
METHODS OF DIGITAL LIBRARY USABILITY

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Abstract

The digital library is the widely accepted term describing the use of digital technologies to acquire, store, preserve and provide access to information and material originally published in digital form or digitised from existing print, audio-visual and other forms. Today most institutions are providers of technology-based services and are often involved in the production of systems supporting their initiatives. When aiming to satisfy user needs and guarantee acceptable tools and environment for consuming the assets of institutions, it is necessary to be familiar with the main standards and guidelines regulating usability. In this paper the authors highlighted the methods, forms, and issues of digital library usability. Usability should not be confused with 'functionality', however, as this is purely concerned with the functions and features of the product and has no bearing on whether users are able to use them or not. Increased functionality does not mean improved usability. Comparable to any other system, a digital library must possess usability properties so it can be usable by the digital library's users. Digital library usability properties can influence usability attributes and allow users to easily and effectively accomplish digital library tasks.

Keywords: Digital Library/ Usability/ Access/ Heuristics/ Usability Methods and Requirement/ Usability components and importance.

1. Introduction

Usability is a multidimensional attribute that relates to the impact a project has on its end-users. In general it refers to the efficiency with which a customer can do their tasks with the project, and their overall satisfaction with that process. It should be considered from a systems perspective including the hardware and software interfaces, the documentation, packaging, and any other component of the system and processes surrounding it that affects the user. It is a key design and marketing concept meaning the extent to which a product is safe, comfortable, effective, and efficient. It can be measured objectively via performance errors (low error = high usability) and productivity (high speed and quantity output = high usability) and also be measured subjectively via user preferences (likes and dislikes) and interface characteristics (adherence to layout standards).

It is generally characterized as the determining aspect of a system's capability to satisfy the needs and specifications of users. Usability is the degree to which users easily Views about the usability of digital libraries and effectively use a system. It plays a significant role in user acceptance of a system. Its attributes depend upon a set of usability properties that are designed into the system. Usability properties are elements such as simplicity, readability, navigability, etc. Designing a usable interface is a critical concern for digital library development. In the case of a digital library, the interface is a gatekeeper to the collection. If the interface isn't understandable, or doesn't work, the digital library holdings remain essentially inaccessible.

Usability is one of the focuses of the field of Human-Computer Interaction. As the name suggests, usability has to do with bridging the gap between people and machines. A user interface (or human-computer interface) refers to the parts of a hardware and/or software system that allow a person to communicate with it. This includes output devices (the way the computer talks to a user) and input devices (the way a user talks to the computer).

2. Meaning and Definitions

Usability, in the context of digital libraries, can be defined as the effectiveness, efficiency, and personal satisfaction with which people are able to access and make productive use of the resources in a digital library. People interact with a digital library (and most other computers programs) through some sort of human-computer interface. The importance of the interface and the functionality it enables cannot be overemphasized. 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. Usability means making products and systems easier to use, and matching them more closely to user needs and requirements.

Usability is 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"

Shneiderman¹⁹ suggests a concept of universal usability that would guarantee successful utilisation of technology by any citizen. Universal usability is a broader concept than universal access, which by itself does not assure usable technologies. Usability is understood not as a sum of components but as a broad research agenda based on three main issues, or challenges:

1. **Technology diversity.** Technology-based issues cover hardware, software and networks. Owing to the rapid obsolescence and variety of technology-based products and services there is a need to provide users with flexible and compatible equipment.
 2. **User diversity.** Individual user features, such as skills, age, gender, income, culture, personal traits, disabilities etc. that pre-condition the way and extent to which an individual will rely on technology.
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3. Gaps in user knowledge. Diverse levels of knowledge necessary to interact with computer-based system. Technology designers should provide users with interfaces structured according to user knowledge levels

ISO standards offer two approaches to usability: ⁴

1. Product-oriented approach. Usability is treated as a set of requirements that software or hardware products (ISO standards concentrate only on software issues, although a general framework both for hardware and software should be established) should meet in order to become usable. This approach is useful as it provides a framework for what should be achieved in order to develop usable products and facilitates management of contractual agreements between developers and customers of technology. An important advantage of the product-based view is that standards define the relationship of usability to product quality. This allows interpreting usability as a quality management activity
2. Process-oriented approach puts a focus on the integration of usability issues into the process of development of ICT-based products. This approach balances the significant weakness of orientation to independent sets of features, as any specified attributes cannot predict user behaviour, the way users reach their specific goals in a certain working context. Therefore, usability is achieved when the design process is user-centric and encompasses specific context characteristics, such as user, tasks and environment attributes. However, the process-oriented approach often offers only some hints helping to manage the process of usability evaluation but mentions nothing about what usability consists of (ISO 9241-11 (1998)).

According to Nielsen⁹, usability has become a question of survival in the economy of the internet. The author affirms “there is an abundance of available sites, [therefore] to leave is the first defense mechanism when the users find difficulties”. These difficulties are usually related to the organization schemes, navigation systems, search system and labeling systems of information in the web. That is, because of the great number of available options today, the information architecture can determine the user permanence or abandonment of the virtual systems.

Usability, as Nilsen¹⁶ argues, is a quality attribute that assesses how easy user interfaces are to use, making it possible to the customers to develop tasks in a clear, transparent, agile and useful way. This concept corroborates the one prescribed by norm ISO 9241-11 (1998), which considers usability the “capacity that an interactive system offers its users, in a determined operation context, for the accomplishment of tasks, in an effective, efficient and pleasant way”.

For the Usability Professional’s Association – UPA21, usability is directly related to quality of the product, as well as to the user’s efficiency, effectiveness and satisfaction. This same association defines usability as a set of techniques developed to create usable products, with a user-centered approach. Usability means that the people who use the product can do so quickly and easily to accomplish their own tasks. This definition rests on four points: (1) Usability means focusing on users; (2) people use

products to be productive; (3) users are busy people trying to accomplish tasks; and (4) users decide when a product is easy to use.

Usability starts with a philosophy²² - a belief in designing to meet user needs and to focus on creating an excellent user experience - but it is the specific process and methodology that produce the real goal of usability. A new usability process starts by looking at who uses a product, understanding their goals and needs, and selecting the right techniques to answer the question, "How well does this product meet the usability requirements of our users?"

3. Components of Usability

Usability is a multi-dimensional quality of a product, includes the following key attributes:

- **Learnability :** The ability of the user to discover and understand product capabilities and how to use them.
- **Utility:** The completeness and appropriateness of the product in achieving end-user goals.
- **Efficiency:** The ease of use of the product in helping end-users to accomplish their critical tasks.
- **Memorability:** The extent to which a casual user can remember how a product works and retain proficiency with it.
- **Error Management:** How errors are prevented, recovered from, and managed to minimize loss and user frustration.
- **Satisfaction:** The degree to which users enjoy using and interacting with the product.

4. Importance of Usability

The first law of e-commerce is that if users cannot find the product, they cannot buy it either. From the user's perspective usability is important because it can make the difference between performing a task accurately and completely or not, and enjoying the process or being frustrated. From the developer's perspective usability is important because it can mean the difference between the success or failure of a system. From a management point of view, software with poor usability can reduce the productivity of the workforce to a level of performance worse than without the system.

In all cases, lack of usability can cost time and effort, and can greatly determine the success or failure of a system. Given a choice, people will tend to buy systems that are more user-friendly. On the digital library, usability is a necessary condition for survival. If a project is difficult to use, user leave. If the project fails to clearly state what a company offers and what users can do on the site. If project information is hard to read or doesn't answer users' key questions, they leave. There's no such thing as a user reading a manual or otherwise spending much time trying to figure out an interface.

It is important to realize that usability is not a single, one-dimensional property of a user interface. Usability is a combination of factors including:

- **Ease of learning** - How fast can a user who has never seen the user interface before learn it sufficiently well to accomplish basic tasks?
- **Efficiency of use** - Once an experienced user has learned to use the system, how fast can he or she accomplish tasks?
- **Memorability** - If a user has used the system before, can he or she remember enough to use it effectively the next time or does the user have to start over again learning everything?
- **Error frequency and severity** - How often do users make errors while using the system, how serious are these errors, and how do users recover from these errors?
- **Subjective satisfaction** - How much does the user like using the system?

5. Ten Usability Heuristics by Jakob Nielsen

These are ten general principles for user interface design. They are called “heuristics” because they are more in the nature of rules of thumb than specific usability guidelines.

- **Visibility of system status:** The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.
 - **Match between system and the real world :** The system should speak the users’ language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.
 - **User control and freedom:** Users often choose system functions by mistake and will need a clearly marked “emergency exit” to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.
 - **Consistency and standards:** Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.
 - **Error prevention:** Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.
 - **Recognition rather than recall:** Minimize the user’s memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.
 - **Flexibility and efficiency of use:** Accelerators — unseen by the novice user — may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.
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- Aesthetic and minimalist design: Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.
- Help users recognize, diagnose, and recover from errors: Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.
- Help and documentation: Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

6. Usability Methods

The methodologies can be divided into two broad categories: those that gather data from actual users and those that can be applied without actual users present. Usability evaluations can be conducted at many stages during and after the design and development process. There are many tools and methods that may be used during the User-Centred Design process in order to achieve good product usability

Planning & Feasibility	Requirements	Design	Implementation	Test & Measure	Post Release
Getting started	User Surveys	Design guidelines	Style guides	Diagnostic evaluation	Post release testing
Stakeholder meeting	Interviews	Paper prototyping	Rapid prototyping	Performance testing	Subjective assessment
Analyse context	Contextual inquiry	Heuristic evaluation		Subjective evaluation	User surveys
ISO 13407	User Observation	Parallel design		Heuristic evaluation	Remote evaluation
Planning	Context	Storyboarding		Critical Incidence Technique	
Competitor Analysis	Focus Groups	Evaluate prototype		Pleasure	
	Brainstorming	Wizard of Oz			
	Evaluating existing systems	Interface design patterns			
	Card Sorting				
	Affinity diagramming				
	Scenarios of use				
	Task Analysis				
	Requirements meeting				

6.1 Planning & Feasibility overview

The objective is to ensure that usability activities are effectively incorporated into the design and development process, and influence the early feasibility stage of the design and development process. It is important that the usability activities selected should contribute to the business objectives for developing the product.

- **Getting started:** The best time to begin is when one can plan a development project, so one can make a reasonable allocation of resources to the User Centered Design process. Test with real users early in the project and frequently thereafter. Raise awareness about usability in the rest of the development team by engaging them in usability topics.
- **Stakeholder meeting:** A stakeholder meeting is a strategic way to derive usability objectives from business objectives, and to gain commitment to usability. It also collects information about the purpose of the system and its overall context of use.
- **Analyze context of use:** Collect and agree detailed information about:
 - Who are the intended user and what are their task?
 - What are the technical and environmental constraints?
- **ISO 13407:** Human centered design processes for interactive systems. ISO 13407 provides guidance on achieving quality in use by incorporating user centered design activities throughout the life cycle of interactive computer-based systems.
- **Usability Planning:** Usability planning provides an important means of managing individual usability activities as well as the overall role played by usability input within a software engineering programme. It defines the scope of usability work required to produce a user- interface design that is efficient, effective and satisfying in use.
- **Competitor analysis:** Competitor analysis identifies the strengths and weaknesses of competing products or services before starting work on prototypes.

6.2 Requirements:

The objective is to ensure that user and usability requirements are well defined and integrated into relevant product requirements specification. The purposes of usability methods at this stage are to collect information about the user interface, users, tasks and environments, and to agree what aspects should be formalized as requirements.

- **User survey for design:** User surveys are a means of finding out how the software or web site is likely to be used by a specific set of users, and who these users are likely to be. The answers user surveys provide must be relevant to the issues that are important to the design team. User surveys are traditionally carried out by post, but increasingly, the internet is used for this purpose.
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- **Interviews:** The interview is a method for discovering facts and opinions held by potential users of the system being designed. It is usually done by one interviewer speaking to one informant at a time. Reports of interviews have to be carefully analyzed and targeted to ensure they make their impact. Otherwise the effort is wasted.
 - **Contextual inquiry:** The contextual inquiry is a specific type of interview for gathering field data from users. It is usually done by one interviewer speaking to one interviewee (person being interviewed) at a time. The aim is to gather as much data as possible from the interviews for later analysis.
 - **User observation/field studies:** Observational methods involve an investigator viewing users as they work in a field study, and taking notes on the activity that takes place. Observation may be either direct, where the investigator is actually present during the task, or indirect, where the task is viewed by some other means such as through use of a video recorder. The method is useful early in user requirements specification for obtaining qualitative data. It is also useful for studying currently executed tasks and processes.
 - **Analyze context of use:** This information is an essential input to requirements and the planning of other usability methods. It may be collected at an early stage during planning and feasibility or in more detail as part of the usability requirements.
 - **Focus groups:** A focus group is an informal assembly of users whose opinions are requested about a specific topic. The goal is to elicit perceptions, feelings, attitudes, and ideas of participants about the topic. Focus groups are not generally appropriate for evaluation.
 - **Brainstorming:** Brain storming is one of the oldest known methods for generating group creativity. A group of people come together and focus on a problem or proposal. There are two phases of the activity. The first phase generates ideas, the second phase evaluates them. An experienced facilitator is useful.
 - **Evaluate existing system:** Evaluation of an earlier version or competitor system to identify usability problems and to obtain baseline measures of usability.
 - **Card sorting:** This is a method for discovering the latent structure in an unsorted list of statements or ideas. The investigator writes each statement on a small index card and requests six or more informants to sort these cards into groups or clusters, working on their own. The results of the individual sorts are then combined and if necessary analyzed statistically.
 - **Affinity diagramming:** Affinity diagramming is used to sort large amounts of data into logical groups. Existing items and/or new items identified by individuals are written on sticky notes which are sorted into categories as a workshop activity.
 - **Scenarios of use (Use cases):** Scenarios specify how users carry out their tasks in a specified context. They provide examples of usage as an input to design, and provide a basis for subsequent usability testing. They are user- and task-oriented use cases.
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- **Task analysis:** Task analysis analyses what a user is required to do in terms of actions and/or cognitive processes to achieve a task. A detailed task analysis can be conducted to understand the current system and the information flows within it. These information flows are important to the maintenance of the existing system and must be incorporated or substituted in any new system.
 - **Requirements meeting:** A workshop attended by users and developers who identify usability requirements that can be tested later in the development process.

6.3 Design overview

The objective of the design phase is to create and develop a user interface design that is based on the requirements specification, and that supports the users with their task at hand. Early designs will be simple and sketchy.

- **Design Guidelines:** Guidelines for user interface design summarise good practice and provide useful high and low level guidance on the design of usable interfaces. Adherence to specific guidelines can be specified as part of the usability requirements. Designers and developers should then familiarise themselves with the relevant guidelines, and expert evaluation should be used to check for compliance with the most important guidelines.
 - **Paper prototyping:** Paper prototypes or other mockups are used clarify requirements and enable draft interaction designs and screen designs to be very rapidly simulated and tested.
 - **Heuristic evaluation:** Heuristic evaluation is a form of usability inspection where usability specialists judge whether each element of a user interface follows a list of established usability heuristics. Expert evaluation is similar, but does not use specific heuristics.
 - **Parallel design:** Parallel design is a method where alternative designs, often interface designs, are created by two to four design groups at the same time. The aim is to assess the different ideas before settling on a single concept for continued development.
 - **Storyboarding:** A storyboard is a low fidelity prototype consisting of a series of screen sketches. They are used by designers to illustrate and organize their ideas and obtain feedback. They are particularly useful for multi-media presentations.
 - **Evaluate prototype:** Participative user based evaluation of a paper or machine prototype to identify usability problems, where the user is probed to explain their expectations and problems.
 - **Wizard of Oz:** The Wizard of Oz technique enables unimplemented technology to be evaluated by using a human to simulate the response of a system.
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- **Interface Design Patterns:** Interface design patterns are solutions to frequently-occurring problems and situation in the design of interfaces. The end users and the implementation teams conceptualise the interfaces in terms of interface design patterns.

6.4 Implementation overview

The objective of usability activities at the implementation stage are to ensure that detailed design takes account of usability principles.

- **Style guides:** Style guides are used to provide a consistent look and feel. They should be defined as part of usability requirements and conformance should be monitored during development.
- **Rapid prototyping:** In rapid prototyping interactive prototypes are developed which can be quickly replaced or changed in line with design feedback. This feedback may be derived from colleagues or users as they work with the prototype to accomplish set tasks.

6.5 Test & Measure

The purpose of testing and measuring is to assess the degree to which user and Organisational requirements have been achieved, and to provide feedback in a form that can be used by designers and developers to improve the user interface design.

- **Diagnostic evaluation:** User based evaluation of a working system, where the primary objective is to identify usability problems.
 - **Performance testing:** Performance testing is a rigorous usability evaluation of a working system under realistic conditions to identify usability problems and to compare measures such as success rate, task time and user satisfaction with requirements
 - **Subjective Assessment (testing & post-release):** Subjective assessment tells the evaluator how the users feel about the software being tested. This is distinct from how efficiently or effectively they perform with the software. The usual method of assessment is to use a standardised opinion questionnaire to avoid criticisms of subjectivity.
 - **Heuristic evaluation:** Heuristic evaluation is a form of usability inspection where usability specialists judge whether each element of a user interface follows a list of established usability heuristics. Expert evaluation is similar, but does not use specific heuristics.
 - **Critical Incident Technique Analysis:** End users are asked to identify specific incidents which they experienced personally and which had an important effect on the final outcome. The emphasis is on incidents rather than vague opinions. The context of the incident may also be elicited. Data from many users is collected and analysed.
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- **Pleasure based approach:** In addition to usability based approaches to evaluate whether or not a product fulfils user needs it is also possible to evaluate the pleasure of the product. This is a new set of approaches and to some extent goes beyond traditional usability testing.

6.6 Post release testing and measurement

It must be understood that all measurement involves sampling. A sample is a small subset of a large and usually indefinable population.

- **Post release testing:** Thus there is a considerable need to continue testing and measurement after the product has been released, to gain an increasingly truer picture of how the product is performing in relation to the usability goals set for it.
- **Subjective Assessment (testing & post-release):** Subjective assessment tells the evaluator how the users feel about the software being tested. This is distinct from how efficiently or effectively they perform with the software. The usual method of assessment is to use a standardised opinion questionnaire to avoid criticisms of subjectivity.
- **User survey for design:** User surveys are a means of finding out how the software or web site is likely to be used by a specific set of users, and who these users are likely to be. The answers user surveys provide must be relevant to the issues that are important to the design team.
- **Remote evaluation:** Subjective assessment tells the evaluator how the users feel about the software being tested. This is distinct from how efficiently or effectively they perform with the software. The usual method of assessment is to use a standardised opinion questionnaire to avoid criticisms of subjectivity.

7. Usability Requirement

Usability requirements can take the form of how accurately users complete their tasks, how long they take and how satisfied they are. A new system should at least be as good as any existing or competitive system or there is a significant risk of project failure.

- Define the main goals the users are to perform
 - Define a comprehensive list of all tasks the users will perform
 - Prioritise tasks according to their importance (e.g. frequency or safety).
 - Define task characteristics, such as goals, time of performing, inputs and dependencies, output, variability, frequency, duration, time constraints, flexibility, physical and mental demands, linked tasks, safety, and criticality.
 - Define and analyse tasks and sub-tasks and identify obstacles for solving tasks.
 - Identify the usage environment through usage scenarios.
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- Investigate environmental characteristics including physical and organisational
- Identify and prioritise functional requirements based on user task and environmental requirements.

8. Conclusion

Usability is about much more than the “look and feel” of the digital library. The interface of a digital library should communicate its functions and navigational structure to new users with a minimum of “cognitive overload.” In other words, novice users should be able to devote most of their thinking to the task at hand (reviewing various educational resources to find the best one to meet specific instructional needs) rather than to the task of figuring out how to search within the collection of resources in the first place. Usability is not just a concern for new users. Frequent patrons of a digital library expect to pick up where they left off. If new features have appeared since their last visit, these must be communicated without distracting from the patrons’ reasons for accessing the library.

Initially, usability referred to such terms as ease of use, user-friendliness, and ease of learning that implied providing users with systems requiring minimum cognitive and physical effort to accomplish their tasks successfully. However, in most cases user interaction processes and outcomes are affected by a broader context of user goals, tasks, and user environment – aspects that are not reflected in the notion of easy-to-use technology.

Usability of a digital library primarily relates to its accessibility, i.e. how easily users can interact with the interface of the digital library, how easily they can find useful information, how easily they can use the retrieved information, etc. In general if information can be accessed easily then the digital library will be used frequently. By implication, therefore, a well-designed digital library should have good usability features.

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