Review Article

User Experience (UX) Evaluation in Gamified Processes: a bibliographic Review

Evaluación de la experiencia del usuario (UX) en procesos gamificados: una revisión bibliográfica

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Abstract

Introduction: in the context of technology design, the measurement and understanding of user experience (UX) have gained crucial relevance. This aspect addresses the pressing need to understand in detail how users interact with and experience technological artifacts. This review focuses on user experience in the design of gamified processes and products, considering that despite advances in inclusivity and accessibility, some individuals still cannot access the benefits of technological tools.
Objective: the objective of this documentary review is to identify and analyze the techniques and methods employed to evaluate user experience in the context of gamified processes and products.
Methods: a structured literature review was utilized to gather information on the techniques and metrics used in UX evaluation. A diversity of indicators was examined, ranging from usability to more subjective aspects such as aesthetics, as well as the evaluation approaches applied in previous studies.
Results: the findings revealed a wide variety of indicators and metrics used in the evaluation of UX in technological environments. Both the differences and similarities in evaluation practices were highlighted. The review underscored the complexity of user experience and the importance of considering not only usability but also broader aspects, especially in the realm of gamification.
Conclusions: is concluded that adopting multidisciplinary approaches and using validated tools is essential to achieve a more comprehensive and applicable understanding of gamified products or processes. This will enhance understanding at the intersection of technology and gamification.

Keywords: : assessment, User Experience, Gamification

Resumen

Introducción: en el contexto del diseño de tecnologías, la medición y comprensión de la experiencia de usuario (UX) han adquirido una relevancia crucial. Este aspecto aborda la imperante necesidad de comprender en detalle cómo los usuarios interactúan y experimentan los artefactos tecnológicos. En esta revisión se aborda la experiencia de usuario en el diseño de procesos y productos gamificados, considerando que, a pesar de los avances en inclusividad y accesibilidad, todavía hay personas que no pueden acceder a los beneficios de las herramientas tecnológicas.

Objetivo: identificar y analizar las técnicas y métodos empleados para evaluar la experiencia de usuario en el contexto de procesos y productos gamificados.

Métodos: se utilizó una revisión bibliográfica estructurada para recopilar información sobre las técnicas y métricas utilizadas en la evaluación de la UX. Se examinó una diversidad de indicadores que van desde la usabilidad hasta aspectos más subjetivos como la estética, así como los enfoques de evaluación aplicados en estudios previos.

Resultados: los hallazgos revelaron una amplia variedad de indicadores y métricas en la evaluación de la UX en entornos tecnológicos. Se destacaron tanto las diferencias como las similitudes en las prácticas de evaluación. La revisión subrayó la complejidad de la experiencia de usuario y la importancia de considerar no solo la usabilidad, sino también aspectos más amplios, especialmente en el ámbito de la gamificación.

Conclusiones: se concluye que es fundamental adoptar enfoques multidisciplinarios y utilizar herramientas validadas para lograr una comprensión más completa y aplicable en productos o procesos gamificados. Esto incrementará el entendimiento en la intersección entre la tecnología y la gamificación.

Palabras clave: evaluación, Experiencia de usuario (ux), gamificación

Why was it conducted?:
The study was conducted with the aim of identifying and centralizing a set of technical tools applicable to the UX evaluation of gamified processes. It is understood that gamification can transform artifacts and define procedures through the use of game elements, mechanics, and dynamics. Such transformations frequently necessitate a profound understanding of user experience. In this context, the tools and indicators used in UX evaluation can prove highly valuable for evaluating gamified processes. The objective was to contribute to the work of professionals and researchers engaged in these topics within scientific research, addressing a recognized need within our research teams. Centralizing information and understanding how the field of UX can contribute to gamification or other contexts is of significant utility for those of us working from pragmatic and applied perspectives.

What were the most relevant results?
Key findings in UX research include the definition and measurement framework by Hassenzahl and Tractinsky (2006), which identified five main themes: antecedents, experience as a process, consequences, metrics, and design. Law et al. (2014) further unified industry practices with a consensual definition of UX. Specific models for mobile applications (Galván, Saenz, and Sánchez, 2019) and online education (Oviedo, García-Serrano, and García-Peñalvo, 2021) provide tailored tools for UX evaluation. Hassenzahl and Monk (2010) highlighted the positive correlation between aesthetics and usability, emphasizing the importance of visually appealing design. Yanez, Cascado, and Sevillano (2020) categorized UX evaluation techniques into inspection methods, user-based methods, and predictive techniques, citing important guidelines like the WAI Initiative and Nielsen's heuristics. Practical tools include A/B testing, user tests, and questionnaires like the System Usability Scale (SUS), using metrics such as success rate and user satisfaction.

What do these results contribute?
These findings clarify UX definitions and measurements, standardizing industry practices and facilitating professional collaboration. Context-specific models offer precise evaluation tools, while the emphasis on aesthetics underscores the need for visually appealing designs. The variety of evaluation techniques provides a structured guide for professionals, enabling effective UX improvements. Overall, these results support the development of standardized practices and personalized approaches for enhancing user experience in various contexts.

Graphical Abstract
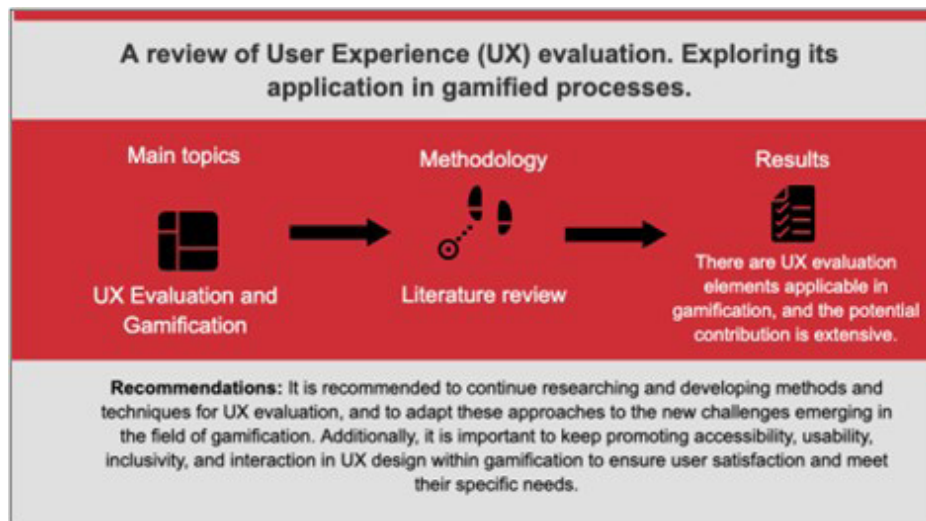
Introduction

In recent years, the number of technological products available on the market has been progressively increasing. Modern societies have more options when choosing devices and tools to meet specific needs. The creation of websites, for example, has had a significant impact on the technological market due to its growth, becoming one of the most utilized formats and mediums for the generation and transmission of social, cultural, political, and economic content and information, among others (1).

This increase is not only observed in products with clear utility. Video games can be understood as a type of technological development whose use is predominantly for entertainment purposes. Even so, it is found that people are increasingly interested in them. In a quick search of the term "videogame" on Google Trends (9), it is observed that, on a scale of 0 to 100 that classifies the popularity of the term in the search engine, with 0 being no popularity and 100 being maximum popularity, the average popularity in a review of the last 5 years has increased globally. The following graph shows that the indicator tends to rise above the 75 popularity line, which was less frequent in previous years:


Graph 1: Popularity of the term "Videogame" on Google Trends (9)

This increase in the production and use of technology can be attributed to its capacity to satisfy a wide variety of human needs through a diversity of products and solutions. For example, in video games, players can satisfy needs such as entertainment, creativity, identity, and affection in a vast array of available games. Furthermore, serious games, such as educational, historical, social, political, and health-related games, can address needs related to understanding, protection, participation, and identity (19). This demonstrates that video games, and games in general, are powerful tools from the perspective of human needs analysis. This idea also extends to various software technologies, such as social networks, applications, and websites, as well as devices like mobile products, computers, and smart TVs, among others (19).

Possibly for these and other reasons, games have been integrated into other contexts such as education (29), health (30), and business processes (29). In recent years, this has been done through serious games, video games, and gamification. Regarding the former, Scolari (28) updates Huizinga's idea by adding some elements to the conceptualization and stating that games are "cultural constructions designed to generate narrative experiences in individuals… of an interpersonal nature in which the individual immerses themselves in a narrative in which they participate as protagonists, influencing its development and resolution" (p. 24). This also applies to video games, which can be understood as a form of technological advancement that transfers all game components to virtual environments and spaces, retaining their narrative element (28).

Although video games are primarily a form of entertainment and do not necessarily aim to solve social or human problems, they are being used for other purposes (31). In this context, we refer to serious games, which can be defined, according to ABT (32), as "the art and science of games that simulate life, whether in industry, government, education, or personal relationships." These games are designed to represent, model, or simulate real-world situations to test theories, explore possibilities without incurring high experimentation costs, train people, and develop specific skills, or even measure competencies. Serious games have defined objectives and processes and differ from traditional games or video games in that they are not framed within the entertainment industry (33) but are oriented towards objectives and purposes, such as evaluating or improving skills or knowledge (34).

On the other hand, gamification can be understood as the application of game dynamics and mechanics in non-gaming contexts to generate behavior changes and encourage the achievement of process objectives, with real-world implications (35). Unlike serious games, gamification accompanies real processes and directly intervenes in their outcomes; it does not simulate them. Gamification has been developed to leverage the characteristics of games and their potential to generate engagement and motivation in participants or players. Its use, like that of games and video games, is on the rise, and being an emerging phenomenon with less than two decades of constant research and application, the concept shows very high usage, even surpassing that of games. This can be seen in Graph 2, which shows the interest in the concept over time.
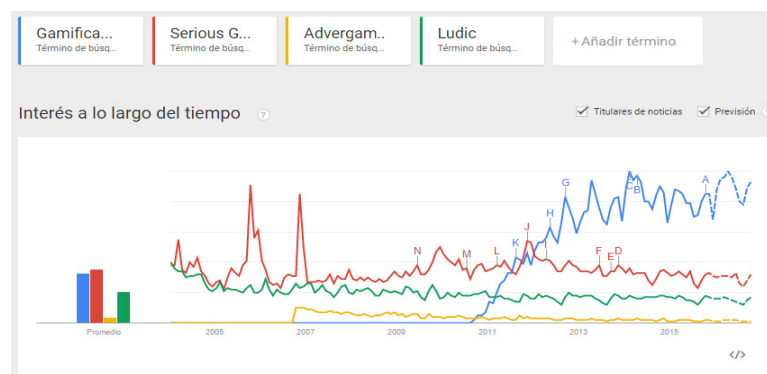
Graph 2: Interest in the concept of gamification over time. Google Trends (9)

However, although a high percentage of people can satisfy a wide range of their needs through the diversity of software technologies, artifacts, and processes like gamification, there is a percentage that cannot do so due to their own particular conditions, such as physical or psychological characteristics, or social, cultural, and/or economic conditions of their context. This implies that some processes and artifacts are created with limitations in their capacity for inclusion or accessibility. These aspects must be addressed from the inclusive design approach, which, according to Joyce (14), "... describes methodologies for creating products that understand and empower people of all backgrounds and abilities. It can address accessibility, age, economic situation, geographic location, language, race, and more" (p. 1). "... inclusive design involves empathizing with users and adapting interfaces to address the diverse needs of those users. Inclusive design generates patterns of inclusion" (p. 1), impacting aspects such as accessibility, usability or playability, adaptability, aesthetics, and satisfaction.

At this point, understanding the user is a task of fundamental interest, which in recent years has been assumed by an approach called User Experience (UX). UX and its practice, User Experience Design (UX Design), have become key factors for the success of information and communication technologies. The quality of the experience influences satisfaction, efficiency, and effectiveness in the interaction of users with technological and innovative processes and products (3), which is extremely beneficial for gamification.

Its potential lies in its user-centered approach and the constant evaluation of the experience, which involves the measurement and interpretation of multiple subjective and objective factors, such as usability, inclusion, accessibility, immersion, aesthetics, interaction, and satisfaction. Additionally, each context and each user may present different needs, expectations, and preferences, requiring a personalized and flexible evaluative approach. Therefore, there arises the need to know the techniques, tools, and specific indicators that allow for a reliable, efficient, and effective evaluation of user experience, which will improve the way inclusive and accessible gamified processes are created.

In the present article, some selected sources from databases and scientific journals were reviewed, and the most frequent techniques, tools, and indicators in UX evaluation were identified and analyzed to determine their possible use in the evaluation of gamified processes. The search was guided by the following research question: What are the most relevant and effective methods, techniques, and tools for evaluating user experience?

Therefore, the methodology employed is presented below, which consisted of a structured review of relevant scientific articles in which the methods and techniques used to evaluate user experience were identified and analyzed. Next, the results are detailed, presenting a variety of indicators and metrics used in UX evaluation, such as usability, user satisfaction, accessibility, and aesthetics. Subsequently, the discussion is presented, reporting the differences and similarities in the evaluation approaches used in the reviewed studies. Finally, the conclusions section highlights the importance of considering multiple dimensions of user experience and recommends the use of multidisciplinary approaches and validated tools to obtain a more comprehensive understanding of the phenomenon studied and its applicability in gamification and gamified products or processes.

Methodology

A structured literature review method was employed, also known as a systematic review. It is essentially an orderly bibliographic review process that cannot be classified as a true systematic literature review (SLR) [51]. For the purposes of this study, the focus was not on achieving the rigor or timeliness required by SLRs but rather on finding answers to research questions by considering various sources and being more flexible in the selection and filtering process. The goal was to map a broader range of knowledge and subsequently describe the elements of greatest interest.

1. Definition of research questions and inclusion and exclusion criteria

From the initial research question, a set of more specific questions was developed that could be directly answered by the results and findings. The questions formulated are presented in the following table:

Table 1. Research questions

Level	Acronym	Questions
Primary	QP	What are the most relevant and effective methods, techniques, and tools for evaluating accessible and inclusive user experience?
Secondary	Q1	What are some relevant background studies on UX evaluation?
Secondary	Q2	What are the most commonly used UX evaluation techniques?
Secondary	Q3	What are some tools used in UX evaluation?

Guided by the above questions, we sought to broadly understand how to evaluate user experience, to then explore the possibility of using evaluative tools in gamified processes. To start, inclusion and exclusion criteria for the studies to be reviewed were defined. These are presented in the following table:

Table 2. Inclusion and exclusion criteria

No.	Inclusion criteria	Exclusion criteria
1	Studies published as articles, book chapters, or theses	Conferences, presentations, or essays
2	Studies resulting from completed research	Studies in progress or partial research reports
3	Studies with an instrumental focus oriented towards UX evaluation	Reflection or conceptualization studies
4	Studies derived from scientific or academic research processes	Studies conducted in the industry or within the framework of business processes
5	Studies written in English or Spanish	Written in languages other than English or Spanish

2. Systematic search for relevant information sources in scientific databases and specialized journals.

The scientific sources used were primarily Scopus, complemented by searches in Google Scholar and ScienceDirect. For the article search, the most relevant keywords were considered, such as: 'evaluation,' 'user experience,' 'indicators,' 'accessibility,' and 'inclusion.' These keywords were combined to create the basic search algorithms. The following table shows the terms and search strings:

Table 3. Terms and search strings

Search terms	Search strings
Evaluation	Evaluation AND Inclusive AND Accesible AND User AND Experience
User Experience	Evaluation AND Inclusive OR Accesible AND User AND Experience
Inclusive	Evaluation AND User AND Experience
Accesible	User AND Experience AND Analytics
Indicators	User AND Experience AND indicators

3. Selection, review, and reading of the identified studies

Once the searches were conducted and the criteria and filters were applied, a panoramic review of the results based on the title was carried out. This allowed for the selection of a set of articles, whose abstracts and results were then reviewed. At this stage, some articles were discarded, and the remaining ones were read in their entirety. From each reading, sections, ideas, graphs, and tables that contributed to answering the questions posed in this study were extracted and recorded in a notebook for analysis or categorization.

4. Analysis of the relevant content results through a thematic approach

The content results included in the notebook were reviewed and classified based on their contribution to one of the research questions. Therefore, four thematic grouping approaches derived from the questions were considered: Background (Q1), UX evaluation techniques (Q2), UX evaluation tools (Q3).

5. Synthesis of the findings

The content analysis allowed for the extraction of ideas to contribute to the answers to the questions. Everything was synthesized in the present document, and the findings are presented in the results section described below.

Results

To begin with, all articles were reviewed, and the selected ones were subjected to a content criteria review associated with the research questions. The following table shows the compliance or non-compliance of each criterion according to each source. It is important to mention that the classification was done exclusively to profile each article according to the criterion in which its contribution was most observed; this does not mean that it could not contribute to another criterion to a lesser extent.

Table 4. Compliance with criteria in the reviewed articles

Author	Source	Criterion			
		Reports key background	Has an instrumental focus	Reports techniques	Reports tools
Hassenzahl y Tractinsky	12	Complies	Does not comply	Does not comply	Does not comply
Law, Roto, Vermeeren, Kort y Hassenzahl	15	Complies	Does not comply	Does not comply	Does not comply
Galván, Saenz y Sánchez	7	Complies	Does not comply	Does not comply	Does not comply
Oviedo, García y García	22	Complies	Does not comply	Does not comply	Does not comply
Hassenzahl y Monk	11	Complies	Does not comply	Does not comply	Does not comply
Yanez, Cascado & Sevillano	26	Does not comply	Complies	Complies	Does not comply
Nielsen	20	Does not comply	Complies	Complies	Does not comply
Davis, F.D. et al.	5	Does not comply	Complies	Does not comply	Complies
OIS	13	Does not comply	Complies	Does not comply	Complies
Lazar, J. et al.	16	Does not comply	Complies	Does not comply	Complies
González, A.M. et al.	8	Does not comply	Complies	Does not comply	Complies
Väänänen-Vainio-Mattila	25	Does not comply	Complies	Does not comply	Complies
Preece, J. et al.	24	Does not comply	Complies	Does not comply	Complies
Lewis, C. et al.	17	Does not comply	Complies	Does not comply	Complies
Ponto, K. et al.	23	Does not comply	Complies	Does not comply	Complies
Brooke, J.	2	Does not comply	Complies	Does not comply	Complies
O'Brien, H. & Toms, E.	21	Does not comply	Complies	Does not comply	Complies
Csikszentmihalyi, M.	4	Does not comply	Complies	Does not comply	Complies
W3C	37	Does not comply	Complies	Complies	Does not comply
Plaisant & Shneiderman	36	Does not comply	Complies	Complies	Does not comply
Brooke, J.	43	Does not comply	Complies	Does not comply	Complies
Sauro y Lewis	45	Does not comply	Complies	Does not comply	Complies
Dillman	46	Does not comply	Complies	Does not comply	Complies

Q1: What are some key background or relevant studies in UX evaluation?

The reviewed literature includes theoretical, applied, and review studies. Among these, Hassenzahl and Tractinsky (12) conducted a critical study of research on User Experience (UX), addressing the lack of consensus on its definition and measurement, and its impact on technological development. Their analysis revealed seven fundamental thematic areas in UX research, including emotion, aesthetics, meaning, perception, cognition, motivation, and value.

Law, Roto, Vermeeren, Kort, and Hassenzahl (15) contributed to the debate by proposing a broad definition of UX and identifying seven key elements: utility, aesthetics, ease of use, efficiency, effectiveness, emotions, and values. Additionally, Galván, Saenz, and Sánchez (7) presented a UX evaluation model for mobile applications, addressing usability, accessibility, visual design, navigation, content, information quality, performance, interactivity, innovation, and user satisfaction.

Oviedo, García, and García (22) explored the relationship between UX and digital inclusion in online education and highlighted the importance of overcoming inclusion barriers to improve the user

experience. Finally, Hassenzahl and Monk (11) investigated the relationship between the aesthetics of technological products and their perceived usefulness, finding a positive correlation between visual beauty and perceived ease of use when aesthetics are related to functionality. Below is a summary table in which the reviewed articles can be observed, taking into account the title, authors, year of publication, methodology, results, and conclusions.

Table 5. Reviewed articles

Article Title	Authors	Year	Research Question	Methodology	Results	Conclusions
User Experience - A Research Agenda	Hassenzahl, M., & Tractinsky, N. (12)	2006	How can user experience be defined and measured?	Literature review and conceptual analysis	A definition of UX is proposed and five main themes for research are identified: background, experience as a process, consequences, metrics, and design	User experience is a relevant topic for research and practice, and further studies are needed on its nature, impact, and measurement
Understanding, Scoping and Defining User Experience: A Survey Approach	Law, E., Roto, V., Vermeeren, A., Kort, J., & Hassenzahl, M. (15)	2014	How is user experience understood and defined in practice?	Survey of UX industry professionals	Different definitions and practices of user experience in the industry are identified, and a consensus definition is proposed	User experience is a complex and multidimensional concept, and its practice in the industry varies depending on different disciplines and contexts
An evaluation model for the user experience of mobile applications	Galván, Saenz & Sánchez (7)	2019	How can user experience be measured for mobile applications?	Design of a UX-based evaluation model	The model is tested and validated with real users of mobile applications, and the most influential factors in UX are identified	The proposed evaluation model is effective and useful for assessing UX in mobile applications
Exploring the relationship between UX and digital inclusion in online education	Oviedo, M., García-Serrano, A., & García-Peñalvo, F. J. (22)	2021	How does user experience influence digital inclusion in online education?	Survey, data analysis, and literature review	The most influential variables in user experience and digital inclusion are identified, and their relationship is analyzed	UX and digital inclusion are important aspects to consider in online education, and further research is needed
The Inference of Perceived Usability from Beauty	Hassenzahl, M., & Monk, A. F. (11)	2010	How is the perception of beauty related to the perceived usability of digital products?	Experimental study with appearance and perceived usability variables	The results showed that beauty can influence the usability of digital products and that the relationship between beauty and usability varies depending on the type of task	The perception of beauty is a valid and useful indicator for inferring the perceived usability of digital products

Q2: ¿ What are the most commonly used UX evaluation techniques?

Several studies contribute to understanding UX evaluation (6, 10, 18, 27); however, among those reviewed, the study by Yanez, Cascado & Sevillano (26) is particularly useful due to its expanded, comprehensive, and structured nature. According to the authors, there are three focus areas for UX evaluation: 1. Developing new evaluation techniques; 2. Applying off-the-shelf techniques; and 3. Adapting traditional techniques. Depending on their conceptions, evaluators may choose an approach for practical work, thus leaning towards one set of techniques or another.

Techniques

Table 6. UX Evaluation Techniques in Yanez, Cascado & Sevillano (26)

Dimension	Category	Subcategory	Technique
On real systems or prototypes	Expert-led	Inspection methods	Guideline or standard inspection
			Heuristic evaluation
			Cognitive walkthrough
			Pluralistic walkthrough
			Task analysis
	User-based methods	Consultation methods	Questionnaires
			Field observations
			Focus groups
			Shadowing method
		Testing methods	Co-discovery learning
			Question and answer protocols
Predictive	Analytical modeling	-	-
	Simulation	-	-

In the previous table (Table 6), the classification of techniques described by Yanez et al. (26) was organized, which encompasses most of the techniques used in UX evaluation and all those presented by the authors in their text. Many of these techniques adhere to or are based on guidelines such as standard inspection or heuristic evaluation, so it is worth mentioning the most popular ones:

Guidelines

1. W3C WAI Initiative (37)

The Web Accessibility Initiative (WAI) is an initiative led by the World Wide Web Consortium (W3C), an international organization dedicated to developing standards for the World Wide Web, aimed at improving web accessibility for people with disabilities. The WAI Initiative, through the WCAG, establishes guidelines for inclusive web design based on the seven principles of universal design (38), proposing clear principles and measurable success criteria to ensure that websites are accessible to people with disabilities, including those with visual, auditory, motor, cognitive, and other impairments.

Equitable use: The design should be easy to use and suitable for all individuals regardless of their abilities and skills. It should provide the same ways of use for all users: identical when possible and equivalent when not.

Flexibility in use: The design should accommodate a wide range of individual preferences and abilities, allowing users to choose their mode of interaction or adapt to their pace of use.

Simple and intuitive design: The design should be easy to understand, regardless of the user's experience, knowledge, skills, or concentration level. It should eliminate unnecessary complexity and prioritize the organization of information according to its importance.

Perceptible information: The design should effectively communicate the necessary information to the user, regardless of their sensory abilities or environmental conditions.

Tolerance for errors: The design should minimize risks and the consequences of accidental or unintended actions.

Low physical effort: The design should be usable efficiently and comfortably with minimal physical effort, avoiding or minimizing repetitive actions.

Space and access for use: Spaces and sizes should be appropriate for access, reach, manipulation, and use by the user, regardless of their size, posture, or mobility.

2. Nielsen's Basic Heuristics

Nielsen [20] established ten basic guidelines for usability:

Visibility of system status: The system should keep the user informed at all times.

Match between system and the real world: The system should speak the user's language.

User control and freedom: The system should provide a clearly marked emergency exit.

Consistency and standards: Established conventions should be followed to facilitate understanding.

Error prevention: The system should prevent errors and anticipate inappropriate actions.

Recognition rather than recall: System options should be readily available.

Aesthetic and minimalist design: Dialogues should not contain irrelevant or rarely used information.

Help users: Errors should be addressed with instructions that inform the user.

Help and documentation: Provide textual help and documentation for inexperienced users.

3. Shneiderman and Plaisant's Recommendations

These are eight recommendations for human-computer interaction design. These recommendations are highly useful when designing interfaces based on the specific requirements of users. Plaisant & Shneiderman [36]:

Consistency: Use familiar icons, colors, fonts, and other design elements.

Shortcuts: Provide shortcuts for executing certain tasks in the system.

Informative feedback: The user should be aware of the status of the processes they are performing.

Dialogue: The system should communicate with the user.

Error handling: Provide users with simple ways to correct errors.

Allow for easy reversal: Users should be able to backtrack through their actions.

Promote a sense of control: Provide the expected control over the system and facilitate interaction.

Reduce memory load: Implement a hierarchy of information to aid retention.

Q3: What are some tools used in UX evaluation?

In recent years, various tools have been used to evaluate or measure user experience. Tests, indicators, and indexes are among the most commonly used. Among the tests, A/B testing, user tests, questionnaires, and surveys can be mentioned: A/B testing is a valuable UX methodology that involves comparing two versions (A and B) of a design or interface to evaluate which produces better results in specific metrics. This approach is essential for assessing changes in design, content,

or functionalities, providing concrete data that supports informed decision-making and the continuous improvement of user experience (40).

On the other hand, user tests, whether moderated or unmoderated, are crucial for understanding how real users interact with a system. These tests provide valuable insights into specific challenges and areas for improvement, allowing designers and developers to assess the product's usability (41, 42). Questionnaires are structured tools that gather data on user experience, evaluating aspects such as satisfaction and perception. Brooke's System Usability Scale (SUS) (43) and other questionnaires provide quantitative data that allow for a broader understanding of user preferences and perceptions. Finally, surveys are instruments that collect information through open or closed questions, allowing for feedback on the overall user experience (44). Sources such as Sauro and Lewis's "Quantifying the User Experience" (45) and Dillman's book (46) on online surveys provide guidance for collecting and analyzing mixed data.

Regarding indicators, a search was conducted on some of the most popular or frequently used ones in user experience studies. The results are organized in the following table:

Table 7. Indicators for User Experience Evaluation

Aspect	Indicators	Formula	Authors	Year
Usability	Success rate	Tasks completed successfully / Total users	Nielsen, J. (20)	1993
	Efficiency	Tasks completed / Time spent	Davis, F.D. et al. (5)	1989
	User error	Number of errors / Total actions	OIS (13)	1998
	Interaction time for users with disabilities	Interaction time per task / Total interaction time for users without disabilities	Lazar, J. et al. (16)	2004
Inclusivity	Satisfaction level of diverse users	Average satisfaction rating of diverse users	Hassenzahl & Monk (11)	2010
	Equity of use	Proportion of users who complete tasks / Total users	González, A.M. et al. (8)	2020
	Level of adaptability to different cultural contexts	Percentage of features adapted to different cultures	Väänänen-Vainio-Mattila (25)	2008
Interaction	Interaction efficiency	Tasks completed successfully / Total interactions	Preece, J. et al. (24)	2019
	Number of steps to complete a task	Number of steps required to complete the task	Lewis, C. et al. (17)	1994
	Diversity of interaction actions	Number of different actions performed / Total possible actions	Ponto, K. et al. (23)	2018
Overall User Experience	User Satisfaction Index (USI)	Sum of user satisfaction ratings / Total users	Brooke, J. (2)	1986
	Engagement	Interaction time / Total duration	O'Brien, H. & Toms, E. (21)	2008
	Flow	Rating scale from 1 to 7	Csikszentmihalyi, M. (4)	1990

These indicators aim to measure the relationship between people and phenomena such as satisfaction, perception, achievement, and emotion, and the technology used along with its characteristics such as friendliness, aesthetics, functionality, etc.

Discussion

UX evaluation

User experience is a critical factor for the success of any digital product or service, which is why its evaluation and measurement have become increasingly common practices in the technology industry. Generally, it can be observed that the methods used to evaluate user experience include surveys, interviews, usability testing, and log analysis, with commonly used metrics and indicators such as ease of use, user satisfaction, and system effectiveness. There are also more specific indicators tailored to certain contexts, such as digital inclusion in online education. Additionally, several articles suggest the importance of considering beauty and aesthetics in user experience evaluation.

When comparing the articles, several similarities and differences in indicators, metrics, and evaluation methods used to measure user experience can be found. Regarding similarities, all

articles agree on the importance of evaluating experience, satisfaction, efficiency, effectiveness, usefulness, accessibility, aesthetics, and usability as key indicators for measuring user experience. Additionally, several articles mention the importance of context and needs in UX evaluation. In terms of differences, specific situations use distinct indicators and metrics. For example, the study by Hassenzahl and Tractinsky (12) has a general approach; Law et al. (15) has a specific one; while Galván et al. (7) and Oviedo et al. (22) have particular and specialized approaches.

UX evaluation applied to gamification

From the above, if we consider the application of user experience (UX) evaluation in the context of gamification, it can be said that the contribution is significant. With UX evaluation, the goal is to ensure that game elements are designed effectively and provide a satisfying and enriching experience to participants in a gamified process, which is of great value. In this case, the user-centered approach aims to deeply understand users' needs, preferences, and motivations through research and analysis methods to design game elements that optimally align with the interests and goals of the audience. This can be seen in the creation of prototypes and their subsequent testing with real users to identify interactions with game elements, allowing for iterative adjustments and improvements in gameplay and usability. All this is crucial for maintaining user engagement, balancing challenges to be stimulating without being overwhelming, and recognizing user feedback in real-time.

An interesting case could be the application of A/B testing in the evaluation of gamification to determine which game elements are more effective for the intended purposes. Other measurement practices may include continuous evaluation and mixed methods evaluation (qualitative and quantitative) (39). Gamification is applied to a process by establishing a specific combination of game elements, mechanics, and dynamics, which must continuously adapt to the characteristics of the players, the established goals, and the context in which it is used. The mentioned evaluation practices enable such adjustments to be made based on objective and precise information. Finally, participant feedback is invaluable for adapting the design to their needs and expectations.

Conclusions

In conclusion, user experience (UX) evaluation is a significant topic in technology research, processes, and designs. The articles reviewed in this study presented a variety of methods and techniques for evaluating UX, which can be categorized into Methods for real systems or prototypes and Predictive Methods. The application of UX evaluation in the context of gamification pertains to a process that is often characterized as an innovation process. In this context, UX evaluation indicators can be used, with some depending on the types of elements involved. For example, some gamified processes may include technological or digital components subject to user interface evaluation, while others might involve physical cards, in which case gameplay, usability, satisfaction, and other evaluations would apply. Similarities were found among the articles regarding the importance of accessibility, usability, inclusivity, and interaction. It is important to note that as technology and knowledge advance, new challenges for UX evaluation in gamified processes emerge, and understanding continuously evolves.

Furthermore, the relationship between UX and gamification promises to be beneficial. Some authors (47) have explored this relationship in the reverse direction: the impact of gamification on UX. This suggests a potential future research direction, considering that gamification could transform how users interact with applications and platforms, positively contributing to the overall experience. Research topics could include User Engagement (48), Motivation and Achievement (49), Enhanced Learning Experience (49, 50), Immediate Feedback, Personalization and Social Experience, Engaging Problem Solving, Reducing Dropout, and Developing Positive Habits (50).

Therefore, it is recommended to continue researching and developing methods and techniques for UX evaluation and to adapt these approaches to new challenges arising in the field of gamification. Additionally, promoting accessibility, usability, inclusivity, and interaction in UX design within gamification should be prioritized to ensure user satisfaction and meet specific needs.

Finally, as a constructive contribution derived from this study, the following guide is proposed to incorporate UX evaluation into gamified processes.

1. Understanding the Context:

Familiarize yourself with the goals of the gamified process and the context in which it is applied.

Identify the specific characteristics of the target audience and their needs.

2. Selection of Heuristics:

Use Nielsen's basic heuristics as a starting point to evaluate the usability of the gamified process.

Visibility of system status.

Match between the system and the real world.

User control and freedom, etc.

Consider Shneiderman and Plaisant's recommendations to ensure effective interaction and a satisfying experience.

3. UX Evaluation Techniques:

Combine expert-driven and user-based evaluation methods.

Conduct heuristic inspections to identify potential design issues.

Use surveys and questionnaires to gather data on user perception and satisfaction.

Perform user testing to observe how participants interact with the gamified process and identify areas for improvement.

4. Evaluation Tools:

Implement A/B testing to compare different versions of the gamified process and assess their impact on engagement and participation.

Use indicators of usability, efficiency, and user satisfaction to measure the performance and effectiveness of the gamified process.

5 Iteration and Continuous Improvement:

Analyze the results of the UX evaluation and prioritize areas for improvement.

Make adjustments to the design and implementation of the gamified process based on the findings.

Iterate in the cycle of evaluation and continuous improvement to optimize the user experience and achieve the established goals.

This brief guide is proposed based on the identified and analyzed elements, considering a simplified integration of various UX evaluation elements with the evaluation of gamified processes.

Ethical implications

The authors do not have any type of ethical involvement that should be declared in the writing and publication of this article.

Conflict of interest

The authors declare that they did not receive resources for the writing or publication of this article.

Financing

CRediT authorship contribution statement

Johnatan A Taborda: conceptualization, Project administration, Methodology, Writing – review & editing, Writing – original draft.

Acknowledgments

References

1. Acosta Espinoza JL, Lenin León Yacelga AR, Sanafria Michilena WG, Acosta Espinoza JL, Lenin León Yacelga AR, Sanafria Michilena WG. Las aplicaciones móviles y su impacto en la sociedad. Revista Universidad y Sociedad [Internet]. 2022 [cited 2024 Sep 25];14(2):237–43. Available from: http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S2218-36202022000200237&lng=es&nrm=iso&tlng=en

2. Brooke J. SUS-A quick and dirty usability scale. 1996 [cited 2024 Sep 25]; Available from: https://seg.nju.edu.cn/tools/smarttv/download/A%20quick%20and%20dirty%20usability%20scale.pdf

3. Córdoba Cely C. La experiencia de usuario: de la utilidad al afecto. Iconofacto [Internet]. 2013 Oct [cited 2024 Sep 25];9(4):56–70. Available from: https://repository.upb.edu.co/handle/20.500.11912/7334

4. Cziksentmihalyi M. Flow: The Psychology of Optimal Experience. Harper & Row [Internet]. 1990 Jan [cited 2024 Sep 26]; Available from: https://www.researchgate.net/publication/224927532_Flow_The_Psychology_of_Optimal_Experience

5. Davis FD, Bagozzi RP, Warshaw PR. Fred D. Davis, Richard P. BaUser Acceptance of Computer Technology: A Comparison of Two Theoretical Models. Management_Science [Internet]. 1989 [cited 2024 Sep 26];35(8):982–1003. Available from: https://pubsonline.informs.org/doi/10.1287/mnsc.35.8.982

6. Palomino Diaz FP, Freddy Alberto Paz Espinoza (Ass), Mag Miguel Arturo Moquillaza Vizarreta (Ass). Investigación de los métodos de evaluación de la experiencia de usuario que aplican analítica web: una revisión sistemática. 2021 Mar 8 [cited 2024 Sep 26]; Available from: https://tesis.pucp.edu.pe/repositorio//handle/20.500.12404/18523

7. Nosheen M, Sayed Z, Saad Malik M, Fahiem MA. An Evaluation Model for Measuring the Usability of Mobile. Office Applications through User Interface Design Metrics. 641 Mehran University Research Journal of Engineering & Technology [Internet]. 2019 [cited 2024 Sep 26];38(3):2413–7219. Available from: https://pdfs.semanticscholar.org/b552/f4bf41ecbc1e85aed7afffb39f86d86ec560.pdf

8. Rodriguez J, Cardoso P, Monteiro J, Figueiredo M. Handbook of Research on Human-Computer Interfaces, Developments, and Applications. Vol. 1. Hershey_PA: IGI_Global; 2016. Avalaible from:

https://books.google.com.co/books?hl=es&lr=&id=nlWiDAAAQBAJ&oi=fnd&pg=PP1&dq=Handbook+of+Research+on+Human-Computer+Interfaces,+Developments,+and+Applications+&ots=9Z9SjSRW0I&sig=yJFRMGLoV0g1PFKWiryZ83zYDNY&redir_esc=y#v=onepage&q=Handbook%20of%20Research%20on%20Human-Computer%20Interfaces%2C%20Developments%2C%20and%20Applications&f=false

9. Google. Google Trends. 2023 [cited 2024 Sep 26]. Avalaible from: https://trends.google.es/trends/

10. Hay L. Researching UX: Analytics: Understanding Is the Heart of Great UX [Internet]. 1st ed. Vol. 1. SitePoint; 2017 [cited 2024 Sep 26]. Available from: https://books.google.com.co/books?hl=es&lr=&id=ZczDEAAAQBAJ&oi=fnd&pg=PT2&dq=Researching+UX:+Analytics:+Understanding+Is+the+Heart+of+Great+UX&ots=SicJ-kARPU&sig=5ZZHyqCSAJI-iLIPRn05smK1x_X8&redir_esc=y#v=onepage&q=Researching%20UX%3A%20Analytics%3A%20Understanding%20Is%20the%20Heart%20of%20Great%20UX&f=false

11. Hassenzahl M, Monk A. The inference of perceived usability from beauty. Human-Computer Interaction [Internet]. 2010 Jul [cited 2024 Sep 27];25(3):235–60. Available from: https://doi.org/10.1080/07370024.2010.500139

12. Hassenzahl M, Monk A. The inference of perceived usability from beauty. Human-Computer Interaction [Internet]. 2010 Jul [cited 2024 Sep 27];25(3):235–60. Available from: https://doi.org/10.1080/07370024.2010.500139

13. International Organization for Standardization OIS. ISO 9241-210:2019(en), Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems [Internet]. 2017 [cited 2024 Sep 27]. Available from: https://www.iso.org/obp/ui/en/#iso:std:iso:9241:-210:ed-2:v1:en

14. Joyce A. Inclusive Design [Internet]. 2022 [cited 2024 Sep 27]. Available from: https://www.nngroup.com/articles/inclusive-design/

15. Law ELC, Roto V, Hassenzahl M, Vermeeren APOS, Kort J. Understanding, scoping and defining user experience: A survey approach. Conference on Human Factors in Computing Systems - Proceedings [Internet]. 2009 Apr [cited 2024 Sep 27];719–28. Available from: https://dl.acm.org/doi/10.1145/1518701.1518813

16. U.S. General Services Administration (GSA), Department of Health and Human Services (HHS). Research-Based Web Design & Usability Guidelines. 2006. Available from: https://www.hhs.gov/sites/default/files/research-based-web-design-and-usability-guidelines_book.pdf

17. Lewis C, Rieman J. Task-Centered User Interface Design A Practical Introduction. 2008 Dec 16 [cited 2024 Sep 27]; Available from: http://www.hcibib.org/tcuid/

18. Mordecki D. Miro y entiendo. Guía práctica de usabilidad web. Ed. Acad. Española; 2012. Available from: https://mordecki.com/wp-content/uploads/2021/06/MiroyEntiendo.pdf

19. Max-Neef M, Elizalde A, Hopenhayn M, Herrera F, Zemelman H, Jatoba J, et al. Desarrollo a Escala Humana una opcion para el future version de Cepaur Fundacion Dag Hammarskjold [Internet]. Development Dialogue Numero especial. Londres: CEPAUR; 1986 [cited 2024 Sep 27]. Available from: https://www.daghammarskjold.se/wp-content/uploads/1986/08/86_especial.pdf

20. Nielsen J. Usability Engineering [Internet]. MountainView: Morgan_Kaufmann; 1994 [cited 2024 Sep 27]. Available from: https://books.google.com.co/s?hl=es&lr=&id=95As2OF67f0C&oi=fnd&pg=PR9&dq=Usability+Engineering.+Morgan+Kaufmann.+&ots=3dAECmbp0r&sig=_8lbmfL1L9O1wdc1MDxg69yp498&redir_esc=y#v=onepage&q=Usability%20Engineering.%20Morgan%20Kaufmann.&f=false

21. O'Brien HL, Toms EG. What is user engagement? A conceptual framework for defining user engagement with technology. Journal of the American Society for Information Science and Technology [Internet]. 2008 Apr 1 [cited 2024 Sep 27];59(6):938–55. Available from: https://onlinelibrary.wiley.com/doi/full/10.1002/asi.20801

22. Zaharias P, Mehlenbacher B. Exploring User Experience (UX) in virtual learning environments. International Journal of Human Computer Studies [Internet]. 2012 [cited 2024 Sep 27];70(7):475–7. Available from: https://www.researchgate.net/publication/257481786_Exploring_User_Experience_UX_in_virtual_learning_environments

23. Bowman DA. The Encyclopedia of Human-Computer Interaction, 2nd Ed. | IxDF [Internet]. 2014 [cited 2024 Sep 27]. Available from: https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed?srsltid=AfmBOor64-mg_jtQ3c42qYD8B4_4gfYn5YQLa5TdDcAWKamQjE5y562W

24. Sharp Helen, Rogers Yvonne, Preece Jenny. Interaction design : beyond human-computer interaction [Internet]. 4th ed. John Wiley & Sons, Inc.; 2023 [cited 2024 Sep 27]. 720. Available from: https://katalog.ub.uni-heidelberg.de/cgi-bin/titel.cgi?katkey=69228294

25. Baranauskas C. Palanque, P. Abascal JDS, Barbosa J. Human-Computer Interaction – INTERACT 2007. Baranauskas C, Palanque P, Abascal J, Barbosa SDJ, editors. 2007 Sep 10 [cited 2024 Sep 27];4663. Available from: http://link.springer.com/10.1007/978-3-540-74800-7

26. Yáñez-Gómez R, Cascado-Caballero D, Sevillano JL. Academic methods for usability evaluation of serious games: a systematic review. Multimedia Tools and Applications [Internet]. 2017 Feb 1 [cited 2024 Sep 27];76(4):5755–84. Available from: https://link.springer.com/article/10.1007/s11042-016-3845-9

27. Dankov Y, Bontchev B. Towards a Taxonomy of Instruments for Facilitated Design and Evaluation of Video Games for Education. ACM International Conference Proceeding Series [Internet]. 2020 Jun 19 [cited 2024 Sep 27];285–92. Available from: https://doi.org/10.1145/3407982.3408010

28. Scolari CA 1963. Homo Videoludens 2.0: de Pacman a la gamification [Internet]. Barcelona: Universidad Mayor; Universitat de Barcelona; 2013 [cited 2024 Sep 27]. Available from: http://repositori.upf.edu/handle/10230/26009

29. Maheshkar Chandan, Sharma Vinod. Handbook of research on cross-cultural business education [Internet]. IGI Global; 2018 [cited 2024 Sep 27]. 463. Available from: https://books.google.com/books/about/Handbook_of_Research_on_Cross_Cultural_B.html?hl=es&id=elkatAEACAAJ

30. Browne K, Anand C, Gosse E. Gamification and serious game approaches for adult literacy tablet software. Entertainment Computing [Internet]. 2014 Aug 1 [cited 2024 Sep 27];5(3):135–46. Available from: https://www.sciencedirect.com/science/article/pii/S1875952114000147

31. Cairns P, Cox A, Imran Nordin A. Immersion in Digital Games: Review of Gaming Experience Research. Handbook of Digital Games [Internet]. 2014 Apr 7 [cited 2024 Sep 27];337–61. Available from: https://onlinelibrary.wiley.com/doi/full/10.1002/9781118796443.ch12

32. Abt CC. Serious games. UniversityPressOfAmerica [Internet]. 1987 [cited 2024 Sep 27];176. Available from: https://books.google.com.co/books?hl=es&lr=&id=axUs9HA-hF8C&oi=fnd&pg=PR13&dq=serious+games+abt+clark&ots=d0S3bey7uS&sig=zfwxfi6NEuDvLY_1exgiWemb2AE&redir_esc=y#v=onepage&q=serious%20games%20abt%20clark&f=false

33. Calderón A, Ruiz M. A systematic literature review on serious games evaluation: An application to software project management. Computers & Education [Internet]. 2015 Sep 1 [cited 2024 Sep 27];87:396–422. Available from: https://www.sciencedirect.com/science/article/pii/S0360131515300166

34. Gebhard P, Tsovaltzi D, Schneeberger T, Nunnari F. Serious Games with SIAs. The Handbook on Socially Interactive Agents [Internet]. 2022 Oct 27 [cited 2024 Sep 27];527–46. Available from: https://dl.acm.org/doi/10.1145/3563659.3563676

35. Zichermann G, Cunningham C. Gamification by design: Implementing game mechanics in web and mobile apps [Internet]. 1st ed. books.google.com. O´Reilly_Media; 2011 [cited 2024 Sep 27]. Available from: https://books.google.com/s?hl=es&lr=&id=Hw9X1miVMMwC&oi=fnd&pg=PR7&dq=Gamification+by+design:+Implementing+game+mechanics+in+web+and+mobile+apps&ots=0tjkbq4von&sig=VH4TQbWDLcvpHNGqy0oTkdUb5eY

36. Plaisant C, Shneiderman B. Show me! guidelines for producing recorded demonstrations. Proceedings - 2005 IEEE Symposium on Visual Languages and Human-Centric Computing [Internet]. 2005 Oct [cited 2024 Sep 27];171–8. Available from: https://ieeexplore.ieee.org/abstract/document/1509501

37. W3C. Web Content Accessibility Guidelines (WCAG) 2.1 [Internet]. 2023 [cited 2024 Sep 27]. Available from: https://www.w3.org/TR/WCAG21/

38. Center for Universal Design. The Principles of universal design. lanecc.edu [Internet]. 1997 [cited 2024 Sep 27]; Available from: https://www.lanecc.edu/sites/default/files/governance/facilities/principlesofuniversaldesign06-07.pdf

39. Cresswell JW, Plano-Clark VL, Gutmann ML, Hanson WE. Advanced mixed methods research designs. Handbook of Mixed Methods in Social and Behavioral Research [Internet]. 2003 [cited 2024 Sep 27];209–40. Available from: http://www.sagepub.com/upm-data/19291_Chapter_7.pdf

40. Kohavi R, Henne RM, Sommerfield D. Practical guide to controlled experiments on the web: Listen to your customers not to the hippo. Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery and Data Mining [Internet]. 2007 Aug 12 [cited 2024 Sep 27];959–67. Available from: https://dl.acm.org/doi/10.1145/1281192.1281295

41. Dumas JF, Redish JC. A Practical Guide to Usability Testing | Guide books. Greenwood Publishing Group Inc [Internet]. 1993 Jan 1 [cited 2024 Sep 27]; 412. Available from: https://dl.acm.org/doi/abs/10.5555/573014

42. Rubin J, Chisnell D. Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests [Internet]. 2nd ed. Indianapolis: Wiley_Publishing_Inc; 2008 [cited 2024 Sep 28]. 348. Available from: https://books.google.com/s?hl=es&lr=&id=MjNGDgAAQBAJ&oi=fnd&pg=PA3&ots=lPwI1IoWkC&sig=RHecbKlnI01u2T8N4ki_sjd1BTE

43. Brooke J. SUS-A quick and dirty usability scale. 1996 [cited 2024 Sep 28];7. Available from: https://seg.nju.edu.cn/tools/smarttv/download/A%20quick%20and%20dirty%20usability%20scale.pdf

44. Lewis JR, Sauro J. The Factor Structure of the System Usability Scale. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) [Internet]. 2009 [cited 2024 Sep 28];5619 LNCS:94–103. Available from: https://link.springer.com/chapter/10.1007/978-3-642-02806-9_12

45. Sauro J, Lewis JR. Quantifying the User Experience: Practical Statistics for User Research [Internet]. 2nd ed. Morgan_Kaufmann; 2016 [cited 2024 Sep 28]. 350. Available from: https://books.google.com.co/books?hl=es&lr=&id=USPfCQAAQBAJ&oi=fnd&pg=PP1&dq=Quantifying+the+User+Experience:+Practical+Statistics+for+User+Research&ots=VzYiX-9pRj&sig=OuMXzqYeL7RquguRQQbgdhBnxbs&redir_esc=y#v=onepage&q=Quantifying%20the%20User%20Experience%3A%20Practical%20Statistics%20for%20User%20Research&f=false

46. Dillman DA, Smyth JD, Christian LM. Internet, Phone, Mail and Mixed-Mode Surveys: The Tailored Design Method. redalyc.org [Internet]. 2016 [cited 2024 Sep 28]; 154:161–76. Available from: https://www.redalyc.org/pdf/997/99746727009.pdf

47. Zichermann G, Cunningham C. Gamification By Design [Internet]. 1st ed. Vasa. O´Reilly; 2011 [cited 2024 Sep 28]. 208. Available from: https://books.google.com.co/s?hl=es&lr=&id=Hw9X1miVMMwC&oi=fnd&pg=PR7&dq=Gamification+by+design:+Implementing+game+mechanics+in+web+and+mobile+apps&ots=0tjk8o7vns&sig=egG7FmR_OjuM1GiiHhU2KXZrKis&redir_esc=y#v=onepage&q=Gamification%20by%20design%3A%20Implementing%20game%20mechanics%20in%20web%20and%20mobile%20apps&f=false

48. Werbach K, Hunter D. For the Win, Revised and Updated Edition. The Power of Gamification and Game Thinking in Business, Education, Government, and Social Impact [Internet]. For the Win, Revised and Updated Edition. Philadelphia: University of Pennsylvania Press; 2020 [cited 2024 Sep 28]. Available from: https://doi.org/10.9783/9781613631041

49. McGonigal Jane. Reality Is Broken: Why Games Make Us Better and How They Can Change the World [Internet]. NewYork: Penguin_Books; 2011 [cited 2024 Sep 28]. Available from: https://books.google.com.co/s?hl=es&lr=&id=yiOtN_=fnd&pg=PT11&dq=Reality+is+broken:+Why+games+make+us+better+and+how+they+can+change+the+world&ots=flgkTHa_Tv&sig=O30WMx531vsU7_2sFnkKDr1FpFI&redir_esc=y#v=onepage&q=Reality%20is%20broken%3A%20Why%20games%20make%20us%20better%20and%20how%20they%20can%20change%20the%20world&f=false

50. Reiners T, Wood LC. Gamification in education and business. Gamification in Education and Business [Internet]. 2015 Jan 1 [cited 2024 Sep 28];1–710. Available from: https://link.springer.com/book/10.1007/978-3-319-10208-5

51. Guirao Goris SJA. Utilidad y tipos de revisión de literatura. Ene [Internet]. 2015 Jan [cited 2024 Sep 28];9(2):0–0. Available from: https://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1988-348X2015000200002&lng=es&nrm=iso&tlng=es