



Gamification and Usability in Educational Contexts: A Systematic Review

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Abstract. The introduction of gamification in educational environments in recent decades has gained relevance thanks to the flexibility it presents to adapt to the wide variety of platforms and applications that have resulted in the integration of technology, entertainment, and education [1]; however, the implementation of gamification in classrooms presents challenges, which are mainly associated with low playability [2], often due to lack of motivation of users. Requires that these platforms are designed under the application of usability metrics in pedagogical terms that make it possible to identify and manage the limitations or deficiencies in achieving learning objectives. Therefore, this paper aims to explore the scientific literature on usability heuristics from a pedagogical point of view used in gamification in teaching-learning processes. We worked under the method of three main activities: planning, review, and publication [3]. The reviewed productions provide empirical and theoretical data in the field of pedagogical aspects to be considered to evaluate the pedagogical usability as the user interface for a conducive interaction, ability to entertain, and a learning experience. In addition, it was found that the methods and/or techniques used are associated with external assessments focused on user-centered design because they identify the degree of user satisfaction.

Keywords: Gamification · Usability · Education

1 Introduction

Currently, information technologies have been transfigured into pedagogical tools, producing new ways of learning in which technology and education are articulated to assist the learning and teaching processes as an alternative to making knowledge a possibility of transforming the environment [4]. ICTs have helped to narrow the space-time gap, which has led to the search for new pedagogical tools that strengthen the teaching-learning processes [5]. Virtual learning environments, especially gamification, are contributing to the transformation of pedagogical processes in general; this has encouraged other international research that has allowed to know the potential of these tools in different areas of

knowledge, highlighting the role of immersion and motivation of learners in the implementation of these tools, in addition to the challenges involved in adapting these tools to school environments.

In Colombia, the implementation of gamification has been gaining relevance in recent years. Although it is still incipient, it is worth highlighting the efforts made by the Ministry of Education promoting virtual learning environments seeking to promote new learning routes in the educational process, framed in the quality of the same, promoting by some research centers a vision of the subject of usability in these platforms [6].

In this sense, Gómez [7] defines gamification as the art of using fun and captivating elements, usually games, and applying them to real and productive environments in a conscious and studied way. While Carreras [8] conceptualizes it as the use of game elements and mechanics in non-game contexts, to guide people's behavior and achieve certain goals, such as stimulating interest, encouraging a behavior change, or conveying a message or content.

Currently, different technological tools have been developed to address education, acquiring great relevance to the use of gamification as a didactic instrument, seeking the union of technological resources and education [9]; to which, Perosi & Lion [10] state that these initiatives need to develop intellectual activities that challenge thinking about game design in cognitive and learning terms, demanding the implementation of usability heuristics in terms of learning in gamification initiatives used in pedagogical processes, only currently, there are limited methods and/or techniques built to quantify usability in these educational platforms [11].

Usability is conceptualized as a set of evaluation techniques that offer a series of results that allow conclusions to be drawn about the use of software in an environment [12]. While González and Farnós [13] define it as the assessment of the degree of ease of use of a digital program and the type of satisfaction that this use generates in the user, which refers to the fact that software, especially educational software, should induce the user's interest in the contents offered by its ease of access and understanding, as well as the degree to which it satisfies the user's needs.

Viñals, Blanco & Cuenca Amigo [1] state that gamification of learning has become scientific didactic par excellence, producing its acceptance, especially in young people who skillfully handle these technologies, particularly those of entertainment; however, this does not guarantee that they manipulated for the development of personal learning. This leads to the fact that young people do not use information technologies for educational purposes, making necessary the search for the integration of technological and educational resources, being this the case of video games in educational processes, which present difficulties in adapting these tools to school environments, while ensuring that these are attractive, developed to entertain and must provide a learning experience related to educational objectives [2]; This is one of the challenges of the digital era where the teacher must influence the construction of the competent digital being.

The introduction of gamification in classrooms presents significant challenges, which are mainly associated with low playability to such an extent that, in many cases, they look like a textbook or a test-type exam, causing students to lose motivation [14]; by leaving out different aspects related to the characteristics present in the game [15]. In addition, Rubio-Méndez [14] exposes that the selection/design of the type of video games must be

adjusted to the knowledge, practices, skills, or competencies that are to be transmitted, making it necessary to identify those that will be appropriate in each case to offer students a good and effective tool for their learning. Therefore, it is required, as exposed by Massa [15], to work to understand how to design, manage and evaluate gamification in different contexts that allow the fulfillment of the proposed learning achievements.

Gamification has had a great reception, especially by young people, as a method of entertainment; however, its potential in educational environments has been wasted, but these initiatives must be designed under the integration of technologies, entertainment, and education. Requires that these platforms are designed under the application of methods and/or techniques that allow value the usability in terms of learning, achieving when implementing these initiatives contributing to the development and selection in school environments. This is the challenge of contemporary society in the immersion of gamification in the teaching-learning processes to establish indicators to assess the usability and usefulness of these platforms that enable the identification and management of limitations or deficiencies in its implementation in school environments used in pedagogical processes; Therefore, the purpose of this paper is to explore the scientific literature on usability heuristics from a pedagogical point of view used in these gamification platforms in educational processes, which can serve as a basis for the construction of a usability heuristic from a learning perspective in these platforms in the teaching-learning processes that contribute to the design and/or selection of these programs.

State of the Art. In the educational context, gamification of learning has been implemented in various disciplines of science, technology, engineering, mathematics, and medicine [16]; focusing largely at the university level, with various approaches and pedagogical results but, to a lesser extent at the high school level, therefore, it is required to reduce the gap present in the implementation of gamification at different levels of education [17]; which are associated with the difficulties in adapting these tools to pedagogical processes, while ensuring the game's characteristic features such as being attractive, developed to entertain, in addition to providing a learning experience related to educational goals [2].

Promoting the generation of tools to evaluate gamification in educational contexts, highlighting usability by allowing to determine the impacts of gamification implementation [17]. Usability metrics in learning processes have been oriented in ISO standards, inducing assessments focused on technical aspects of a design accessible to the user, while the assessment aimed at knowing about the pedagogical usefulness of gamification as a tool for teaching and learning has been highlighted [18].

2 Methodology

For the development of the present research, a systematic review was carried out, this being a process that concentrates the results of multiple original investigations based on different strategies to reduce bias. For the execution of the present study, we worked under the proposed method, which consists of three main activities: planning, review, and publication [3]. As stated by Gomes, Cruz, and Horta [19], it is necessary to focus on five relevant aspects for the review: (i) Formulation of the Research Question, (ii) Search Strategy, (iii) Selection of Studies, (iv) Extraction of Information, and (v) Summary of Results.

2.1 Formulation of the Research Question

The present exploratory systematic review had the purpose of knowing the usability heuristics from the point of view of learning in gamification platforms based on the following research questions:

- What pedagogical aspects should be taken into account to evaluate the usability of a gamification platform used in the teaching-learning process of environmental education in middle school students?
- Usability heuristics has used what methods and/or techniques from the learning perspective to evaluate gamification platforms?
- Do usability heuristics from a learning perspective contribute to the design and/or selection of gamification platforms in the teaching-learning process for middle school students?

2.2 Search Strategy

The research was conducted using the advanced search option in the electronic databases Scopus, Dialnet, and Redalyc. Likewise, the search string was defined based on the following keywords of the research questions, both in Spanish and English, which are presented in Table 1.

The search strategy employed was similar in all four databases, using the title sections, abstracts and keywords using AND and OR complements to select specific datasets. An example of the search strategy used is presented below TITLE-ABS-KEY (usability AND gamification AND education).

Table 1. Search strategy and results by descriptors.

Fuente	Estrategia de búsqueda	Número de resultado
Scopus		13
	TITLE-ABS-KEY (usability AND gamification AND education) AND (LIMIT-TO (EXACTKEYWORD, “Gamification”) OR LIMIT-TO (EXACTKEYWORD, “Education”))	121
		9
Dialnet	usabilidad AND gamificación AND educación	5
Redalyc	“usabilidad AND gamificación AND educación”	175
	TITLE-ABS-KEY (usability AND gamification AND education)	173
	usabilidade AND gamificação AND educação	153

2.3 Selection of Studies

For the present study, the following selection criteria were selected: to include all publications between the years 2015 to 2022, published in English, Spanish and Portuguese; as a type of document, articles from indexed journals refereed academic publications and graduate theses were considered. Also, the content of the documents had to deal with usability heuristics from a pedagogical point of view used in gamification platforms in educational processes.

The exclusion criteria included articles in languages other than English, Spanish, and Portuguese. In addition to publications whose title, keywords, abstract and content were not directly related to the research question and were not related to the review's objective. Likewise, the publications were subjected to filtering of duplicate articles. The results obtained are shown in Figure or Table 1.

3 Results

The results of the research are presented below, following the proposed methodology, 24 articles were selected for the synthesis and review based on the reading of the articles that allow the extraction of information, which contributes to the resolution of the research questions and thus, compare them qualitatively.

3.1 Pedagogical Aspects to be Taken into Account to Evaluate the Usability of Gamification Platforms Used in the Teaching-Learning Process

Gamification is conceptualized by Carreras [8] as the use of game elements and mechanics in non-game contexts; to guide people's behavior and achieve certain goals. While Kenwright [20] defines it as the application of game principles to something that is not necessarily a game that has among its objectives to help people motivate themselves, placing it within the boundaries of serious games. The authors Ishaq, Rosdi, Mat, & Abid [21] propose four recommendations that should be taken into account in the development of gamified platforms in the educational context associated with: a) goal orientation, b) achievement, c) reinforcement, and d) a fun orientation.

In the ISO 25000 Standard of 2015 and ISO 25010 Software Quality Requirement Evaluation (SQUARE), a common framework was created for the evaluation of the quality of software products, where it is expressed, that usability is the "ability of the software product to be understood, learned, used and be attractive to the user when used under certain conditions". Too, it is made up of the following sub-characteristics that help in its assessment: Ability to recognize its suitability, Ability to learn, Ability to be used, protection against user errors, and Aesthetics of the user interface, Accessibility [22].

The measurement of usability in learning processes has been based on ISO standards fundamentally on three postulates evaluated by users: the first is the ease of learning that refers to predictability; the second is flexibility, inherent to the possibilities of information exchange between the user and the system; and the third is robustness that responds to the perceived level of support for the achievement of objectives [23].

Cocunubo-Suárez, Parra-Valencia, & Otálora-Luna [24] express that there have been some difficulties in evaluating usability in educational platforms from the international software quality standards associated with the characteristics or pedagogical aspects that must be assessed for educational software to be usable in educational environments. This has contributed to the fact that in educational contexts, the evaluation of usability is mainly oriented to technical aspects of a design accessible to the user, while to a lesser extent, assessments aimed at knowing about the pedagogical usefulness of the resources that can be used as tools for teaching and learning are used [18].

Therefore, proposals have been designed based on the ISO 25000 standards of the aspects to be taken into account in usability evaluations in virtual learning environments, such as Pedagogical ease, Support, help, and documentation, Content, User interface, Error handling, Tools, Flexibility, Standards, in addition, they are complemented with eight sub-characteristics [24].

Turpo [23] proposes pedagogical usability based on three aspects to be taken into account in the assessment of virtual educational environments: the first is the user interface for a conducive interaction, the second is the design of training activities relevant to learning and the third is the verification of the scope of learning: In addition, it accompanies them with three fundamental sub-characteristics associated with the organization of teaching, the process, and achievement of learning and the development of learning skills.

Also, the perceived usability of the application of gamified platforms has been parameterized from the evaluation of aspects such as attractiveness, clarity, manageability, stimulation, and innovation of the application [25]. While the assessment of usability in game-based learning platforms is divided into three aspects: the first is the enrichment and transfer of knowledge, and the second is the usability of the platform and overall experience of the game session compared to other modes of learning [26].

3.2 Techniques and/or Methods Used in Usability Heuristics from a Learning Perspective to Evaluate Gamification Platforms

Usability can be measured in two different contexts; the first is an internal method from the application of heuristics performed by a panel of experts, which is usually implemented in the development stage; the second is an external method that allows assessment used by end-users, i.e., when the platform is finished [24]. It is worth mentioning that these evaluation methods complement each other in practice.

Different techniques have been used to evaluate usability in educational environments, among which are:

- Fun Experience Design (FED), has been used to know the degree of usability of gamified platforms by knowing the degree of satisfaction of students by evaluating the user experience [27].
- User Experience Questionnaire (UEQ), implemented to identify the level of usability satisfaction by allowing the evaluation of specific aspects of the application of gamification through scales ranging from positive to negative assessment [25].

- System Usability Scale (SUS), allows us to analyze usability variables and learnability through a 10-item questionnaire with five response options, ranging from strongly disagree to strongly agree [28].
- User Experience (UMUX), is used to evaluate the perceived usability of an application after a short period of interaction; from a Likert scale, a questionnaire alternating positive and negative statements with which respondents rate their satisfaction [29].
- Goal-Question-Metric (GQM), has been applied to evaluate usability characteristics by taking international software quality standards as a guide, assessing goals, through quantifiable questions, and using quantitative as well as qualitative metrics [30].

The techniques used to evaluate the pedagogical usability have been designed mostly from the Likert scale, which is a psychometric instrument that allows obtaining quality data from a series of questionnaires where the respondent must indicate their agreement or disagreement on a statement [31].

3.3 Contribution of Usability Heuristics from a Learning Perspective to the Design and/or Selection of Gamification Platforms in the Teaching-Learning Process

For the development of gamified platforms, it is necessary to follow usability guidelines from the learning perspective to achieve the construction and consolidation of a tool for the development of user learning [21]. Because the application of this type of heuristics allows achieving a balance between technology, pedagogy, and the learning objectives sought, in addition to knowing the satisfaction propitiated from the interactions with the gamified platform [23].

Aspects related to usability and pedagogy are fundamental for gamification to be successful and meet the objectives proposed in the teaching-learning process [24], because, as expressed by Turpo [23] usability in pedagogical processes, goes beyond the aesthetics of the interface, attractive or ergonomic design, it implies satisfaction with the service and/or training product, through the achievement of content and activities proposed when developing certain competencies.

By applying usability heuristics associated with pedagogy, we seek to achieve full harmony of using technology in conjunction with pedagogy, because the important thing is not only to focus on technological artifacts but, it is essential to focus attention on didactics and human cognition, [18]. This is a criterion that influences the quality of the design of the e-learning platform in the overall satisfaction of the learning experience [26].

Therefore, the use of usability heuristics in gamified platforms used in teaching-learning processes is considered a main issue when evaluating any application [32]; because it allows having enough assessment criteria to work on the correct application of gamification in educational environments [27].

4 Discussion

The evaluation of usability in gamified platforms used in teaching-learning processes is mainly oriented to technical aspects of a design accessible to the user, while to a

lesser extent assessments aimed at knowing about the pedagogical usefulness of the resources that can be used as tools for teaching and learning are used learning [18]; thus, it is necessary a broader look that integrates technological features such as interfaces, the characteristics of gamification and pedagogical characteristics allowing to achieve a balance between technology, entertainment, and educational processes.

Therefore, the design of usability assessment metrics is required, as proposed by Turpo [23] and Chan, Chan, & Agnes [26], an assessment based on three main aspects related to the enrichment and transfer of knowledge, the design of training activities relevant to learning and the overall user experience when using the platform. This will allow us to know relevant aspects that lead to the successful introduction of gamification in educational contexts. This makes it necessary to incorporate usability metrics focused on user-centered design (UCD) [33]; which makes it possible to know the degree of satisfaction of end consumers, this is an important criterion to work on the maximize application of gamification in educational environments.

The above may be an explanation for the perceived trend in the techniques used in usability metrics applied to educational platforms that are mostly applied in external contexts that allow the end-user to evaluate gamification from a questionnaire designed using the Likert scale methodology (Peters, Oleari, & Sardu, 2019). Resulting in knowing the usability problems presented by gamification from real users of the system leading to its solution [33].

This implies exploring the relationships between the perceived usability of a gamified educational application and the impact on student motivation, allowing not only to help design better interfaces, but also to obtain an impact on the learning processes of users (Andrade, Law, Farah, & Gillet, 2020). Therefore, this research should serve as a basis for the construction of usability heuristics from a pedagogical point of view in gamified platforms in the teaching-learning processes that contribute to the design, selection, and assessment of the effects of these programs on students. Techniques and/or methods used in usability heuristics from a learning perspective to evaluate gamification platforms.

5 Conclusions

Gamification has great potential to become a pedagogical tool, thanks to the nature of the human being to want to play more than to work, experience, and enjoy more than to possess [34]. In addition, it increases the motivation to learn but, for this to happen, the user's educational needs must be met [28]; it is here where the use of usability heuristics in gamified platforms becomes relevant to achieve harmony between technology, entertainment, and pedagogy; so that the gamification strategy is successful and meets the objectives proposed in the teaching-learning process.

The findings of this review show the interest in analyzing the possibilities offered by gamification in the teaching-learning processes, recognizing the importance of maintaining the characteristics of the game such as its ability to entertain, in addition to providing a learning experience according to the proposed objectives. Thus, it has been emphasized the need to design and deliver pedagogical usability heuristics that allow its measurement from three main aspects related to the enrichment and transfer of knowledge, the design of training activities relevant to learning, and the overall user experience when using the platform [23].

Among the methods and/or techniques used, external evaluations focused on user-centered design stand out, since these metrics allow identifying the degree of user satisfaction, which is an important criterion to work on the application of gamification in educational environments [33]; by allowing adapting these to the contexts and needs of students; likewise, designing accessible and usable platforms. Usability metrics based on user evaluation are constructed from a questionnaire using the Likert scale methodology [29].

6 Future Investigations

After conducting the research, it is considered that there is still much work to be done to obtain usability metrics from the point of view of pedagogy used in gamified platforms to assess the user interface for a conducive interaction and ability to entertain, in addition to a learning experience according to the proposed objectives.

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