✓	×	×	×	×
189	Springer link	A Mixed Reality-Based Chemistry Experiment Learning System to Facilitate Chemical Laboratory Safety Education	✓	✓	✓	✓	✓
190	Springer link	Perceptions of a family-based lifestyle intervention for children with overweight and obesity: a qualitative study on sustainability, self-regulation, and program optimization	✓	×	×	×	×
191	Springer link	Students' perceptions of Kahoot!: An exploratory mixed-method study in EFL undergraduate classrooms in the UAE	✓	✓	✓	✓	✓
192	Springer link	Applications of educational data mining and learning analytics on data from cybersecurity training	✓	×	×	×	×
193	Springer link	Thinking more wisely: using the Socratic method to develop critical thinking skills among healthcare students	✓	×	×	×	×
194	Springer link	Exploring collaborative caption editing to augment video-based learning	✓	✓	×	×	×
195	Springer link	Exploring quality attributes of smart classrooms from the perspectives of academics	✓	✓	×	×	×
196	Springer link	Adapting Employee Engagement Strategies Amid Crisis: Insights from the COVID-19 Pandemic	✓	×	×	×	×
197	Springer link	Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review	✓	✓	×	×	×
198	Springer link	On the adoption and effects of source code reuse on defect proneness and maintenance effort	✓	×	×	×	×
199	Springer link	Virtual museums: interpreting and recreating digital cultural content	✓	×	×	×	×
200	Springer link	Insights into software development approaches: mining Q &A repositories	✓	×	×	×	×
201	Springer link	Integrating design science research and design based research frameworks for developing education support systems	✓	✓	×	×	×
202	Springer link	Digitalization and Digital Transformation of the Thermal-Power Industry as a Factor of Improving the Thermal Infrastructure Efficiency (a Review)	✓	×	×	×	×
203	Springer link	Improving Financial Literacy and Supporting Financial Decisions: Developing a Personalized Configurator	✓	✓	✓	✓	✓
204	Springer link	Design Thinking: from Bibliometric Analysis to Content Analysis, Current Research Trends, and Future Research Directions	✓	✓	×	×	×
205	Springer link	Design, development, and evaluation of a virtual reality game-based application to support computational thinking	✓	✓	✓	✓	✓
206	Springer link	Learning teamwork through a computer game: for the sake of performance or collaborative learning?	✓	✓	✓	✓	✓
207	Springer link	Digital interventions for subjective and objective social isolation among individuals with mental health conditions: a scoping review	✓	×	×	×	×
208	Springer link	Utilizing personas as a methodological approach to support prospective mathematics teachers' adaptation and development of digital mathematics learning resources	✓	✓	✓	✓	✓
209	Springer link	E-learning bibliometric analysis from 2015 to 2020	✓	✓	×	×	×
210	Springer link	Did library learners benefit from m-learning strategies? Research-based evidence from a co-citation network analysis of the literature	✓	✓	×	×	×
211	Springer link	Plagiarism as a Social Contract, a New Way to Approach Plagiarism	✓	×	×	×	×

212	Springer link	An immersive virtual reality learning environment with CFD simulations: Unveiling the Virtual Garage concept	✓	✓	✓	✓	✓
213	Springer link	Bosses without a heart: socio-demographic and cross-cultural determinants of attitude toward Emotional AI in the workplace	✓	×	×	×	×
214	Springer link	A panoramic view and swot analysis of artificial intelligence for achieving the sustainable development goals by 2030: progress and prospects	✓	×	×	×	×
215	Springer link	Primary and secondary school teachers' perceptions of their social science training needs	✓	✓	×	×	×
216	Springer link	Adaptive user interfaces in systems targeting chronic disease: a systematic literature review	✓	✓	✓	✓	✓
217	Springer link	Playing out diplomacy: gamified realization of future skills and discipline-specific theory	✓	✓	×	✓	×
219	Springer link	Implementation of tele visit healthcare services triggered by the COVID-19 emergency: the Trentino Province experience	✓	×	×	×	×

Source: Own elaboration