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GAMIFIED LEARNING PLATFORM FOR HEALTH EDUCATION: USABILITY EVALUATION STUDY

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ABSTRACT

The research sought to evaluate the usability of a gamified learning platform built to mediate the teaching process of students with expert judges. Methodology: this is a methodological development research, descriptive with a quantitative approach, of an applied nature. The sample consisted of 8 people with 2 evaluation segments being judges from the technology area, coming or not from the research anchor higher education institution and expert judges from the teaching area. Data collection was online by signing the TCLE. The instrument was a questionnaire adapted to Nielsen's heuristics. The data were grouped and analyzed using statistical data analysis methods in order to obtain four types of metrics used in usability evaluation and in Nielsen's Heuristics, which are: effectiveness, efficiency, satisfaction and severity. Results: The usability of the platform is 72.5%. Severity (25.0%) can be classified as low, Effectiveness is regular (67.6%) and Satisfaction is good (75.0%). As for Efficiency, it cannot be measured due to the covid19 pandemic. Considerations: In this way, it is important to highlight the use of digital platforms, to facilitate the reach of information.

INTRODUCTION

The use of new technologies and tools to support training and education allows expanding the means of professional qualification towards a more problem-solving competence (ALMEIDA; SILVA; MACHADO, 2013). According to Oliveira (2018) in education, many researchers have sought to incorporate the use of gamification into the learning process, for motivation and engagement of their students. In this sense, gamification is an emerging phenomenon, which derives directly from the popularization and popularity of games, and their intrinsic abilities to motivate action, solve problems and enhance learning in the most diverse areas of knowledge and life of individuals (FARDO, 2013). In addition, it assumes the use of elements traditionally found in games, such as narrative, feedback ystem, reward system, conflict, cooperation, competition, clear objectives and rules, levels, trial and error, fun, interaction and interactivity (FARDO, 2013). Thus, games are no longer just a means of entertainment and are now used in several important areas, for example: industry, health and education. Games are motivating because they involve the cognitive, emotional and social area of the players (OLIVEIRA, 2018). It is understood that institutions, whether

private or public, not only have the function of complying with the laws, charging with funding for the development of teacher training, but also investing in new teaching technologies, developing and stimulating active methodologies.

This was a major challenge for private and public institutions amid the Coronavirus pandemic experienced around the world. Technological support for teachers, as well as training in the use of technological tools, was and is the big change for the "new normal", moving away from traditional teaching and seeking teaching through digital technology, motivating students to stay in school and seek knowledge. These factors led us to conduct this research in the context of digital technologies used for health education, starting with a bibliographical survey of scientific productions on gamified platforms for health education, which indicated that studies on this topic are still in numbers. very reduced on the investigation of the problem involving gamified platforms and teaching and learning. The research was based on the following research question: is a gamified learning platform built to mediate the teaching/learning process of students adequate and statistically usual according to expert judges?

Therefore, the general objective was to evaluate the usability of a gamified learning platform built to mediate the teaching/learning process of students with expert judges.

MATERIALS AND METHODS

It was a study of the methodological development research type, descriptive with a quantitative approach, of an applied nature, on the usability evaluation of an educational digital technology platform. Judges from the field of technology, whether or not from the higher education institution (HEI), which is the anchor of the research and a specialist in the teaching area, were used as a source. The research had as anchor HEI a private University Center, based in Belém do Pará. The sample consisted of 8 people with 2 evaluation segments. The first segment formed by specialists in the field of technology and the second segment with IES professors. The sample quantity is a recommendation of ISO/IEC 25062/2011, defined in ISO 9241-11 (ISO/IEC 2006- ABNT 2011). The Inclusion Criteria were specialists who develop their teaching activities with active methodologies and gamified learning platforms and specialists in the technology area who develop activities in the area of software development, applications and the like and the Exclusion Criterion specialists were those who do not develop their teaching activities with active methodologies and gamified learning platforms and specialists in the technological area who do not develop activities in the area of software development, applications and the like. Data collection was all carried out online.

Through an invitation, the Informed Consent Form (TCLE) was subsequently sent, which was signed and forwarded to the researcher, and finally the link to access the platform and the evaluation instrument was sent, due to the COVID-19 Pandemic. The instrument used was an adapted online questionnaire with open and closed questions, containing technical aspects of usability evaluation. The acquired data were grouped and later analyzed using statistical data analysis methods in order to obtain four types of metrics used in usability evaluation and in Nielsen's Heuristics. Common measures of effectiveness included percentage of task completion, frequency of errors, frequency of participant assistance by the tester, and frequency of access to help or documentation by participants during the task. The degrees of severity were evaluated by the participants on a scale of zero (0) to four (4), according to Nielsen (1993), presented to them through the tool docs.google.com/forms. For a better visualization and analysis of the acquired qualitative data, the Wordclouds tool (wordclouds.com) was used, which allows the creation of word clouds using different shapes and images, thus facilitating the identification of the most repeated words by the judges. The project was approved by the ethics committee under number CAAE 34583520.8.0000.5701.

RESULTS AND DISCUSSION

The present study analyzed the opinion of 8 judges to evaluate the characteristics of a Gamified Learning Platform for Health Education. Descriptive statistics were presented by frequency distribution and trend, central and variation measures. To evaluate the usability measures of the learning platform, quantitative methods were developed to assess Severity, Effectiveness, Satisfaction against 10 app features. To carry out this evaluation, degrees of severity were used on a scale from zero (0, no problems) to four (4, very serious problems) and, as described by Nielsen (1993), the central point of the scale (Score 2) corresponds to the existence of low priority problems.
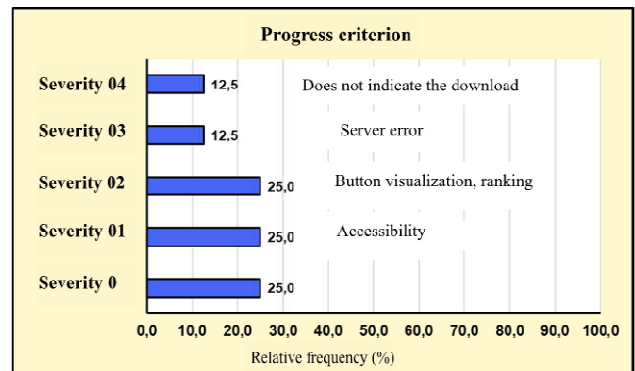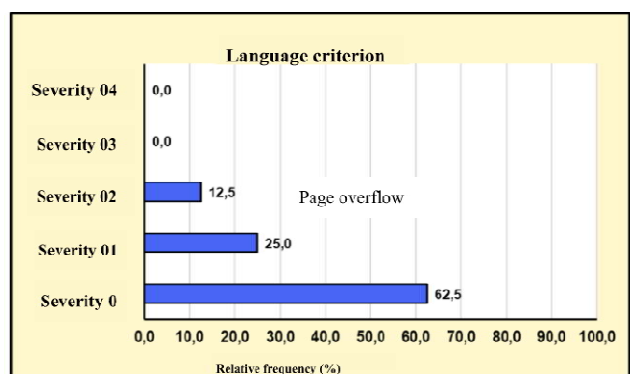

Source: Own elaboration, 2021.

Graph 1. Distribution of responses for criterion C1-Progress criterion, in the context of usability severity of the Gamified Learning Platform for Health Education

Graph 1 refers to the Progress Criterion, characterized by the question: "Are users informed about the progress on the platform with the appropriate response and in an acceptable time?".

It was shown that 25.0% of the evaluators opted for Severity 0 (indicating satisfaction), 25.0% opted for Severity 1 (low), 25.0% opted for Severity 2 and only 12.5% opted for Severity 3 (high severity) and Severity 4, which is the highest degree of dissatisfaction. The progress indicator must be in a place that is easy for the user to see, making decisions quicker during the game. Nokelainen (2006) emphasizes the importance and role of feedback. For the author, he should be immediate and encouraging. When given by people (teacher or colleagues), it is more valuable, however, this depends on the quality of interaction offered by the system. And the interaction with the gamified platform for Health Education took place at a very troubled time when we experienced the Covid19 pandemic, which led many of the participants to adapt to the use of digital platforms (CORDEIRO, 2021).
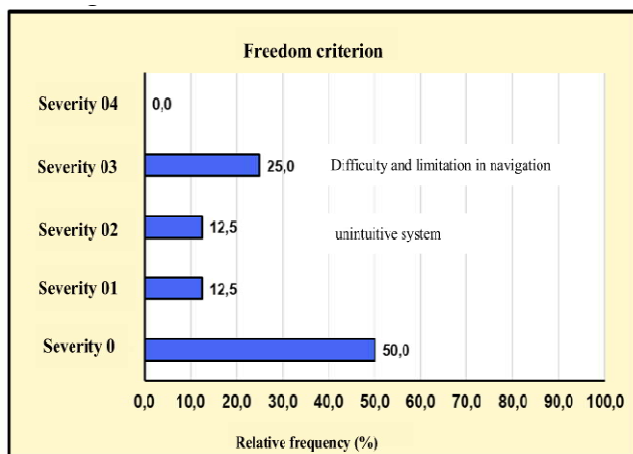

Source: Own elaboration, 2021.

Graph 2. Distribution of responses for the C2-Language criterion, in the context of usability severity of the Gamified Learning Platform for Health Education

Graph 2 refers to the language criterion, defined by the question: "Does the platform use concepts and language familiar to users instead of specific technical terms? Does the platform use real-world combinations and present information in a natural and logical order?"

It identified that 62.5% of the evaluators marked "Severity 0", 25.0% opted for Severity 1 and only 12.5% opted for Severity 2. It is observed that with this evaluation, the evaluator becomes interested in platforms that are leaner, more intuitive, faster and with the fewest pages possible, speeding up the interest in achieving the objectives proposed by the platform.

An important characteristic of the search process for optimized solutions is described by Kleijnen and Wan (2007, p. 28) when he says "that all simulation optimization methods address interactive heuristic practices". As for the meaning of the word intuition, it has always been present in philosophical systems from Greek antiquity to contemporary philosophy, having been presented with different meanings. What they all have in common is the understanding of intuition as an immediate view (without mediation) of something in its entirety (GUIMARÃES, 2005).
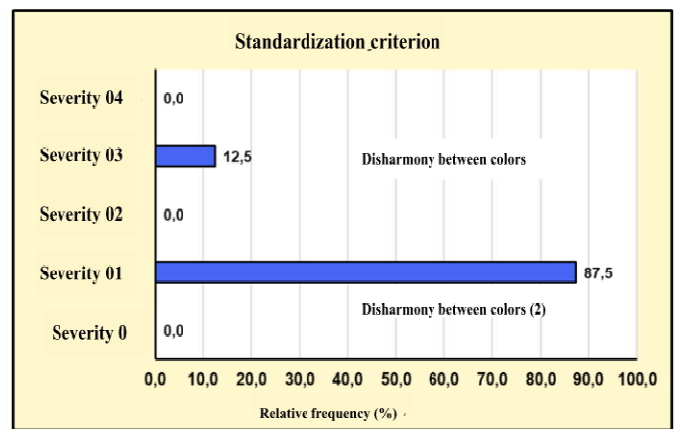

Source: Own elaboration, 2021.

Graph 3. Distribution of responses to the C3-Freedom criterion, in the context of usability severity of the Gamified Learning Platform for Health Education

Graph 3, corresponding to Criterion Liberada, defines the question "Can users do what they want and when they want?

Without going through extensive messages." It was noticed that 50.0% of the evaluators opted for Severity 0, 25.0% for Severity 3 and 12.5% for Severity 1 and 2. In this regard, it is clear that the navigability of the platform is in a deadlock, and must be corrected so that the user can achieve their goals.

As evaluative strategies of this process, the evaluators pointed out basic problems that can trigger the user's demotivation, the focus is related to the importance of the interaction with the system, that is, how satisfactory, pleasant or motivating the interaction is.

Having a good navigability on the platform requires power, according to Nielsen (1993), the heuristic of user control and freedom allows the user to easily undo and/or redo their actions, considering that users often perform wrong actions in the system and they need an "emergency exit" that allows them to get out of the unwanted state easily, without having to travel long distances. It is worth noting that an interactive system corresponds to any computational system (software) that, in order to carry out its functions and activities, necessarily needs (depends on) the action of a user, that is, its activities are only carried out when resulting from these interactions, man machine (BARBOSA; RABAÇA, 2002).
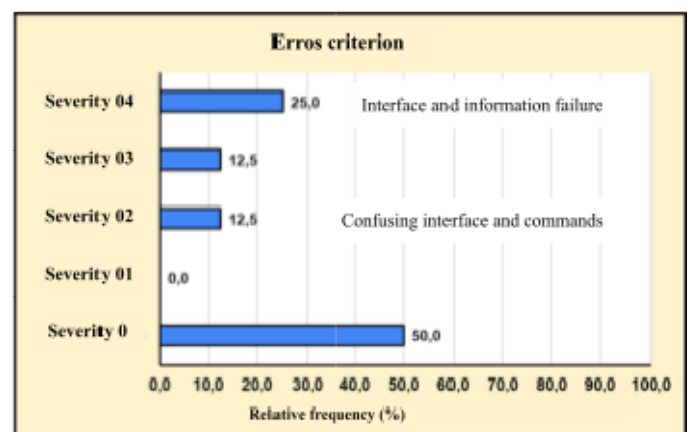

Source: Own elaboration, 2021.

Graph 4. Distribution of responses for criterion C4-Standardization criterion, in the context of usability severity of the Gamified Learning Platform for Health Education

Chart 4 Representing the Standardization criterion, corresponds to the question "Do design elements (drawings), such as objects and actions, have the same meaning or effect in different situations?".

It was observed that 87.5% of the evaluators marked Severity 1 and 12.5% Severity 3.

The observation made by the evaluator in relation to the colors is of great importance to allow a greater harmonization of the environment, playing with the colors leaving a more pleasant and interactive environment, to the point of generating autonomy for the player. Regarding the first comment, an error may have occurred when the evaluator accessed the platform, which could be a browser error. Typically, design problems identified early are cheaper and easier to correct than those identified in the long term (BERTINI et al., 2006).

Source: Own elaboration, 2021.

Graph 5. Distribution of responses to the C5-Errors criterion, in the context of usability severity of the Gamified Learning Platform for Health Education

Graph 5, portrayed by the Errors Criterion, corresponds to the question "Would users make mistakes that they would not make in better interfaces?".

Making it possible to observe that 50.0% of the evaluators opted for Severity 0, 12.5% marked Severity 2 and Severity 3 and 25.0% opted for Severity 4. In this heuristic, color was once again scored as a problem found, in addition, of course, to problems with the programming code that will be corrected in a timely manner. According to Bertini et al. (2006) the set of heuristics elaborated by Jacob Nielsen is used as a way to prevent usability errors and satisfy interface quality requirements in several application domains.

Therefore, it is expected that such heuristics will also be used as a basis for evaluating platform interfaces.

Visibility criterion

Severity	Relative frequency (%)
Severity 04	0,0
Severity 03	0,0
Severity 02	25,0 Excess of pages
Severity 01	25,0
Severity 0	50,0

Source: Own elaboration, 2021.

Graph 6. Distribution of responses for criterion C6-Visibility criterion, in the context of usability severity of the Gamified Learning Platform for Health Education

Graph 6, characterized by the Visibility Criterion, represents the question: "Are the project elements, such as objects, actions and options, visible? Is the user forced to remember information from one part of the system to another?".

It made it possible to demonstrate that 50.0% of the evaluators opted for Severity 0, 25.0% marked Severity 1 and 2.

Based on the results obtained from the analyses, the platform must undergo a reformulation, considering in particular the evaluation carried out by the evaluators who consider severity 2. Reducing the number of pages can generate greater user motivation and make the platform more intuitive, that is, the user does not need to retrieve information from one part of a dialog to another, making navigability more pleasant and autonomous.

Methods criterion

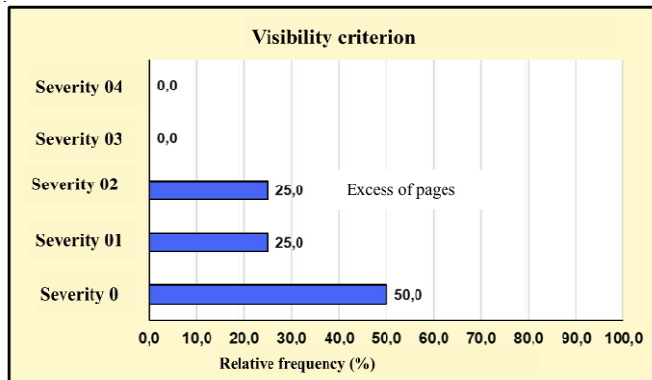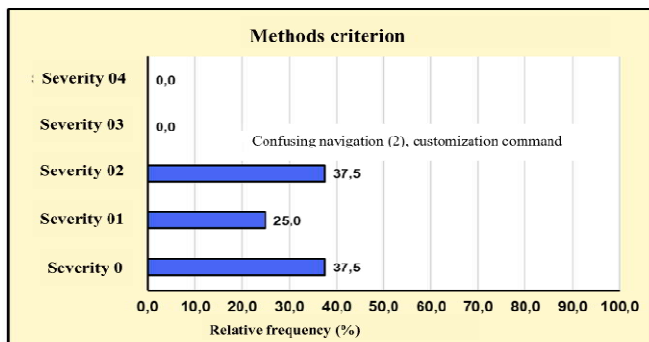| Severity	Relative frequency (%)
Severity 04	0,0
Severity 03	0,0 Confusing navigation (2), customization command
Severity 02	37,5
Severity 01	25,0
Severity 0	37,5

Source: Own elaboration, 2021.

Graph 7. Distribution of responses for criterion C7-Methods criterion, in the context of usability severity of the Gamified Learning Platform for Health Education
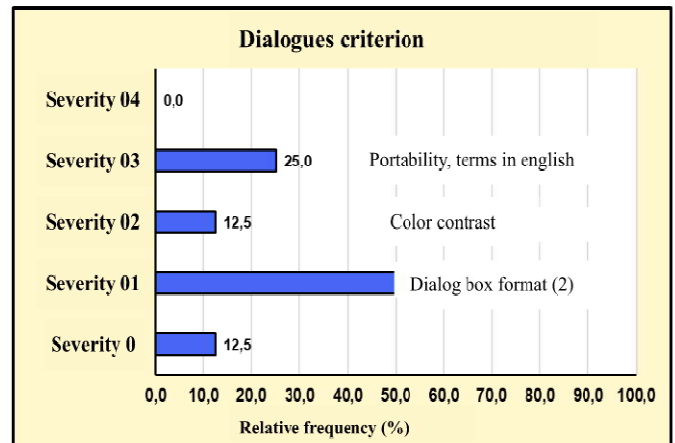
In graph 7 represented by the Criterion Methods, it defines the question: "Are the task methods efficient? Can users modify frequent actions or shortcuts?"

It was observed that 37.5% of respondents marked Severity 0 and Severity 2, while 25% opted for Severity 1.

A dashboard is an information management tool that helps monitor and display key performance indicators (KPIs), metrics and data that indicate continuous process improvement.

This observation is of great value, as it will improve the generation of reports by the tutor user to act and intervene in the student user. In this heuristic, the intuitive reason and the reduction of the number of pages were taken into account, today the platform can count on a page in the administrative area that allows the visualization of the class and

its progress in the game, as well as the visualization of a single student and its progress in the subjects studied, as well as the student himself can follow his development in the different segments of the game.

Dialogues criterion

Severity	Relative frequency (%)
Severity 04	0,0
Severity 03	25,0 Portability, terms in english
Severity 02	12,5 Color contrast
Severity 01	Dialog box format (2)
Severity 0	12,5

Source: Own elaboration, 2021.

Graph 8. Distribution of responses for the C8-Dialogues criterion, in the context of usability severity of the Gamified Learning Platform for Health Education
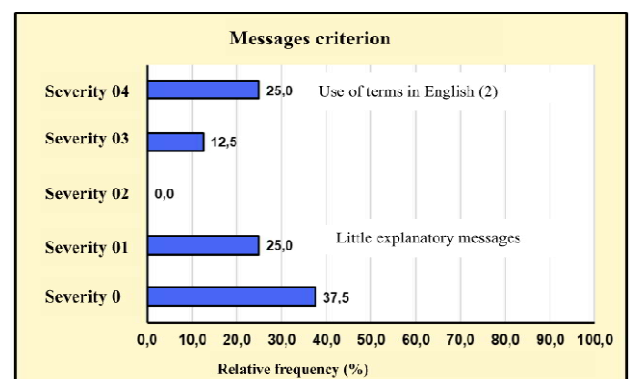
Graph 8, illustrated by the Dialogues Criterion, corresponds to the question: "Do the dialogues contain irrelevant or rarely used information?".

This allowed us to show that 12.5% of respondents chose Severity 0 and 2, 50% Severity 1 and 25% Severity 3.

In this heuristic, we can analyze a flaw in the programming code, as well as the use of a non-compatible browser, causing the interface to become "messy", but the use of the English language is usual on all platforms, considering it a mandatory language for the developer of programs and platforms that are easy and intuitive to use, we can thus bring the translated terms to the platform, thus facilitating the user's understanding.

Here we demonstrate the harmonization of colors, fonts and size, taking into account the tips to improve the dialog boxes and mainly the program coding problem was pointed out, so that errors and confusion do not occur on the page.

Color is related to the different wavelengths of the electromagnetic spectrum and, therefore, is perceived by people as a sensation that allows them to differentiate objects in space with greater precision. Thus, the perception of color also becomes one of the essential elements in understanding an environment and its components (NUNES, 2012).

Messages criterion

| Severity	Relative frequency (%)
Severity 04	25,0 Use of terms in English (2)
Severity 03	12,5
Severity 02	0,0
Severity 01	25,0 Little explanatory messages
Severity 0	37,5

Source: Own elaboration, 2021.

Graph 9. Distribution of responses for criterion C9-Messages criterion, in the context of Usability Severity Gamified Learning Platform for Health Teaching

The question represented by graph 9 corresponding to Criterion Messages was: "Are the error messages expressed in full language (without codes)? Do they describe the problem exactly and suggest a solution?

It showed that 37.5% of the participants chose the degree of severity 0, 25.0% chose Severity 1 and 4 and only 12.5% Severity 3.

This heuristic is equivalent in the evaluation criterion to the heuristic already mentioned above, seeking a better understanding of the platform for lay people who do not know the English language, thus seeking to concentrate the information on a single page, being more explanatory and without the use of words in English.
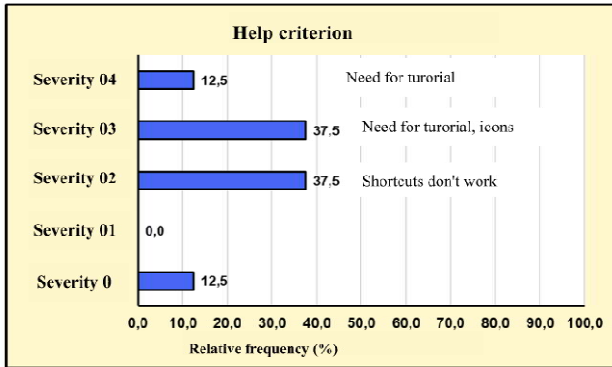
Source: Own elaboration, 2021.

Graph 10. Distribution of responses to the C10-Help criterion, in the context of Usability Severity Gamified Learning Platform for Health Education

Graph 10, reproduced by Criterion Help, corresponds to the question: "Is appropriate help provided? Is this information easy to find and focused on the user's task?

Of the participants approached, 12.5% chose the degree of severity 0, 37.5% opted for Severity 2 and 3 and 12% for Severity 4.

The analysis of this heuristic is quite curious, because in this context users should fully experience the platform and thus attach content to be read and create a tutorial to help the student when needed. We observed that in this criterion the judges did not use the platform in full, but only evaluated whether or not there was a tutorial. However, we know that the platform allows attaching these files and tutorials which were included in the observed prototyping. In this heuristic, the suggestions of the judges were respected, creating a page where a tutorial on using the platform can be included and for the student to follow in each segment of the screen, as well as creating shortcuts where the user can optimize the time during use the platform and the game.

Table 1. Summary of the usability of the Gamified Learning Platform for Health Education

Criteria	Severity (%)	Effective ness (%)	Satisfaction (%)	Usability (%)
Platform usability summary				
C1 - Progress	37.5	59.4	62.5	61.5
C2 - Language	0.0	90.6	100.0	96.9
C3 - Freedom	12.5	72.9	87.5	82.6
C4 - Standardization	25.0	68.8	75.0	72.9
C5 - Errors	25.0	60.2	75.0	70.1
C6 - Visibility	12.5	81.3	87.5	85.4
C7 - Methods	25.0	75.0	75.0	75.0
C8 - Dialogues	25.0	66.7	75.0	72.2
C9 - Messages	25.0	60.2	75.0	70.1
C10 - Help	62.5	40.6	37.5	38.5
Summary				
Average	25.0	67.6	75.0	72.5
Standard deviation	16.7	13.8	16.7	15.5
Median	25.0	67.7	75.0	72.6
p-valor*	0.1352	0.8829	0.1352	0.4243

Source: Own elaboration, 2021.

Quantitative methods to evaluate usability based on severity, effectiveness, satisfaction, in relation to 10 heuristic characteristics of the application, were applied as indicated in the table below. Among the 10 evaluation criteria, Language, in terms of usability, obtained a positive evaluation of 96.9% and a maximum score of 100% in the evaluation in terms of Satisfaction. On the other hand, the Help criterion was the worst evaluated with only 37.5% of satisfaction. Usability is a component of the ISO 9241 Standard defined as:"The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." The term designates the degree of ease with which the user accomplishes his objectives, without the aid of a human helper, that is, how easy it is to use something; mechanical, electronic or digital" (ISO 9241-11, 1998). Obtaining a good score to evaluate usability allows the product to achieve good engagement/or results, promote adherence and consequently increase user loyalty.

Evaluation of usability in obtaining the four types of Nielsen metrics

Severity Assessment (SEV) of the Gamified Learning Platform for Health Education – PAGES: Severity evaluation showed normal distribution (p = 0.1352, Shapiro-Wilk); therefore, it is represented by arithmetic mean central tendency = 25.0% (low severity). The criteria that presented the highest severity values were: Help (severity 62.5%) and Progress (37.5%). For Oliveira (2014) "knowing the risks in advance and classifying them within a certain easy-to-understand logic is a risk management challenge. In this context, measurement and monitoring play a fundamental role in controlling the most critical areas of the project. For each area of knowledge of the project, there are procedures that can support the decision making of the leaders involved in the project. With this, from the moment that this information translates the overview of the points of greater severity of the project and that these risks are controlled, the project has a great chance of success".

Effectiveness Assessment (EFC) Gamified Learning Platform for Health Education – PAGES: The Efficacy assessment showed normal distribution (p = 0.8829, Shapiro-Wilk), therefore, it is represented by the arithmetic mean central tendency = 67.6% (from fair to good efficacy). This level (from fair to good) of effectiveness is indicated by the evaluators, mainly in the items Progress (59.4%), Standardization (68.8%), Errors (60.2%), Dialogs (66.78%) and Messages (60.2%). The Help criterion (40.6%) was the one that obtained the worst evaluation. And the criteria Language (90.6%), Visibility (81.3%) and Methods (75%) were the best evaluated. The effectiveness of an application shows the quality of what you want to achieve from a previously planned objective.

Satisfaction Assessment (SAT) Gamified Learning Platform for Health Education – PAGES: The evaluation of Satisfaction presented normal distribution (p = 0.1352, Shapiro-Wilk); therefore, it is represented by the arithmetic mean central tendency = 75.0% (good satisfaction). This level of satisfaction is indicated by the evaluators, mainly in the areas of Language (100%), Freedom (87.5%) and Visibility (87.5%). The level of satisfaction of the platform was considered good, indicating a user satisfaction which shows the opinion of this and a good performance of the platform being applicable in the job market and especially with teachers. The lack of a consistent definition of satisfaction and of a theory to guide its measurement is reflected in the diversity of methodological approaches adopted by the studies. There are important considerations in the operationalization of the concept of satisfaction, that is, in the definition of its components or dimensions and in the way of measuring it (Ware et al., 1975; Williams &Calnan, 1991).

Usability Assessment (USB) Gamified Learning Platform for Health Education – PAGES: The Usability evaluation showed a normal distribution (p = 0.4243, Shapiro-Wilk), therefore, it is represented by the central tendency of the mean = 72.5% (good usability). This level of usability is indicated by the evaluators, mainly in terms of Language (96.9%), Freedom (82.6%) and Visibility (85.4%).

However, the Help criterion showed low levels of usability (38.5%). The use of educational digital technology can be an efficient strategy in the teaching/learning process, but the development of this tool requires, in addition to rich and dynamic pedagogical content, a well-planned interface that is intuitive to the user (RODRIGUES, 2013). Therefore, it is necessary to carry out usability tests, of which ISO/IEC25062 of April 27, 2011, instructs specialists in carrying out these tests. According to Carvalho LR (2016) after a systematic review study showed that one of the most used usability evaluation methods is the heuristic evaluation (MARTINS, 2013). Among them, we can mention Nielsen's heuristics (1993), a simple and low-cost method, capable of finding several usability problems with a reduced number of evaluators, in a short period, which have high reliability in the results, in addition to enable suggestions to be provided for improving the interface.

General Considerations: The usability of the platform is 72.5%. This assessment is carried out based on Severity, Effectiveness and Satisfaction criteria. Severity (25.0%) can be classified as low, Effectiveness is regular (67.6%) and Satisfaction is good (75.0%). The strengths of the platform are Satisfaction with regard to the handling of Errors and Messages and Satisfaction with Visibility and Methods. On the other hand, the points that most need to be improved refer to the severity of the language, especially with regard to the use of terms in English and the excessive number of pages. The main suggestions of the evaluators were the use of graphs (sectors or tables) to indicate the progress on the platform, improving the positioning of the buttons, as on the left side they cause discomfort to the user, visualization of information such as: time of use on the site, awards, competition with other users and a great way of motivation, hall of fame for highlighting etc.; and indicate the progress of downloads.

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