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UNDERSTANDING SEMIOTIC ISSUES IN USABILITY EVALUATION OF CULTURAL HERITAGE WEBSITES: THE *DICE* CASE STUDY

Cultural Heritage applications are information intensive websites addressing several targets. For this reason they have to pay special attention to their communication quality, in particular to their usability aspects. This paper presents both a proven methodology called MiLE+ used for the systematic evaluation of interactive applications and it illustrates the DICE (Distributed Infrastructure for Cultural hEritage) case study. In particular, we highlight the fundamental role of semiotic design as one of the most important dimensions for a usable application.

Keywords: usability evaluation, semiotics, cultural heritage websites, semiotic design, heuristic evaluation.

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1. Introduction and Motivation

In the last years, Cultural Heritage websites have been growing in term of complexity and the activity of assessing the quality degree of the applications is becoming an arduous task. Establishing the quality means to take into account the degree of satisfaction that the users have during the interaction with the web site. The most important "units of measurement" of satisfaction is the usability, as it is *the effectiveness, efficiency, and satisfaction with which specified users achieve specified goals in particular environments (ISO 9241 definition).* One of the fundamental design dimensions that affect the usability of an application is the semiotics. Indeed, the capability of an application to use symbols, icons, words, interactive widgets... familiar and easy to understand for the user, means to establish a fruitful dialogue between the user and the web site. In this paper we try to both highlight how it is possible to measure the usability of an application and to underline the fundamental role of semiotic design.

2. State of the art and related works

2.1. State of the art on usability evaluation

Usability has recently assumed a much greater importance in the internet economy than it had in the past (Nielsen 1999), since a web site is an "open product", accessible by anyone who navigates in the WWW. There are several techniques that can be used for evaluating the usability of an application. These techniques are divided into two main categories: *Usability Inspection Methods* and *Empirical Testing.* Usability Inspections methods (also called "Expert Review" methods) is the generic name for a set of methods based on having expert evaluators instead of final users inspect or examine usability-related aspects of a user interface (Nielsen et al. 1994). During a usability inspection an inspector (called also usability reviewer) judges the application but the results of his analysis strictly depends on the different usability criteria that have been used. Indeed, the comments or critiques on the application under inspection are derived on the inspector's skills and competences, on usability principles, or a set of previously-defined guidelines. The focus of usability inspection methods is set on usability problems or breakdowns of the user-interface which can be anticipated before involving final end-users. In general, the main goal of usability inspection methods is to detect usability problems in an existing user interface, and then

using these problems to formulate recommendations for fixing the problems and improving the usability of the design (Nielsen et al. 1994).

Empirical Testing mainly consist of user testing, in which usability properties are assessed by observing how the system is actually used by some representatives of real users (Whiteside & Holtzblatt 1988) (Dix et al. 1998). User-testing evaluation provides the of trustiest evaluation because it assesses usability through samples of real users. However, it has a number drawbacks, such as the difficulty to properly select correct user samples and to adequately train them to manage advanced functions of a website (Matera et al. 2002). Furthermore in a limited amount of time it is difficult to reproduce the actual usage situation. This condition is known as the "Hawthorne effect" (Roethlisberger & Dickson 1939): observed groups can be affected by observation alone. Failures in creating real-life situations may lead to "artificial" conclusions rather than realistic results (Lim, Benbasat & Todd 1996). Another drawback of User testing is that it is significant in terms of time, effort and cost. However, it is very useful for quick analysis of the look and feel of the interface as it is possible to verify users' "real-time" reactions.

Within these two categories (User Testing and Inspection Methods) the most current usability evaluation techniques for web applications are alternatively based on two main approaches: Heuristic-driven evaluation and task-driven (scenario-driven) evaluation.

In the *heuristic-driven* evaluation checklists and usability principles are used (Nielsen 1999). The main drawbacks related to this methodology refer both to the usability principles inspiring the reviewer that are very good for detecting problems but provide poor design suggestions for the re-design; on the other hand, heuristic is very effective for measuring usability qualities of the site but captures very hardly the evaluation of complex scenarios. *Task-driven* evaluation provides sets of tasks guiding the user testing, walkthrough and inspection techniques (Rosson et.al. 2002; Brinck et al. 2002). Normally, the evaluation based on tasks is used within a scenario, that is, the description of a concrete episode of use of the application, a "story about use" (Cato 2001; Carroll 2002). This methodology has some disadvantages, in particular Scenario-based approaches can easily detect the feasibility of a task, i.e. whether a task can be actually accomplished or not but thy do not identify what exactly caused the failure or the success of the task.

All the methodologies presented above have been created in order to work alone one from the others. It seems that for performing an accurate

usability inspection, some approaches must be mixed together in order to exploit the advantages and diminish the drawbacks of the single methodology. Moreover, these methods are lacking for the evaluation of semiotic issues of interactive applications.

2.2. State of the art on semiotic design

Recently, relevant branches of HCI (Human Computer Interaction) pointed out the semiotic issues involved in the interaction between the user and the machine. Within this heterogeneous and wide research field, main streams of research – such as Semiotic Engineering and Computer Semiotics - tried to interpret each man-machine interaction as a message or set of messages conveyed from the designer to the user through the application (Garcia 1995; De Souza 1993; Andersen 1990). The concept of *designer's deputy* has been introduced and deeply studied, that is, how HCI designers should represent their understanding of the application in such a way that the users of their products can see what they mean (De Sousa 2005).

In the last years more specific semiotic theories and models have been developed considering particular families of applications and particular kinds of interaction and communication paradigm. In the hypermedia sector, new semiotic studies are dealing with the process of interpretation of hyperlinks. From the field of Computational Engineering many researches focussed on the so called *Information Scient theory*, (Xerox's Palo Alto Research Center), devoted to the understanding of the dynamics staying behind the process of searching a large information space – a website, for example - by a user. From the field of Linguistics and Semiotics, researches focused on hyperlinks and their importance in the process of text's coherence building (Mazzali-Lurati 2003). Moreover, many linguistic studies aim also at observing how well known concepts and theories could be reinterpreted considering hyper-textual applications and their differences with traditional media (Bernstein 2000; Calvi 2000; Wirth 2002). Anders Fagerjord stresses with an interesting approach the difference between linear and non linear consultation of a document, proposing an interesting taxonomy for differentiating navigational links with respect to their dialogic purpose (Fagerjord 2001). Susana Pajares Tosca in the paper "A pragmatics of links" (Pajares 2000) applies Dan Sperber and Deirdre Wilson's relevance theory to the experience of a user while interprets a web link.

These researches aims at understanding and describing the user interpretation process of a link, since it is essential for letting the reader coherently understand contents. However, these theoretical approaches lack in defining a practical and ready-to-use conceptual tool supporting designers and evaluators in their activities. Current well-structured web usability evaluation methods and techniques consider semiotic aspects as generic criteria for evaluating the user satisfaction, often confusing and blending them with other usability problems (i.e. problems related to navigation, to content, or to layout design). Very few methods are giving the right importance of semiotic design and evaluation as a standing alone problematic and provide supporting tools for better solving it.

A last remark regards the boundaries of web semiotics as intended in the paper. Even if terms like "ontologies" and "semantics" are here frequently used, their meaning should be distinguished from the ones assumed in Semantic Web and Web Ontology sectors, where these terms are related to the representation of data on the World Wide Web through formal languages (e.g. XML, RDF) in a manner "understandable" by machines. In such studies, the term semantic refers to the aim to make this representation "meaningful" for a machine, at defining new formal languages and models able to represent information in order to be automatically managed by an artificial agent. Semantic web is not strictly related to HCI problematic, to usability issues or user's understanding of web signs. Therefore, the reader should keep in mind this difference and interpret the term "ontology" with respect to the overall purpose of the paper and the contexts in which it is being used.

3. MiLE+: an overview

MiLE+ (Milano-Lugano Evaluation method, developed in cooperation between Politecnico di Milano and University of Lugano) is the (r)evolution of MiLE method (Triacca et al. 2003, 2004). MiLE+ is one of the first methodologies that explore in depth the usability problems related to semiotic design. In chapter 4, we present the conceptual approach to semiotic analysis employed by MiLE+ and in chapter 5 we illustrate a case study for showing some semiotic issues identified using this method.

MiLE+ proposes two types of inspection activities, namely *Technical Inspection* and *User Experience Inspection*, and an empirical activity called *Scenario-based User Testing*. It is important to underline that in this paper we focus our attention in particular in the explanation of the inspection activities.

Before explaining the activities of MiLE+ it is important to underline that it employs general elements for performing its activities. These elements are *Scenarios*, Heuristics and Usability Evaluation Kit (U-KIT). Scenarios are "stories about use" (Cato 2001; Carroll 2002), describing a typical user, one or more goals, and elements of the context of use (place, time, circumstances of use, etc.). MiLE+ uses scenarios as the driver for usability evaluation, because their role is crucial for an effective usability evaluation. As said in the *Background and related works, heuristics* are usability guidelines/principles that allow the evaluation of an application. MiLE+ provides two sets of heuristics that should help the evaluation: Technical Heuristics and User Experience Indicators (UEIs). Technical Heuristics are a set of heuristics enabling to evaluate the design quality (in all its aspects) and to spot implementation breakdowns. Technical Heuristics are organized in design dimensions (e.g. content, navigation, graphics) and associate each design dimension to a list of guidelines which help the inspector to analyze each dimension from a "design" perspective. User Experience Indicators (UEIs) refer to aspects of usability which cannot be evaluated by those who are not final users. In other words, User Experience Indicators allow anticipating the potential problems that end-users may encounter during their experience with the website. Therefore, they allow the evaluation of each scenario's quality with respect to these user experience characteristics. *The Usability Evaluation Kits (U-Kits)* is a library of specific evaluation tools, which comprises a library of scenarios (User Profiles, Goals and Tasks) related to a specific domain, a library of Technical Heuristics and a library of User Experience Indicators. The evaluator could use the existing libraries (or selecting only a part) and/or he can create new libraries and kits following the conceptual approach provided by MiLE+.

3.1. Technical Inspection

The aim of MiLE+'s Technical Inspection is the identification of design problems and implementation breakdowns. The output of this evaluation is a number of "technical" problems that are application independent (e.g. the fact that the font size of a text is too small – graphic technical problem – it is a problem independent from the type of application). During this analysis the evaluator examines the web application taking into account a number of design dimensions, assuming the point of view of the designer and not of the end-user (like during the User Experience

Inspection). The design dimensions are *navigation* (the website's structure), *Content* (information provided by the application), Technology/Performance (*technological performance* of the application. Interface Design (is a broad dimension that includes semiotics - it will be widely discussed in paragraph 4 - *graphics and cognitive* - what the user learns about the application and its content). During the Technical Inspection problems are discovered using the heuristics checklists (selected from the library of technical heuristics – an example is illustrated in Table 1) and scenarios: these two elements compose the U-KIT for Technical Inspection. It is important to underline that the use of scenarios is not mandatory. Indeed, we do not evaluate the adequacy of scenarios, but they are useful for navigating with clear goals within the application (so the inspector can concentrate his/her evaluation on the most important parts of the website).

Table 1: Example of Technical Heuristics library

Dimension		Examples of Heuristics
Navigation		Consistency of the overall navigation
		Control of a guided -tour
Content		Text accuracy
		Multimedia consistency
Technology/Performance		System reaction to errors of a user
		Operations management
Interface design		
	Cognitive	Information overload
		Scannability
	Graphics	Font size
		Text layout
	Semiotics	**Ambiguity of string of characters**
		Conventionality of interaction images
		Grouping Adequacy
		Information Scent
		Position of importance

Table 2: Example of scenario used for the evaluation of a museum website

Scenario description	Well-educated American tourist who knows he will be in town, he wants visit the real museum on December 6th 2004 and therefore he/she would like to know what special exhibitions or activities of any kind (lectures, guided tours, conce rts) will take place in that day.
User profile	Tourist
Goal	Visit the Museum in a specific day
Task(s)	• Find the exhibitions occurring on December 6th 2004 in the real museum • Find information about the museum's location

3.2. User Experience Inspection

The User Experience Inspection is a scenario-based evaluation. This means that the evaluator has to imagine stories of use. During this inspec-

tion the inspector has to examine the adequacy of the scenarios: in this sense the User Experience Inspection is application dependent. For this reason, he has to set-up the "User Experience" KIT tailor-made for the application under analysis. The KIT is composed by the *scenarios library* and the *user experience indicators' library*. For creating a scenarios' library the inspector has to interact with different stakeholders: the client, domain experts, end-users, etc. For example, in creating the library for evaluating a museum websites the inspector should interview the Director of the Museum, he should organize a focus group with art's experts and a focus group with end users. Another complementary way for creating the library is called the "visioning technique" (Cato 2001). The inspector has to imagine which ones are the main end-users, their goals and tasks: it is clear that this technique is more superficial (it is very difficult to create libraries without interacting with the stakeholders), but it can still generate reliable results in the case the inspector is an expert of the application's domain. During the User Experience Inspection the evaluator has to put himself in the "shoes of the (different) users". For making this activity s/he has to know very well the characteristics of the user profiles. In general s/he should be an expert of the application's domain (e.g. cultural heritage application, e-commerce websites...). This means that he has to examine the relevant scenarios selecting some criteria called User Experience Indicators. These criteria are divided in three categories corresponding to the different types of user interaction experiences. These categories are Content Experience Indicators (measure the quality of user interaction with the content of the application), Navigation & Cognitive Experience Indicators (allow the measure of how the navigation works and the cognitive aspects of the application meet the cognitive world of the user) and Interaction Flow Experience Indicators (permit the measurement of how the interaction with the application is appreciated by the users).

Table 3: Examples of User Experience Indicators

Categories of interaction	Examples of User Experience Indicators
Content Experience	Completeness
	Relevance
	Comprehensibility
Navigation & Cognitive Experience	Predictability of interactive elements
	Learnability
	Memorability
Interaction Flow Ex perience	Naturalness
	Engagement
	Recall

The User Experience Inspection is strictly related to the *Scenario-based User Testing*. Indeed, the main goal of the Scenario-based User Testing is to empirically validate or invalidate the results provided by the User Experience Inspection. During the test the user accomplishes several tasks belonging to the critical scenarios identified in the User Experience Inspection.

4. Semiotic Design: the importance of the signs in web applications

In order to understand how signs can be evaluated on a website, let us start making a categorisation of interface elements on webpages with respect to their purpose:

- *Content signs* supporting *user consultation*. These are titles, headings, keywords helping the user to understand and browse the content; for instance, in a page describing a painting of Botticelli in a museum website, the title of the painting, the keywords bolded in the text, and the thumbnail images are signs referring to the main content of the page and helping the user grasp relevant elements of the proposed content.
- *Contextual signs* helping *user orientation* within the website. Through contextual signs, the user can realize what the website is talking about, what the actual page is talking about with respect to the topics covered by the website or with respect to the navigational path followed to that point. In Botticelli's painting page, contextual signs help the user in understanding how s/he reached that page and in contextualising the painting in a broader topic (i.e. this painting belongs to the guided tour of Italian Painters of '500 century).
- *Navigational signs* supporting *user navigation*. It is the case of any sign having the function to put forth pointers to new content or to already visited content. It is the case of menu labels, list of links, content maps, and so on.
- *Operational signs* supporting the *system modification* performed by the user. Operational signs let the user modify the state of the application or of the external world. For instance, a button for inserting an item in the shopping bag, a "submit" button for sending personal information such as a credit card number, a button for subscribing to a newsletter, a button for "confirming an order", etc.
- *Decorative signs* aiming towards *user persuasion*. These are signs which do not have a functional or informative purpose, but aim at modify-

ing the user perception, at instilling a mood or a feeling, at convincing and compelling the user through a proper orchestration of graphics elements, layout and site visual identity.

• *Meta-language signs* helping the user to understand the language of the medium and how interact with it. Examples are the hourglass while waiting for the page to load, the mouse-hand, the links changing state when passing over them, or the simple the blue links underlined for making the user aware of the possibility to interact with an element on the page.

In practice, many usability problems are due to users misunderstanding of the signs purpose, which brings to perform an action on the sign that does not correspond to what the sign has been designed for (e.g. not recognising a link, or trying to click on a non-active element). Web interfaces should make self-evident to the user the purpose of the employed signs for facilitating consultation, for making her/him orient in the application, for proposing new content, etc.

Sign's features should be carefully designed in order to make clear its purpose to the user. In particular, designers should consider: i) the *signifier*, that is, the actual shape of the sign through different forms: a text, an icon, an image, a symbol; ii) the *position*, where the sign is positioned on the page; iii) the *relation with other signs* - the meaning of a sign is often defined by its relation with other elements on the same page or on pages already visited;

A correct use of these features helps a sign to be comprehensible and intuitive on the web. For example, a sign could be well designed in terms of format and relation with other signs, but if, with respect to its scope, it is positioned in a misleading place on the page, its meaning could be misunderstood. Moreover, even though the sign is correctly designed under these features, it could be not well designed with respect to the ontology the website refers to.

4.1. Web Sign and Reference Ontology

Even if the purpose of the sign is clear to the user, s/he should be familiar with the "world" the signifier refers to in order to understand its meaning. Let us give an example: let us consider a generic museum website. On the homepage there is a textual link having the label "Exhibitions"; the user can understand the meaning of the link and if it is worth clicking on it only by having the concept of a museum exhibi-

tion and what it means. The link "Exhibitions" could be well designed in terms of signifier, position, relation with other signs, but if it refers to a concept unknown by the user it will not be understood anyhow.
On the web, there are many different ontologies a sign could refer to:

- *Topic ontology*: : the knowledge concerning the concepts belonging to the particular topics the website talks about. In a museum website the textual link "Exhibitions" uses a term that is comprehensible only if the user knows the concepts typical of the Museum's world.
- *Internet ontology:* the knowledge shared among typical web surfers or among people familiar with web browsing in general. When referring to this ontology, signifiers are understandable only if the user is familiar with the "world" of the web and knows its concepts and conventions. For instance, the links "home", "back", "add to cart", "myShop", "myBlog", "my Plog", "guided tour" are terms intuitive only for users who knows the concept of homepage, of shopping bag, of guided tour, or special kinds of forums, and so on.
- *Website ontology:* a website itself can become generator of knowledge or creator of conventions which are valid and shared only within the boundaries of that specific site. In other words, there may be signifiers referring to concepts which do not belong to the external world the website wants to describe, but which belong to the website in itself. For instance, a museum website could use symbols for representing the different section of the website (a special icon for representing the collections, another icon for representing the exhibitions, a symbol for programs & events, etc.). The user could intuitively understand and recognise the meaning of each symbol and associate it to a section of the website *only* if s/he is familiar with the website itself, or if s/he is helped in this interpretation process by supporting signs (e.g. a text string accompanying the icon).
- *Real world (or background) ontology:* there are concepts belonging to the common background of users and signifiers can count on this shared knowledge to trigger understanding. These are the signs that designers assume as always and easy comprehensible by the users envisioned, since they do not need any further knowledge or explanation to understand them. As an example, in a website devoted exclusively to informatics engineers, complex terms, symbols, graphics, -even if referring to a particular and technical 'world' - are considered background knowledge for that particular kind of users who are experts with such signs.

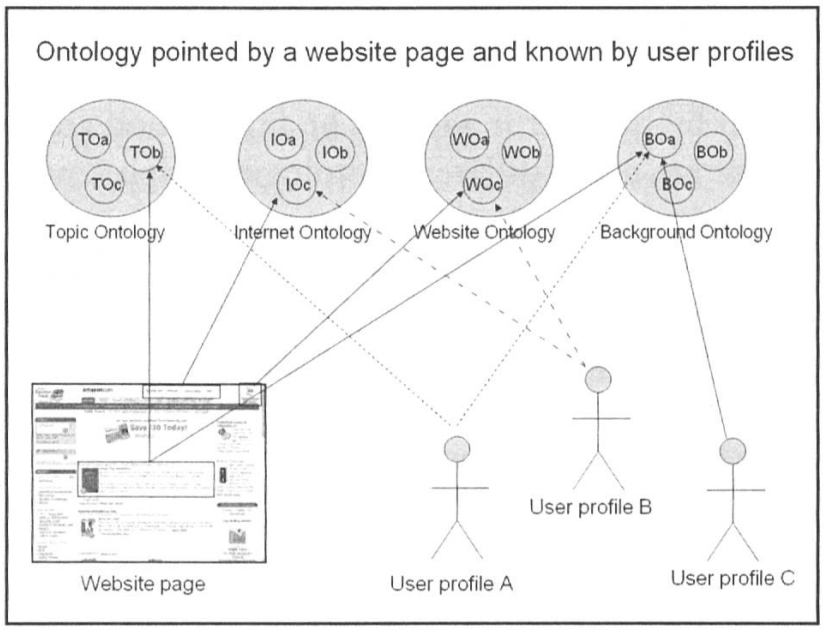

Fig. 1: Website ontology and users known ontology

Figure 1 shows that, on the one side, a web page is composed by signifiers standing for concepts belonging to different ontologies (for example, a sign could refer to a particular Topic Ontology TOb and to a Background Ontology BOa). On the other side, a common user owns only some of the ontologies that signifiers refer to. The more there is a matching between ontologies presupposed by the website and the one owned by the user, the more the interaction with the website is successful and satisfactory.

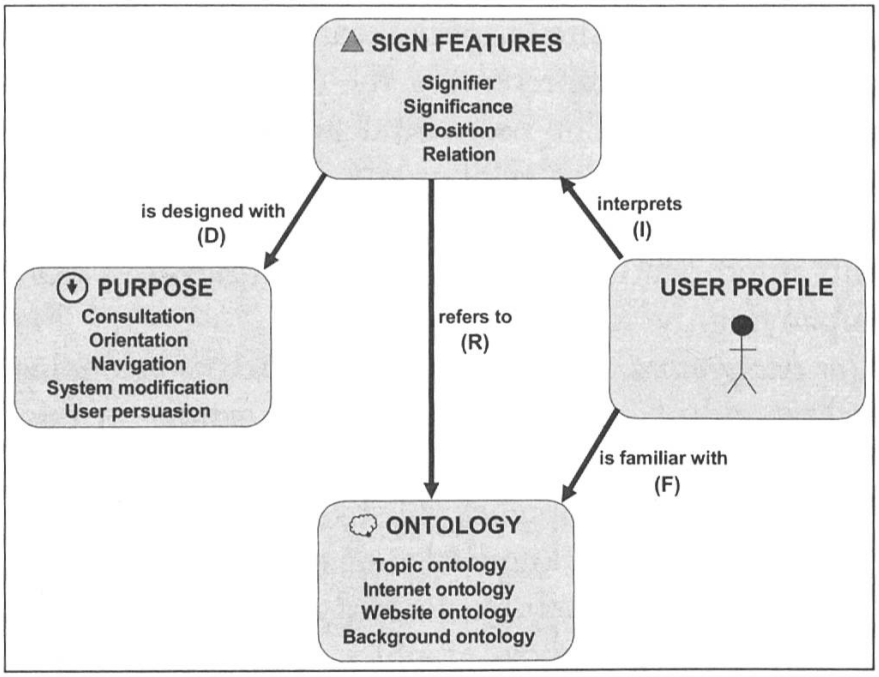

Fig. 2: Founding elements for a web semiotics framework

Only an effective use of signifiers and their features in relation to the corresponding reference ontology makes a sign understandable (see Figure 2). Indeed, a sign could be misleading or not understood because of its representation (i.e. the signifier, its position), or because it refers to concepts not familiar to the user, or because the relation between the signifier and the referred ontology – even though both of them comprehensible by the user - is unclear and misleading.

Figure 2 shows the web semiotic framework and depicts web sign features with respect to its purpose and a particular user profile. A web user having some knowledge of the reference ontology (F) interprets a web sign considering its main elements (I) and try to grasp its meaning and its purpose (D). The framework is a conceptual tool for supporting the design and the evaluation of semiotic elements of web interface, making the experts aware of the hidden relations staying behind user interpretation process and suggesting possible causes of success/failure.

5. The DICE case study

5.1. Presentation

DICE (Distributed Infrastructure for Cultural hEritage) is a project, cofinanced by the Ministry of the University and scientific Research, involving several companies and leading Universities (Politecnico di Milano and Scuola Normale di Pisa). The goal of DICE is to demonstrate the possibility of integrating different information sources in order to create an effective working environment for professional users: researchers, scientists, cultural writers, promoters of cultural events, promoters of culture-oriented tourism, etc. A DICE demonstrator was implemented in March 2004, integrating more than 20 different sources both for "Archaeology in Campania" and for "Ceramic in Campania", holding more than 3,000 pieces of information. Information providers are leading institutions, researchers, publishers, etc, while users are scientists, researchers, publishers, writers, tourism promoters, etc.

In this context, the usability evaluation has been carried out on the prototype of DICE platform. In fact, the discovery of usability problems early in the creation process reduces dramatically the costs for redesign: modifying the prototype is more cost-effective than changing the final full-fledged application. Besides, during the prototyping phase, it is possible to easily introduce structural changes (especially for aspects related

to navigational strategies and the information architecture); on the contrary, the final application does not allow for structural changes without a large investment in terms of time and resources.

For carrying out the analysis of the DICE's prototype all the MiLE+ activities have been considered: first of all, the *Technical Inspection*, then the *User Experience Inspection* and, finally, the *Scenario-based User Testing*. The majority of the activities have been focused on semiotic and interface elements. As stated before, in cultural heritage websites the need of referring to specific ontologies can make arise problems in the understanding the website from a generic user. DICE case study differs from a typical cultural heritage website, since it has been designed considering as final target experts and researches (not common users). This means that for designers, what is usually considered a *topic ontology* (that is, ontologies that designers consider to be not familiar to a generic user) in DICE case study are assumed to be *background ontology*, that is, ontology that designers assume all the users of their website are familiar with. Therefore, even though if terms and concepts referring to the particular context considered (e.g. Ceramics in Campania) are not comprehensible for a common user, they are comprehensible for experts and researches, that is, for the target of the application. As it will be evident from the inspection and user testing, many of the problems found do not deal with terms, concepts and signs belonging to the topic, but are mainly generic problems independent from the domain considered.

5.2. Results of the Usability Evaluation

Before presenting the main results of the analysis, a general consideration should be pointed out regarding the DICE website and its lack of transparency. A web session is a sort of *collaborative project* between a user and a website (and indirectly its stakeholders), each having a particular goal to reach and needing the "help" of the other to reach it. An effective user session usually happens when the goals of designers (to inform, to train, to persuade the user) and the one of the users (to be informed, to be trained, etc.) meet each other. For this reason, designers should explicit to the user the motivations behind some design solutions. As an example, the website presents different paths for getting access to the content, but sometimes the motivation leading the designers to choose some browsing criteria instead of others are not explicated to the user. The lack of transparency of design intentions may bring the user not to compre-

hend how the website describes the real world and is in relation with it (how content has been selected, modeled and organized).

5.2.1. Examples of Semiotic Problems

The following problems have been detected both by usability experts (inspection review) and user testing with potential users of the website. The problems have been analyzed and reported taking into considerations the semiotic principles previously exposed (see section 4).

Content Signs Problem

The label "Le cartelle di lavoro" ("Work Folders") is a term not easily understandable. It refers to the possibility of the user to save the descriptions of cultural objects (that is, to create a bookmark to the pages describing an object) and organise them in folders. This is a problem of *signifier*, that is, the term chosen does not let the user understand how to interpret the box and which is its scope. As a possible solution, designers could make use of terms belonging to the *Internet ontology,* such as *My wish list* or *My preferences*, more understandable because referring to already known concepts.

Fig. 3 : Example of Content Signs Problem in DICE

Navigational Signs Problem

During the navigation and consultation within a specific information object – i.e. the description of a vase or a plate - the user has some problems related to semiotic aspects.

The navigational menu for accessing information related to the object (1) is misleading: it is not clear that this box and its links are related to the object the user is looking at. This is due both to the *position* of the box and to the terms used that are too generic and ambiguous – the user does not understand the difference between "Altre informazioni" ("other information"), simili ("similar") and vedi anche ("see also").

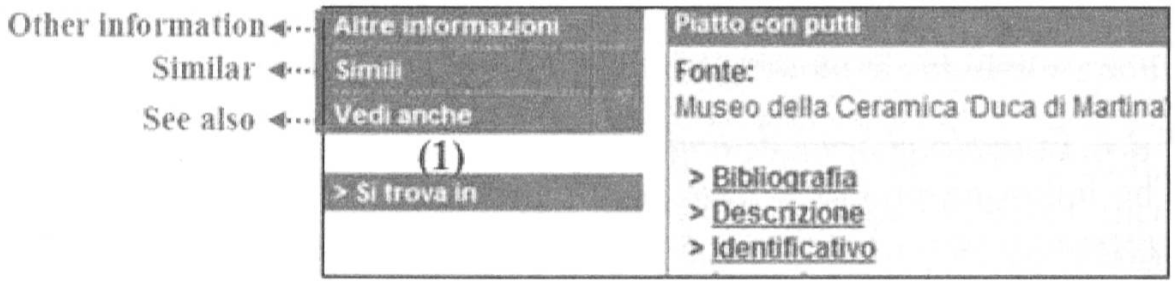

Fig. 4: Example of Navigational Signs Problem – Navigation within a Specific Object

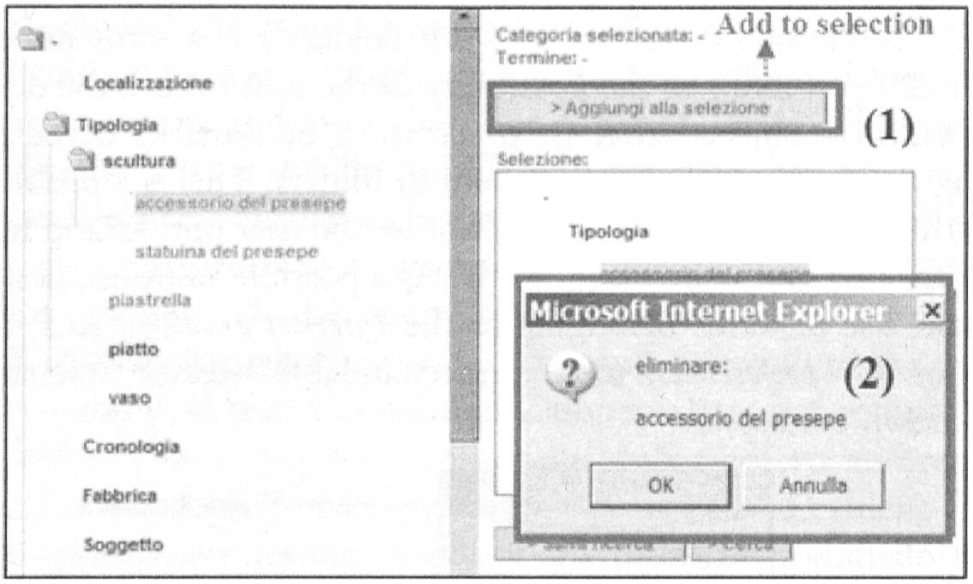

Fig. 5: Examples of Operational Signs Problems within the Search Engine

Operational Signs Problem

In the DICE website the user has the possibility to search for an object by selecting some criteria (kind of object, creator, provenance, etc.). From a list of criteria (left part of the image) the user can select one and add it to the search query. It is not clear to the user that he should click on a criteria and then click on the button "Aggiungi alla selezione" ("Add to selection") (1) to add it to the search query. The causes are probably due to the *position* of the button (it is not clear which is the workflow the user should make in order to add the criteria) and to the *signifier* ("Add to selection" does not make any sense – "add the criteria to the search" would be better).

Furthermore, if the user wants to delete a criterion inserted in the query, there is not any explicit button for deleting it: the user has to click on the criterion and the message box appears to allow deletion (2). The mechanism is not obvious, since it is in contrast with web conventions (the user would expect to have a "delete" button).

6. Conclusions

Cultural Heritage web applications communicate a lot of information addressed to different targets. For this reason the quality's degree of the web site communication has to be carefully evaluated. In this paper we have presented a systematic methodology, MiLE+, for evaluating the usability of an application. Making an application usable means to take into account and analyse its usability from the very beginning of the development. Indeed, it becomes fundamental to assess the real quality of the products during every step of its creation (from the requirements analysis, passing through conceptual and logical design, until the prototypes and the final application). In particular we have stressed the fundamental role of the semiotic design as one of the most important activities for developing an application tailored-made for the end-users. By means of the DiCE case study we have illustrated that even though the application is tailored for a very specific target – and therefore user not familiar with the *topic ontology* should be avoided – semiotic problems can arise. In fact during all the development of the DiCE prototype end-users have been involved in defining the "vocabulary" of the application, but there are other dimensions and other features related to signs that should be considered with respect to the scope the sign has for the user.

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