# User eXperience Heuristics for National Park Websites

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**Abstract.** A national park website extends (in certain way) a physical national park. It does not have a physical location so its elements and information can be appreciated from anywhere in the world. Usability is a well-known concept, for decades. User eXperience (UX) is a broader concept that encompasses usability. The usability and UX evaluation are important tasks to perform when developing any kind of websites. In this regard it is important to evaluate whether a national park website is intuitive, easy to use, and allows users to complete their objectives. National park websites have their own features that differentiate them from other systems, so it is necessary to use a set of appropriate heuristics for these types of websites. The article presents a set of 14 heuristics to evaluate the UX of national park websites. The heuristics were developed using the methodology proposed by Quiñones et al. [2]. To validate and refine the UX heuristics for national park websites, we performed two iterations. In the first iteration the heuristics were validated through heuristic evaluation and expert judgment (survey), while in the second iteration the heuristics were validated through user tests (co-discovery and focus group). Based on validation results, we concluded that the proposed set of heuristics are effective.

**Keywords:** National park websites · User eXperience · Usability · Heuristics

## 1 Introduction

A national park website extends, in certain way, a physical national park. It does not have a physical location so its elements and information can be appreciated from anywhere in the world. After reviewing the literature, we identified that there is no formal definition for national park websites. Based on the review that we performed, we can define a national park website as a collection of web pages that deliver information of a physical national park through multimedia resources. Depending on the type of national parks, their websites offer users information on flora and fauna, images, common activities in the area, recommendations, maps, among others.

Usability is a well-known concept, for decades. User eXperience (UX) is a broader concept that encompasses usability. The usability and UX evaluation are important tasks to perform when developing any kind of websites. It is necessary to assess whether the websites meet the needs of the users and whether it fits properly in the physical, social and organizational context in which it will be used. In this regard it is important to evaluate whether a national park website is intuitive, easy to use, and allows users to complete their objectives. UX should be explicitly considered, since the information, the content, the, presentation and the structure of the website should generate a user-friendly experience, motivating people to learn about the characteristics of the physical national park.

In general terms, usability/UX evaluations methods can be classified into: (1) inspections, where expert evaluators inspect a product to detect potential usability/UX problems; and (2) tests, where real or representative users interact and complete tasks using a product, system, or service. Heuristic evaluation is probably the most common usability inspection method. Expert evaluators detect potential usability problems, based on heuristics [1]. Nielsen's heuristics allow evaluators to inspect a website in a general way, without focusing on specific domain features. However, the above makes it difficult to detect usability domain-specific problems.

National park websites have their own features that differentiate them from other products, so it is necessary to use a set of appropriate heuristics for these types of websites. Moreover, we think that heuristics can help detecting problems related to UX, and not limited to usability aspects [2, 3].

This article presents a set of 14 heuristics to evaluate the UX of national park websites. The heuristics were developed using the methodology proposed by Quiñones et al. [2]. The methodology proposes 8 stages to develop and validate a new set of heuristics. To validate and refine the UX heuristics for national park websites, we performed two iterations. In the first iteration the heuristics were validated through heuristic evaluation and expert judgment (survey), while in the second iteration the heuristics were validated through user tests (co-discovery and focus group). Based on validation results, we concluded that the proposed set of heuristics are effective.

The article is organized as follows: Sect. 2 presents the theoretical background; Sect. 3 shows the methodology used to develop the set of heuristics for national park websites; Sect. 4 presents the final set of User eXperience heuristics for National Park Websites; Sect. 5 details the heuristics' validation; and finally Sect. 6 presents the conclusions and future works.

## 2 Theoretical Background

### 2.1 Usability

According to ISO 9241-210 [4], usability is defined as "the extent to which a product, system, or service can be used by specific users to achieve specific goals with effectiveness, efficiency and satisfaction in a specific context of use". This definition focuses on the concept of quality and the use of a certain product, system or service. Usability focuses on how the user achieves their specified goals, the resources used to achieve the

goals and the degree to which the user needs are met. Jakob Nielsen indicates that the nature of usability is multidimensional [5]. Nielsen states that usability has the following 5 attributes [5]:

1. Learnability: The ease of learning the operation and behavior of the system for inexperienced users.
2. Efficiency: The level of productivity attainable once the expert user has already learned the system. The greater the usability of a system, the faster the user is using it, and the work is done faster.
3. Memorability: The ease of remembering the functionality of the system, so that the occasional user when returning to the system after an inactive period, does not have the need to learn how to use it again.
4. Errors: The system must have a low error rate, that is, users make few mistakes while using the system, and in case they make them help them recover easily.
5. Satisfaction: This is the most subjective attribute. It is the extent to which the user finds the system pleasant to use.

For the development of heuristics for national park websites, all the Nielsen's usability attributes were considered.

## 2.2   User eXperience

Different authors have defined the User eXperience (UX) from different perspectives, so there is no single term that defines it. A user-centered approach would involve not only analyzing the factors that influence the purchase or choice of a product, but also analyzing how customers use the product and the experience resulting from its use [6].

The ISO 9241-210 standard [4] defines the UX as "the perceptions and responses of the person resulting from the use and/or anticipated use of a product, system or service". On the other hand, Nielsen and Norman consider the UX as "an integrating concept of all aspects of the interaction between the end user, the company, its services and products" [6].

Today the UX is being studied, mainly with a multidisciplinary approach. The UX is composed of different aspects or factors. Peter Morville proposes a model with 7 factors that explains the UX [7]:

1. Useful: the content must be original and satisfy a need.
2. Usable: The product or system must be easy to use.
3. Desirable: Image, identity, brand and other design elements are used to evoke emotion and gratitude.
4. Valuable: The product or system must add value to the interested user.
5. Findable: The product or system must have a good navigation and its content must be easily found, so that the user always finds what he/she needs.
6. Accessible: The content must be accessible to various types of people, including those with disabilities.
7. Credible: Users must trust and believe what is presented to them.

For the development of heuristics for national park websites, 6 of the 7 factors mentioned above were considered: useful, valuable, credible, usable, desirable, and

findable. The accessible factor was not considered since there are already clear rules and automatic tools that allow to assess it (such as the rules proposed by the World Wide Web Consortium community) [8].

## 2.3 Heuristic Evaluation

The heuristic evaluation is an expert inspection method that identifies the usability/UX problems that users may encounter when using a product or an interface [9]. The heuristic evaluation is one of the most used methods; it is low cost and allows finding fast usability errors on a website, application or any system that interacts with the user. The expert evaluators (between 3 and 5) evaluate the interface by detecting usability/UX using heuristics.

The product or system is evaluated based on usability heuristics, which can be generic (as Nielsen's Heuristics [10]) or specific (to evaluate usability, UX and specific application domains). According to the set of heuristics chosen, the evaluators are responsible for detecting potential usability/UX problems that a user might encounter when interacting with the system interface being evaluated.

Initially, evaluators work independently to find and document the problems detected. The previous experience that each evaluator has with the system can influence the number of problems encountered. Subsequently a work in group is carried out where the evaluators gather in a single list the problems identified. Then, an individual work continues in which each evaluator independently qualifies the severity, frequency and criticality of each of the problems in the common list. Finally, they return to work in group to consolidate and interpret the results. A ranking of usability/UX problems is established that allows determining which problems are more serious, and therefore more urgent in being corrected.

## 2.4 National Park Websites

The National Forestry Corporation (CONAF, as abbreviated in Spanish) in charge of national parks in Chile defines a physical national park as a generally large area, where there are several unique or representative environments of the country's natural biological diversity, not significantly altered by human action, capable of self-perpetuation and in which species of flora and fauna or geological formations are of special educational, scientific or recreational interest [11].

Other authors define a national park as terrestrial, marine areas, or a combination of both, in a natural or semi-natural state, with slight or no human population, designated to protect the ecological integrity of one or more ecosystems of international, regional or national importance and managed primarily for ecosystem conservation purposes [12].

In the United States, the concept of a national park is understood as a protected area through a law of the United States Congress, managed by the National Park Service. This concept includes all areas designated national parks and most national monuments, as well as other types of protected areas in the country. Only 58 elements of the 395 units of the US National Park System (March 2009) are properly national parks [13].

Although a formal definition of a national park website has not been found, from the literature review we infer that it is a concept that complements the physical national park; therefore, it does not have a location and its elements and information can be appreciated anywhere in the world. In this sense, for this research a national park website has been defined as a collection of web pages that provide information on the physical national park through multimedia resources. In these websites it is possible to find information about flora and fauna, images, common activities of the area, recommendations, maps, among others.

The area protected by a national park usually has a scientific interest for: (1) the presence of native and landscape species; and (2) the beauty of its landscapes. In addition to their importance for the protection of ecosystems, they become important tourist destinations [14]. Through websites, each park seeks to provide information on its main attractions, as well as characteristics of its climate, rates, services offered and activities to be carried out. The images play a critical role in this because they reflect the beauty of the place and encourage visitors to know them.

According to the purpose of the site we have classified a national park website as informative, educational, nature preservation and/or commercial:

- Informative: It allows the user to obtain information about the characteristics and relevant data about a national park.
- Educational: Teach users about characteristics, dangers, historical places, etc. from the physical national park.
- Preservation and conservation of nature: Proposes strategies to protect the physical park from hazards such as destruction, degradation, theft and pollution of the environment.
- Commercial: They seek to recommend and promote some lodgings and places to eat that are associated with the park.

Based on the literature review, we proposed the following features that define a national park website:

1. Updated information: Information about the latest news in the physical park is published in order to keep users updated.
2. Virtual experience: Allows to visit a place without the user moving, offering the user a virtual experience through different resources.
3. Multimedia resources: The way of presenting information is varied, usually through text, images, audios and videos.
4. Permissions, restrictions and recommendations: The website should present clearly the activities allowed within the physical park, recommendations and restrictions before and during a visit; either about the state of the road, the dangers or the accessibility of the park.
5. Information credibility: The information present in the various sections of the national park website should be reliable and credible for the user.
6. Asynchronous interaction: It should allow users to communicate over the Internet asynchronously, that is, temporarily independently, such as forums and blogs.
7. Useful and interesting content: The information and content presented by the website must be useful and fulfill purposes that arouse interest in users.

8. Multi-language content: The website must offer several language options in all its sections.

   For the development of heuristics for national park websites, all the previous features were considered.

## 3    Methodology

To develop the set of UX heuristics for national park websites we applied the methodology proposed by Quiñones et al. [2, 3]. The methodology has 8 stages that can be applied iteratively to develop and validate a new set of heuristics. Table 1 shows the 8 methodology stages.

**Table 1.** Stages of the methodology to develop usability/UX heuristics proposed by Quiñones et al. [2, 3].

| Stage | Definition |
|---|---|
| Step 1: Exploratory stage | Perform a literature review |
| Step 2: Experimental stage | Analyze data that are obtained in different experiments to collect additional information that has not been identified in the previous stage |
| Step 3: Descriptive stage | Select and prioritize the most important topics of all information that was collected in the previous stages |
| Step 4: Correlational stage | Match the features of the specific application domain with the usability/UX attributes and existing heuristics (and/or other relevant elements) |
| Step 5: Selection stage | Keep, adapt and/or discard the existing sets of usability/UX heuristics that were selected in Step 3 (and/or other relevant elements) |
| Step 6: Specification stage | Formally specify the new set of usability/UX heuristics |
| Step 7: Validation stage | Validate the set of heuristics through several experiments in terms of their effectiveness and efficiency in evaluating the specific application |
| Step 8: Refinement stage | Refine and improve the new set of heuristics based on the feedback that was obtained in Step 7 |

### 3.1    The National Park Websites Heuristics Development Process

Generic Nielsen's heuristics [10] are useful for evaluating systems, products or services, but they do not cover all the specific features of a national park website. Given the above, we developed a new set of heuristics using the methodology proposed by Quiñones et al. [2]. To develop the heuristics, we perform two iterations (see Fig. 1). Table 2 summarizes the stages and activities performed in the first and second iteration.
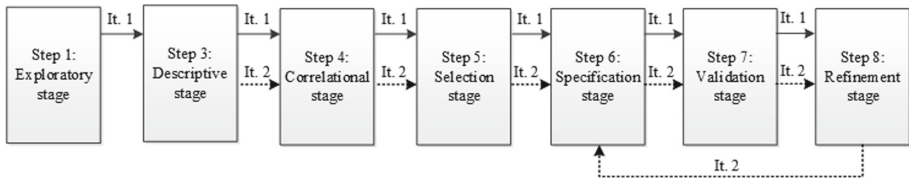
**Fig. 1.** Iterations performed to develop the set of UX heuristics for national park websites.

**Table 2.** Stages and activities performed in the two iterations to develop UX heuristics for national park websites.

| Stage | Activities performed in Iteration 1 | Activities performed in Iteration 2 |
|---|---|---|
| Step 1: Exploratory stage | − Problem statement<br>− Literature review of key concepts, such as: usability, user experience, national park websites, features | Not performed |
| Step 2: Experimental stage | − Not performed due to available time | Not performed |
| Step 3: Descriptive stage | − Selection of set of heuristics to use (Nielsen's heuristics and virtual museums heuristics)<br>− Selection of usability and UX attributes to use (5 and 6 attributes respectively)<br>− Selection of specific features of national park websites to use | − Identification of missing specific feature of national park websites<br>− Selection of specific features of national park websites to use (8 features) |
| Step 4: Correlational stage | − Association of usability attributes and UX factors to the specific features of national park websites identified | − Association of usability attributes and UX factors to the new specific feature |
| Step 5: Selection stage | − Selection of the heuristics to maintain, adapt, eliminate and create using the set of heuristics for virtual museums [15]<br>− Maintain and/or adapt: 12 heuristics<br>− Eliminate: 3 heuristics<br>− Create: 6 new heuristics | − Modification of 13 heuristics selected from the first proposal<br>− Elimination of 5 heuristics of the first proposal<br>− Creation of 1 new heuristic |
| Step 6: Specification stage | − Specification of 18 UX heuristics for national park websites (first proposal) | − Specification of 14 UX heuristics for national park websites (second and final proposal) |
| Step 7: Validation stage | − Validation of heuristics through heuristic evaluation and expert judgment (survey) | − Validation of heuristics through user tests (co-discovery and focus group) |
| Step 8: Refinement stage | − Detection and documentation of improvements to be made (refine 7 heuristics)<br>− Planning of the second iteration (we decided to iterate from stage 3) | − Detection and documentation of improvements to be made (refine 4 heuristics)<br>− Improvement of the writing of the heuristics based on the results obtained in the validation stage |

To develop the UX heuristics for national park websites, the set of specific heuristics for virtual museums (HMV), proposed by Aguirre [15] was used. We decided not to use Nielsen's heuristics [10] as a basis because we consider them too generic; while heuristics for virtual museums have specific elements similar to national park websites.

In the first iteration, we review the literature and select the usability attributes, UX factors and specific application features (see Table 2). To specify the heuristics, we used the template proposed by the methodology of Quiñones et al. [2] including 13 elements: ID, priority, name, definition, explanation, application feature (national park websites), examples, benefits, problems, checklist, usability attributes, UX factors, and related heuristics. In this iteration we proposed a set of 18 heuristics. As a result of the validations performed in the first iteration, we detected redundant elements in the definition, description and elements of the checklist.

We decided to iterate to refine the proposed set. In the second iteration we detected that several heuristics shared elements in common, so we decided to review the specification of the heuristics and join those that were similar. The second and final version of the proposal ended with 14 heuristics to evaluate national park websites.

More details about the stages and activities performed to develop, validate and refine the heuristics can be find in [2] and [3].

## 4    User eXperience Heuristics for National Park Websites

As mentioned above, we proposed a set of 14 heuristics to evaluate the UX on national park websites. Table 3 shows the final set of heuristics including their ID, name and definition. More details about the set proposed can be find in [2] and [3].

**Table 3.**    Set of UX heuristics for national park websites.

| ID | Name | Definition |
|----|------|------------|
| NPH1 | Visibility of system | The national park website should keep the user informed about any process and change of status, within a reasonable time |
| NPH2 | Multimedia resources | The national park website should be attractive to the user by providing a virtual experience when browsing through different multimedia resources, such as images, videos or audios |
| NPH3 | Information of interest | The national park website should provide visible and useful information for the user, such as allowed activities, recommendations, and restrictions |
| NPH4 | Match between system and the real world | The national park website should offer several language options and be familiar to the user, using words, phrases and concepts that are known to him/her |
| NPH5 | User control and freedom | The national park website should allow the user to navigate freely and should provide options to do and undo some action |

**Table 3.** (*continued*)

| ID | Name | Definition |
|---|---|---|
| NPH6 | Consistency and standards | The national park website should be consistent in all its pages, following a coherent structure |
| NPH7 | Information credibility | The information presented in the sections of the national park website should generate user confidence |
| NPH8 | Error prevention | The national park website should be able to prevent or warn the occurrence of problems that may cause errors |
| NPH9 | Minimize the user's memory load | The user should always have all the information available and not be forced to use his/her memory to follow the thread of the interaction |
| NPH10 | Flexibility and efficiency of use | The national park website should be designed so that novice and expert users are able to achieve their objectives when browsing the website |
| NPH11 | Aesthetic and minimalist design | The national park website should show relevant elements, with a design that is pleasing to the eye and that has a logical structure without redundant elements |
| NPH12 | Help the user recover from errors | Whenever an error occurs, clear and simple messages should be shown to the user with the origin of the problem and suggestions to solve it |
| NPH13 | Help and documentation | The national park website should offer help and documentation that is geared towards the specific tasks that the user performs |
| NPH14 | Asynchronous interaction | Users should be allowed to communicate over the Internet asynchronously, that is, temporarily independently, such as forums and blogs |

## 5 Heuristics Validation

The methodology proposed several methods to validate a new set of heuristics [2]. The experiments performed make it possible to check the effectiveness and efficiency of the new set of heuristics when evaluating the UX of national park websites.

To validate the set of heuristics proposed, we performed two iterations. In the first iteration we validated the heuristics through heuristic evaluation and expert judgment. In the second iteration we validated the heuristics through user test, specifically, co-discovery and focus group.

In the heuristic evaluation, we checked the new set of UX heuristics for national park websites (NPH) against heuristics for virtual museums [15] (VMH). The Yellowstone National Park Website (https://www.nps.gov/yell/index.htm) was evaluated by evaluators with similar experience performing heuristic evaluations. The "control group" (3 evaluators) used the VMH to identify usability/UX problems, and the "experimental group" (3 evaluators) used the new set of heuristics proposed, NPH. With the results, we evaluated the effectiveness of the heuristics in terms of the 5 criteria [2,

3]: (1) number of correct and incorrect associations of problems to heuristics; (2) number of usability/UX problems that were identified; (3) number of specific usability/UX problems that were identified; (4) number of identified usability/UX problems that qualify as more severe; and (5) number of identified usability/UX problems that qualify as more critical. The new set of heuristics performs well, and it is an effective instrument when better results than the control heuristics (VMH) are obtained in terms of the 5 criteria.

NPH obtained better results than VMH in the criteria (1) (NPH has a higher percentage of correct associations and a lower percentage of incorrect associations); (3) (NPH finds more specific usability/UX problems than VMH); (4) (NPH finds more usability/UX problems qualify as more severe than VMH); and (5) (NPH finds more usability/UX problems qualify as more critical than VMH). For criterion (2), NPH did not identify the highest amount of problems, so it was necessary to perform additional experiments to review and improve NPH (we performed a second iteration). The detailed results obtained in the heuristic evaluation can be reviewed in [3].

In addition, in the first iteration we applied a survey to 3 experts performing heuristic evaluations. We applied a questionnaire that assesses evaluators' perceptions of PNH, concerning 4 dimensions (D1 – Utility, D2 – Clarity, D3 – Ease of use, D4 – Necessity of an additional checklist) and 3 questions (Q1 – Easiness, Q2 – Intention of use, Q3 – Completeness) [3].

Based on the results, we refined several heuristics. We eliminated 4 heuristics as there were similarities to others. In addition, the experts gave some comments regarding heuristics. In general, experts commented that heuristics covered the specific features of national park websites. One of the evaluators stated that there were similarities between the heuristics "Content visualization" and "Aesthetic and minimalist design"; and between the heuristics "Virtual Experience" and "Multimedia Resources", so we joined some heuristics into one and we refined their specifications.

In the second iteration, we validated the heuristics through Co-discovery and Focus group. Co-discovery (also named "constructive interaction") is a user test method where users work collaboratively to complete tasks when interacting with a system. Users can help each other through difficulties, learn from each other and solve problems together to complete different tasks [16]. Focus group is a technique where a group of users participate in a discussion, in this case, to discuss about their perception using a system in order to identify usability/UX problems.

The Co-discovery test was designed based on the usability/UX problems identified by the control group that were not detected by the experimental group in the heuristic evaluation performed in the first iteration (Yellowstone National Park Website). To design the tasks, those usability/UX problems with a severity greater than 2 and/or a criticality greater than 4 were selected (these problems were: "difficulty finding information due to the English language", "high content of static and theoretical information", "difficulty to use the search engine due to confusing options", "little representation of the calendar icon", and "small size of the images").

In the experiment participated 16 students (8 couples) between 20 and 26 years old of the Multilingual Tourism Administration program, from the University of Playa Ancha, Chile. As a result, most users were satisfied with the information found on the website and would visit it again at another time. In addition, in general the participants

maintained a neutral stance in view of the difficulty of the work done, but the results obtained were mostly effective.

The same users who participated in the Co-discovery test participated in the Focus group. The participants were divided into two groups (one group of 8 people and another group of 6 people, since 2 people could not participate). The objective of the focus group was to collect qualitative information about the perception of users regarding the use of the Yellowstone National Park Website, and then verify if the problems mentioned were possible to evaluate and identify with the set of UX heuristics proposed for evaluating national park websites.

Both groups commented that it would be essential for a national park website to have audios, videos, images, maps and recommendations that complement each other to improve the virtual user experience. The perceptions mentioned indicate that users consider the presence of multimedia resources important, feature covered by the heuristic "Multimedia Resources" (NPH2). Both groups had a negative perception about the amount of information the national park website presented on a single page, which caused them disgust. This problem is covered by the heuristic "Aesthetic and minimalist design" (NPH11).

In addition, the users highlighted positively the presence of content of interest, such as the main information of the park, the map of its extension, recommendations, places to visit and rates. Although, they pointed out that there should be a section that notifies or shows the closest events to make them easier to find. The above is covered by the heuristic "Information of interest" (NPH3). On the other hand, users highlighted that the contents were updated and came from a reliable source, which is related to the heuristic "Information credibility" (NPH7).

Both groups stated that one aspect that the national park website does not consider and that they find highly relevant to deal with is the variety of languages, which is directly related to the heuristic "Match between system and the real world" (HPN4).

Finally, one group positively highlighted the search engine that owns the website, which they considered easy to use and helpful to find what they need, an aspect that is covered by the heuristic "Flexibility and efficiency of use" (NPH10). In addition, they stated that it would be very useful to have a section with the comments and opinions of other users who have visited the park, both virtual and physical, as it gives them greater information security. The above is covered by the heuristic "Asynchronous Interaction" (NPH14). We concluded that all perceptions, opinions and problems discussed by the two groups were evaluated by the set of heuristics proposed.

## 6    Conclusions

The User eXperience (UX) is an important element to consider when designing products, systems and services. In this sense, the UX evaluation is critical to detect those problems that generate frustration, to improve the interaction and the overall user experience.

National park websites are a type of website aimed at delivering information about the physical national park. After reviewing the literature, we did not find a definition about these types of websites, so we proposed a definition based on the description of a physical national park, adding relevant elements related to websites.

The website of a national park does not attempt to replace physical visits, but is aimed at those users who cannot access in person. The website allows them to interact and learn about national parks.

We proposed a set of 14 heuristics to evaluate the user experience on national park websites. We performed two iterations to validate and refine the proposed set. The results obtained allow us to verify that the heuristics are effective, since they allow to detect specific usability/UX problems related to national park websites.

As future work we intent to further validate the heuristics through heuristic evaluations in other case studies, and user tests considering other user profiles.

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