Fachbeitrag

Klaus Thoden, Juliane Stiller, Natasa Bulatovic, Hanna-Lena Meiners, Nadia Boukhelifa

User-Centered Design Practices in Digital Humanities – Experiences from DARIAH and CENDARI

Abstract: User experience and usability (UX) form a key part of research and best practice for product and software development. In this paper, the topic is addressed from the perspective of the Digital Humanities (DH) and approaches undertaken in two DH infrastructure projects, DARIAH and CENDARI are presented. Both projects addressed aspects of UX, focusing on the usage of a single software tool, as well as on an integrated research workflow using several tools and devices. The article lists the main factors, gleaned from research undertaken in the projects, that influence usability practices in the DH, and provides possible recommendations on how to approach them.

Keywords: digital humanities, usability, participatory design

Nutzerorientierte Entwicklungsmethoden in den digitalen Geisteswissenschaften – Erfahrungen aus den Infrastrukturprojekten DARIAH und CENDARI

Zusammenfassung: User Experience und Usability sind wichtige Bestandteile der Forschung und Praxis in der Produkt- und Softwareentwicklung. In diesem Artikel nähern sich die Autoren dem Thema aus der Perspektive der digitalen Geisteswissenschaften. Es werden die Erfahrungen aus zwei Infrastrukturprojekten, DARIAH und CENDARI, näher beschrieben und Handlungsanweisungen abgeleitet. In den Projekten wurden Usability-Studien durchgeführt und nutzerorientierte Methoden eingesetzt, bei denen es einerseits um die Nutzung von unabhängigen Tools, andererseits um einen integrierten Forschungskreislauf mit verschiedenen Tools ging. Aufgrund der in den Projekten gesammelten Erfahrung und durchgeführten Forschung werden Faktoren aufgelistet, die die Entwicklungsmethoden in Bezug auf Usability in den digitalen Geisteswissenschaften beeinflussen.

1 Introduction

In the Digital Humanities (DH), one focus of research centers on the development and advancement of methods and respective tools that can support them. Burdick et al.[1] understand data curation and data analysis as well as editing and modeling as the tasks most relevant to the DH. Using digital tools and services for these tasks is at the core of DH practice. There is an interest in convincing traditional scholars to adopt digital methods and tools and in demonstrating the potential of computing for the humanities. Creating a positive user experience can increase the adoption and usage of tools[2] and therefore, over the past decade, requests have increased for development in line with results from user-centered research methods.

In light of the numerous sources that claim a lack of usability studies for the DH[3] or that developed tools are not intuitive or difficult to use and thus fail user expectations[4], building digital tools with better usability seems difficult to put into practice. Schreibman and Hanlon[5] state that only 31 percent of tool developers actually conduct usability tests. But what are the reasons for this, giv-

1 Burdick, Anne; Johanna Drucker, Peter Lunenfeld, et al.: *Digital_Humanities*. Cambridge, Mass. 2012. 17 f.

2 Gibbs, Fred; Trevor Owens: "Building Better Digital Humanities Tools: Toward Broader Audiences and User-Centered Designs." In: *Digital Humanities Quarterly* 006,2 (2012). http://www.digitalhumanities.org/dhq/vol/6/2/000136/000136.html.

3 Jänicke, Stefan, Greta Franzini, M. Cheema, et al.: "On Close and Distant Reading in Digital Humanities: A Survey and Future Challenges'." In: *Proc. of EuroVis—STARs*. (2015): 83–103.

4 Gibbs and Owens 2012.

5 Schreibman, Susan, Ann M. Hanlon: "Determining Value for Digital Humanities Tools: Report on a Survey of Tool Developers." In: *Digital Humanities Quarterly* 004,2 (2010). http://www.digitalhumanities.org/dhq/vol/4/2/000083/000083.html.

en the abundant literature on usability and on how to develop for good user experience? The theoretical path to a better and great user experience is well laid out. What are the factors that contribute to such a gap, or is the current status of usability in DH tools better than we think?

This paper intends to explore the practice of usability in the DH and the perceived lack thereof. The goal is to find consensus on what good user experience and usability means in the Digital Humanities, what practices this might entail and what factors influence these practices. The authors report on experiences from two infrastructure projects in the DH – CENDARI and DARIAH – both of which have invested considerable resources in research and best practice for usability. Based on these two cases, they will derive the requirements and needs for a fundamental usability practice in the domain of DH.

In the next section, definitions will be given for user experience and usability from various domains, and distilled into a working definition for this paper. Section 3 introduces approaches to user experience in the DH. In section 4, there will be a reflection on the experiences, opportunities and problems from DARIAH and CENDARI. The paper concludes with answers to the questions about the presence of a kind of "reality gap," which manifests itself in the discrepancy between developing a highly accepted theoretical tool and the in practice often poor user experience.

2 Usability and User Experience – Methods to Increase User Satisfaction

User experience, usability and interface design play a tremendous role for DH tools, services and infrastructures because, as Kirschenbaum[6] puts it, "the interface becomes the first and in most respects the exclusive experience of the project for its end users"[7]. Emphasis on usability and user experience in the development process of tools and infrastructure components should be self-explanatory.

The terms *user experience* and *usability* are closely related and often also used synonymously. In the ISO standard 9241-201, usability is defined as the "*[e]xtent to which*

a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." Usability is often used as a generic term under which several methods, requirements and definitions are subsumed. The term "user experience" (UX) is considered to be even broader with the goal to optimize human performance and user satisfaction[8].

In most software development processes, usability considerations are an integral part of a successful product delivery. The methods implemented target the improvement of interface design but also successful human-computer interactions. In his book *Usable Usability*[9], Reiss distinguishes two components of usability. The first component is to see whether the intended functionality is working as it should. He calls this "ease of use." The second component, "elegance and clarity", deals with the expectations users have with regard to certain functionalities. Both components incorporate elements of interface design and human-computer interaction focusing on delivering a product or service that has user-centered design at its core. This is an approach the authors would like to adopt for the remainder of this paper: a useable tool, workflow or service that supports the scholar in obtaining results, in line with the method used, while being transparent about the provenance of these results.

To deliver usable software products and tools, several processes and methods are defined and ideally integrated into the development process. For projects where the requirements of several stakeholders need to be reconciled, participatory design studies have proved successful – an approach that is particularly interesting for the Digital Humanities. Participatory design has been adopted by many disciplines where stakeholders cooperate to ensure that the final product meets everyone's requirements. For interactive software design, the aim is to benefit from different expertise: designers know about the technology and users know their data, their workflow and its context. In a similar vein, Muller[10] describes participatory design

6 Kirschenbaum, Matthew G.: "So the Colors Cover the Wires: Interface, Aesthetics, and Usability." In: *A Companion to Digital Humanities*. Edited by Susan Schreibman, Ray Siemens, John Unsworth. 523–542. Blackwell Publishing Ltd., 2004. http://onlinelibrary.wiley.com/doi/10.1002/9780470999875.ch34/summary.

7 Kirschenbaum 2004, 2.

8 Bevans, Nigel: "What Is the Difference between the Purpose of Usability and User Experience Evaluation Methods?" UXEM'09 Workshop, INTERACT 2009, Uppsala, Sweden 2009. http://nigelbevan.com/cart.htm.

9 Reiss, Eric L.: *Usable Usability: Simple Steps for Making Stuff Better*. John Wiley & Sons, 2012. http://www.books24x7.com/marc.asp?bookid=49784.

10 Muller, Michael J.: "Participatory Design: The Third Space in HCI." In: *The Human-Computer Interaction Handbook*. Edited by Julie J. Jacko, Andrew Sears. Hillsdale, NJ, USA: Lawrence Erlbaum Associates, 2003. 1051–1068. http://dl.acm.org/citation.cfm?id=772072.772138.

as belonging to the in-between domain of end-users and technology developers, which is characterized by reciprocal learning and the creation of new ideas through negotiation, co-creation and polyvocal dialogues across and through differences. Participatory design was also the chosen method for user-centered development within CENDARI. To conclude, we can define two different strands regarding user-centered design practices: first, tools that are developed along usability guidelines, and second, the provision of factors and criteria to evaluate the results of usability practices. In the domain of DH, there seems to be no coherent understanding of these two strands.

3 Approaching User Experience in Digital Humanities

Usability and positive user experiences are important in increasing the acceptance of digital solutions for the humanities. This view is also supported by several surveys that were conducted in the project DARIAH-DE[11] and was also the major outcome of usability studies in TextGrid[12].

Due to the diversity of the DH and the tools developed to serve a wide range of users with varying degrees of technical knowledge and experience, usability and user experience is particularly challenging. Serving tech-savvy users and at the same time convincing other scholars to adopt digital tools will only be possible if the initial hurdles for using these tools are low. In addition to the diversity of the user groups in the DH, the research areas and objects are also very heterogeneous which, with regard to development, complicates the definition of standards or the following of standard procedures. The diverse research areas and objects, which may be very new and are often unexplored, constitute a further barrier to a reliance on experience and accepted methods and practices.

This diversity could lead to missing feedback for developed prototypes and a lack of user requirement analysis, which could be the root cause for unused tools. Prototypes and final products can be assessed, however, using the heuristics of Nielsen[13] or Shneiderman et al.[14]. Usability tests have been undertaken for the DH where these heuristics were consulted for walkthroughs and for evaluation by experts[15]. One finding was that usability problems do not always stem from the particular task that a tool should solve but are often very generic problems. This is in line with the findings of Burghardt[16] who distinguishes generic and very domain-specific usability problems for his research objects: linguistic annotation tools. Within DARIAH-DE, several tools and services were reviewed and tested, revealing similar problems related to usability and user experience. Although these shortcomings may be quite general, they can have a huge impact on the satisfaction of users and what they experience when interacting with a tool. The following problems occurred across products and services: a) ambiguous and inconsistent vocabulary, b) disregard of graphical conventions, c) intransparency of the system status, d) missing documentation, e) missing strategies to avoid mistakes, f) disregard of convention for workflows, e.g. search[17]. Having strategies in place to avoid these common mistakes would already make DH-tools and services much more usable.

An approach often taken for usability is the user study for specific tools, services or infrastructure components. Here, user experience and usability aspects may play a role in investigating user satisfaction with developed features and components. One example is MONK, a web-based text-mining software. In an extensive study, web analytics data and user interviews were analyzed to gain knowledge about the usage of the application[18]. There was an overall satisfaction with the tool offered but it was ob-

11 Gnadt, Timo, Juliane Stiller, Klaus Thoden, et al.: *Finale Version Erfolgskriterien*. DARIAH-DE, R1.3.3, Göttingen 2016. https://wiki.de.dariah.eu/download/attachments/14651583/R133_Erfolgskriterien_Konsortium.pdf; Stiller, Juliane, Klaus Thoden, Oona Leganovic, et al.: *Nutzungsverhalten in den Digital Humanities*. DARIAH-DE R1.2.1/M 7.6. Göttingen 2016. https://wiki.de.dariah.eu/download/attachments/14651583/Report1.2.1-final3.pdf; Bulatovic, Natasa, Timo Gnadt, Matteo Romanello, et al.: "Usability in Digital Humanities – Evaluating User Interfaces, Infrastructural Components and the Use of Mobile Devices During Research Process." In: *Research and Advanced Technology for Digital Libraries*. Edited by Norbert Fuhr, László Kovács, Thomas Risse, et al. 335–346. Cham 2016a. http://link.springer.com/10.1007/978-3-319-43997-6_26.
12 Kaden, Ben, Simone Rieger: "Usability in Forschungsinfrastrukturen für die Geisteswissenschaften: Erfahrungen und Einsichten aus TextGrid III." In: *TextGrid: Von der Community – für die Community: eine virtuelle Forschungsumgebung für die Geisteswissenschaften*. Edited by Heike Neuroth, Andrea Rapp, Sibylle Söring. 63–75.Glückstadt, 2015.

13 Nielsen, Jakob: 10 Heuristics for User Interface Design. 1995. http://www.nngroup.com/articles/ten-usability-heuristics/
14 Shneiderman, Ben, Catherine Plaisant, Maxine Cohen, et al: *Designing the User Interface: Strategies for Effective Human-Computer Interaction*. Harlow 2014.
15 Stiller et al. 2016.
16 Burghardt, Manuel: "Annotationsergonomie: Design-Empfehlungen für Linguistische Annotationswerkzeuge." In: *Information – Wissenschaft & Praxis 63* (5) (2012). doi:10.1515/iwp-2012-0067.
17 Bulatovic et al. 2016(a).
18 Green, Harriett E.: "Under the Workbench: An Analysis of the Use and Preservation of MONK Text Mining Research Software." In: *Literary and Linguistic Computing* 29 (1) (2014): 23–40.

served that the functionalities were geared more towards easy access and approachability than towards offering a flexible tool for the expert user[19]. Here, one can see that researchers are more willing to go to considerable lengths to learn a tool when it provides expert functionalities and enables flexible adaptation to their specific needs. Tools such as MONK have been praised for their ability to teach and their provision of gateway entry into learning more about text mining and its capabilities. Other studies have been surveyed and scholars interviewed to gain insights into other barriers and hurdles that hinder the use of such tools.

Gibbs and Owens[20] identified the lack of integration of users into the design process as well as missing documentation as factors for the low acceptance of tools. In particular, technically challenging tools for visualization and text mining should have usable interfaces and concise documentation with examples of use cases[21]. Technical documentation as well as procedural documentation is essential to ensure the reuse of data and the results of projects. This would help interested parties to understand the scope and goal of online projects[22].

Research has now started to move away from case studies targeted at the requirements of specific DH-tools and instead search for a more generalized approach to usability and user experiences in the DH. For example, Burghardt[23] has developed usability patterns for linguistic annotation tools, arguing that the specificity of the tools requires specific solutions for design and interaction patterns. To the authors' knowledge, Burghardt's approach to usability engineering in the DH is unique.

Participatory design, as one approach to unify the perspectives of several stakeholders, is applied in several infrastructure and tool development projects. Warwick[24] provides explanations for the neglect of participatory design in humanities projects:

It was often assumed that the resources created in digital humanities would be used by humanities scholars, who were not technically gifted or, perhaps, even luddites. Thus, there was little point asking them what they needed, because they would not know, or their opinion about how a resource functioned, because they would not care. It was also assumed that technical experts were the people who knew what digital resources should look like, what they should do and how they should work. If developers decided that a tool or resource was a good one, then their opinion was the one that counted, since they understood the details of programming, databases, XML and website building. The plan, then, was to provide good resources for users, tell them what to do and wait for them to adopt digital humanities methods. (p.1)

Many of these assumptions have been challenged and a number of recent projects have shown that involving DH users in the design process is beneficial in learning about users and their requirements[25]. For example, Heuwing and Womser-Hacker[26] describe user-centered methods applied in the project "Children and their world"[27] to aggregate the requirements for a catalog that can guide the system design. The authors underline the necessity of communication and understanding in DH projects, which often consist of teams from different community practices. Here, one problem is that tools are developed by computer linguists who may lack knowledge of the domain of the respective scholar using the tool. Bridging the gap between the scholar, who can often anticipate the functionalities of a tool but might not know how to build it, and the scientist, who develops the tool but may lack insights into the methods applied or the workflow to be mapped in the digital environment, might be the key to resolving this conflict. In a more recent article, the authors again underline the benefits of user-centered methods in getting different stakeholders closer together in the development process

19 Green, 2014.

20 Gibbs and Owens, 2012.

21 Gibbs and Owens, 2012.

22 Warwick, Claire, Melissa Terras, Isabel Galina, et al.: *Evaluating Digital Humanities Resources: The LAIRAH Project Checklist and the Internet Shakespeare Editions Project.* London, 2007. http://elpub. scix.net/data/works/att/144_elpub2007.content.pdf.

23 Burghardt, Manuel: *Engineering Annotation Usability – Toward Usability Patterns for Linguistic Annotation Tools.* Universität Regensburg 2014. http://epub.uni-regensburg.de/30768/.

24 Warwick, Claire: "Studying Users in Digital Humanities." In: *Digital Humanities in Practice.* Edited by Claire Warwick, Melissa Terras, Juliane Nyhan. 1–21. London, 2012. http://www.facetpublishing. co.uk/title.php?id=7661.

25 Mattern, Eleanor, Wei Jeng, Daqing He, et al.: "Using Participatory Design and Visual Narrative Inquiry to Investigate Researchers? Data Challenges and Recommendations for Library Research Data Services." In: *Program: Electronic Library and Information Systems* 49 (4) (2015): 408–23; Wessels, Bridgette, Keira Borrill, Louise Sorensen, et al: *Understanding Design for the Digital Humanities. Studies in the Digital Humanities.* Sheffield, 2015. HRI Online Publications. http://www.hrionline.ac.uk/openbook/chapter/understanding-design-for-the-digital-humanities; Visconti, Amanda: *Infinite Ulysses.* 2016. http://www.infiniteulysses.com/; Heuwing, Ben, Christa Womser-Hacker: „Zwischen Beobachtung und Partizipation – Nutzerzentrierte Methoden für eine Bedarfsanalyse in der Digitalen Geschichtswissenschaft." In: *Information – Wissenschaft & Praxis* 66 (5–6) (2015): 335–344. doi:10.1515/iwp-2015-0058.

26 Heuwing and Womser-Hacker, 2015.

27 http://welt-der-kinder.gei.de/.

and in guiding successful communication practice among different domain experts[28].

4 Experiences from Two Infrastructure Projects: DARIAH and CENDARI

This section reflects on the experiences made and problems faced in the two infrastructure projects CENDARI and DARIAH, and the opportunities they both offered. The work in DARIAH focused mainly on the evaluation of existing tools and services, as well as their integration into a digital workflow and the iterative monitoring of development processes with regard to usability. CENDARI established and conducted user-centered research with the goal of reflecting user requirements at an early stage in the design process.

4.1 DARIAH

DARIAH[29] is one of the landmark projects within the ESFRI Framework[30] of the European Union and one of the research infrastructures for the arts and humanities. According to the EU, the term "research infrastructure" refers to "facilities, resources and related services used by the scientific community to conduct top-level research in their respective fields, ranging from social sciences to astronomy, genomics to nanotechnologies."[31] The German partner DARIAH-DE[32] is financed by the Federal Ministry of Education and Research (BMBF) and is now in its third funding period. This period will end in early 2019 with the goal to provide a stable and fully developed infrastructure. One of the work packages in DARIAH-DE deals with the usability of digital tools and infrastructure components.

One main aim of this work package in the previous funding period was to accompany the development of tools and services and iteratively give feedback to support the development process. For this purpose, stand-alone applications[33] as well as digital workflows were tested.

In the case of evaluating *stand-alone applications* for instance, some well-established methods were used: heuristic evaluation[34] and thinking aloud tests[35]. Both methods do not need a large setup and are fairly feasible. We are aware that more extensive tests will always yield better results, but testing with a small group and confronting future users with software products will already gain valuable insights. As a first step, the application in question was evaluated heuristically by two usability experts using the guidelines set up by Nielsen[36]. Using such a standardized set of guidelines helps to establish a common measure by which to evaluate different projects. As an additional step, the tools were checked against the specific DARIAH-DE guidelines, which were primarily developed for the tools built for that infrastructure[37]. Secondly, a thinking aloud test was performed in which a subject was asked to fulfill common tasks concerning the tool in question. During that test, the subject is observed by one or two persons who take notes during the experiment and also remind the subject to continue to think aloud while completing the individual tasks. Ideally, a recording of both the audio data and the computer screen are made to better analyze the experiment.

To understand if the interchangeable use of tools and devices during the research workflow is possible and acceptable for researchers, an exemplary *digital workflow* was identified, designed and studied. The workflow comprised several steps that were performed on various devices such as desktop, laptop, digital camera, tablet and custom displays (see Figure 1). First, existing collections of tombstone images were integrated into a research data management (RDM) system (based on the *imeji*[38] software). Next, using a specialized app[39] on a smart device, new nearby locations with tombstones were identified. In

28 Heuwing, Ben, Thomas Mandl, Christa Womser-Hacker: Methods for User-Centered Design and Evaluation of Text Analysis Tools in a Digital History Project. In: *Proceedings of ASIS&T.* 2016. https://www.asist.org/files/meetings/am16/proceedings/submissions/papers/53paper.pdf.
29 Digital Research Infrastructure for the Arts and Humanities, http://www.dariah.eu/.
30 European Strategy Forum on Research Infrastructures, https://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri.
31 https://ec.europa.eu/research/infrastructures/index_en.cfm?pg=what.
32 https://de.dariah.eu/.

33 Stiller, Juliane; Klaus Thoden, Dennis Zielke: *Usability in den Digital Humanities am Beispiel des Laudatio Repositoriums.* Leipzig, 2016. http://www.dhd2016.de/abstracts/vorträge-058.html
34 Nielsen 1995.
35 Lewis, Clayton, John Rieman: *Task-Centered User Interface Design. A Practical Introduction.* 1994. http://grouplab.cpsc.ucalgary.ca/saul/hci_topics/tcsd-book/contents.html.
36 Nielsen 1995.
37 Romanello, Matteo, Juliane Stiller, Klaus Thoden: *Usability Criteria for External Requests of Collaboration. DARIAH-DE R1.2.2/R 7.5.* Göttingen, 2016. https://wiki.de.dariah.eu/download/attachments/14651583/R1.2.2-7.5_final.pdf.
38 https://imeji.org/.
39 See "Orte jüdischer Geschichte" (Places of Jewish history), http://app-juedische-orte.de.dariah.eu/.
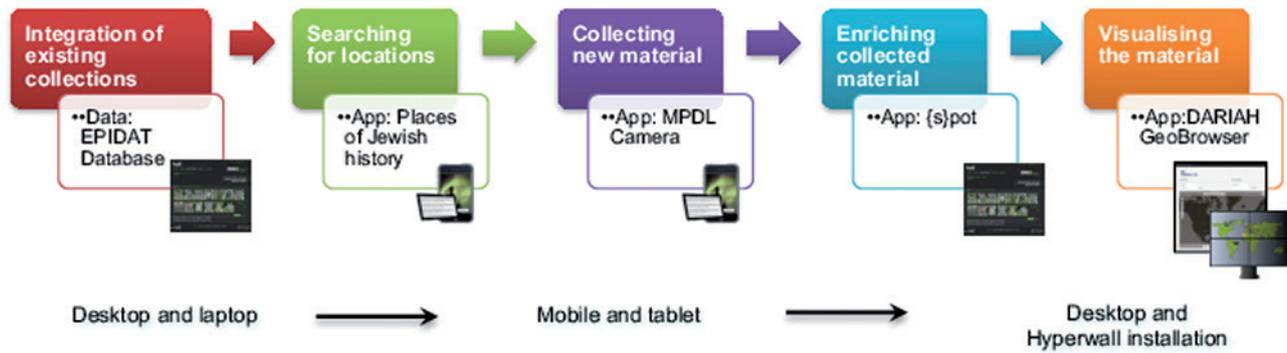
Fig. 1: Exemplary digital research workflow

a subsequent excursion in the field, using another specialized app[40] installed on a digital camera, a smart phone and a tablet, researchers took images of those tombstones. These images were automatically uploaded to the RDM system by the app. The uploaded images were further enriched with domain-specific metadata by using the RDM system web application on a desktop computer. As a final step, the image collections were visualized both on desktop computers and on a so-called Hyperwall display (an array of four 4K screens).

Depending on the task, 2 to 10 scholars were involved in this study. It showed that beyond the usability of one specific tool, the *ease of transition between tools and devices* is an important factor contributing to the overall user experience because researchers in the humanities often use several tools, potentially on different devices, during their research activities. This could necessitate data conversion and switching between devices in order to perform a particular research task. Since researchers commonly work with different devices, also in an everyday context, both multi-device and multi-tool interactions were considered to be acceptable.

One observation was that original *user expectations change depending on the research questions* pursued. We further observed the *expectations of the users from the mobile and web application tools* and how these reflect in the complexity of mobile apps intended for smaller displays, and the applications intended for use on bigger displays (e.g. web applications used on a desktop). In most cases, mobile apps have fewer features and thus a smaller set of interactions are expected to be learned and performed. Conversely, many desktop or web applications are much more feature-rich and seem to be designed under the assumption that the user will eventually spend some time

learning the tool. This is congruent with the expectations that researchers had regarding the devices: for capturing data in the field, it was deemed sufficient to let the device acquire data automatically and to assign only basic keywords. The proper documentation of the field work would later be performed on a desktop computer. On the implementation side, this may mean having to develop different user interfaces for one single backend (the database): a finger-friendly mobile version with reduced functionality plus a desktop application providing the complete functionality. For the visualization of data, it was found that the *high-resolution large displays are not always optimal* since not all applications tested support such high resolution[41]. To conclude, diverse factors influence the user experience in a complex digital workflow spanning several tools and devices, depending on the task they perform and the intent and context of use. This requires multiple approaches in addressing actual user needs. Tool development and efforts need not be underestimated, especially when such tools are part of a larger infrastructure and ecosystem.

4.2 CENDARI

CENDARI (Collaborative European Digital Archive Infrastructure)[42] was a 4-year European Commission-funded project with the aim to integrate digital archives and resources for the pilot areas of medieval culture and the First World War. The project brought together computer scientists and developers on one side, and historians and existing historical research infrastructures (archives, li-

---

40 See LabCam app, http://labcam.mpdl.mpg.de/.

41 Bulatovic 2016(a) and 2016(b).

42 http://www.cendari.eu/.

braries and other digital projects) on the other.[43] CENDARI intended to improve conditions for historical sciences in Europe through active reflection and using the impact of the digital age to respond to scientific and archival practice. The development of a virtual research environment was therefore planned with the aim to support researchers in their work with different tools and features that can facilitate their research.

In order to discern the actual needs and expectations of possible end user or researchers, so-called "participatory design workshops" were planned within CENDARI. The main goal was to determine the major requirements for a future environment, while avoiding the development of features and components that would find little interest among the end users. So the idea itself was a very simple one: why not ask researchers and stakeholders at different institutions what they think a good and usable virtual research environment needs in order to achieve or support defined research goals, or open up research questions in specific research areas. As simple as this may seem, the method of participatory design is not as widely used as one might expect. To understand the difficulties this method involves, in the following we will take a closer look at the method and how it was used in the CENDARI context.

In CENDARI, three participatory design workshops[44] were organized with three different user groups: historians, medievalists, as well as archivists and librarians. Participants held brainstorming sessions about the functionalities of their ideal virtual research environment. With the help of the workshop facilitators, they then produced paper and video prototypes illustrating the desired functionalities. Based on these prototypes and discussions with the participants, the main results of the participatory design sessions were threefold: a delineation of the historians' research workflow, a detailed list of functional requirements and some high-level recommendations to CENDARI.

First, CENDARI described a broad framework of how early stage research is conducted. In this workflow, they describe 11 non-linear steps. The iterative nature of the research workflow was also noted in the literature[45]. These steps were: research preparation, source selection, planning of visits to archives and libraries, archive and library visits, note-taking, transcription, research refinement and

annotation, knowledge organization and restructuring, refinement and writing, continuation and expansion, and collaboration support. Second, it was clear from the video prototypes produced during the participatory sessions that there were shared functionalities between the different user groups. In particular, networking, search, note-taking and visualization were the most popular features participants demanded for an ideal virtual research environment. Third, there were three high-level recommendations to the project: to take into account existing workflows, e.g. paper and digital, and accepted practices such as sharing notes and research material, to envisage methods that encourage participants to share or release research data, and to work closely with researchers by developing early prototypes and test beds.

The CENDARI functional requirements described above were "translated" into functional descriptions, which were evaluated by technical experts and then formed the backbone for software development. An interesting aspect of the development was the creation of use cases and user stories from selected system functions. These were intended to bring researchers and technical experts together by working on real research questions, and to help demonstrate the developed system functionalities in a coherent way.

In addition to these benefits, there were also some problems with this method of developing a new environment. One major issue was the diversity of requirements extracted from the use cases and user stories. Of course, there was accordance regarding some required basic functions like searching and browsing, but there were also great differences in the details. In relation to their respective research questions and areas, researchers came up with highly specific demands that would have required very much time for individual development. This problem could have originated in the selected case studies "First World War" and "Medieval Studies". Both research areas deal with numerous and varied research questions and involve different disciplines. At the same time, demands that were placed on the tools and components were in part delusive and could not be fulfilled. This and other problems led to many lessons being learned within the project, which will have great value for future projects dealing with similar challenges. We will take closer look at the lessons learned in the following section.

Besides the infrastructure and the virtual research environment contributed by CENDARI, the project also highlighted successful strategies for developing DH tools and areas where additional efforts are needed. In this regard, there were three key lessons learned concerning tool *design*, *implementation* and *adoption* that may be gener-

---

43 One should not consider a contradictory construction despite talk of two 'sides'.

44 Boukhelifa, Nadia, Emmanouil Giannisakis, Evanthia Dimara, et al.: "Supporting Historical Research Through User-Centered Visual Analytics." In: *EuroVis Workshop on Visual Analytics (EuroVA)*. 2015. doi:10.2312/eurova.20151095.

45 Mattern et al. 2015.

alized to the domain of DH. Concerning the design of DH tools, participatory design applied to DH problems was found to be a successful methodology in gathering user requirements and in bringing researchers and developers together. However, due to the many user groups involved in CENDARI (historians, archivists and librarians) and their diverse user requirements, decisions had to be made with regard to implementation. A "one system does it all" approach was not feasible. Therefore the strategy was to give priority to common needs amongst the different user groups (e.g. note-taking). This allowed a variety of user scenarios and stories to be implemented but may not have addressed the specific needs of a specialized user group. Finally, besides user-centered design, CENDARI also highlighted the factors that may impact the adoption of a tool, such as data privacy. CENDARI's recommendation was to keep historians' notes private by default and tagged entities[46] public by default. This was seen as being helpful to "spread [...] historical knowledge with little risk of disclosing historians' work"[47]. Another factor was user perception of the cost/benefit of structuring and enriching their research data. CENDARI's strategy was to demonstrate to users how their annotations can be effectively exploited, for example through visualization and faceted search.

5 Reflections and Recommendations for Usability Practices in the DH

Contrary to common perceptions expressed in the literature, as demonstrated with DARIAH and CENDARI, there are many projects in the DH that do address usability and that integrate user-centered design methods. Nevertheless, the resulting tools are often not easy to use or are not self-explanatory. Although usability guidelines and heuristics exist, many DH-tools fail to even comply with the simplest rules. In the following, reflections gleaned from our experiences within the infrastructure projects CENDARI and DARIAH[48] are presented. Three aspects were identified that influence usability practices in the DH: (a) heterogeneous research methods and data, (b) lack of in-

tegration of stakeholders in development processes, (c) project-driven development. Under each of these aspects, recommendations are given for raising the awareness of usability, both in its theoretical understanding and in its implementation during the development of DH tools.

5.1 Heterogeneous Research Methods and Data

One of the biggest challenges in the DH are the diverse research methods executed and the countless research objects in different formats. It is important to note that in the DH, scholars often experiment with new methods or employ old methods on new quantitative data. Generalizing usability guidelines for this domain is therefore very challenging.

5.1.1 Adhere to Standards

Research data can come from various sources and in various formats. Tool development should therefore adhere to standards and openness. For example, preference should be given to a tool that exposes a well-described REST interface over a tool where a direct database is the only means of access. Developing test data sets and providing users with sample data to test and play with the tool should be common practice. When aggregating heterogeneous data, it is difficult to find a common relevant denominator to answer upcoming and as yet ill-defined research questions. The proper representation of such data is a challenging task. It is better to start with a minimal set of attributes and then to iterate as more is learned about each data type. It is preferable that the REST interfaces are designed more generic and the user interfaces more specific.

5.1.2 Choose the Right Methods and Techniques

In essence, every research project tends to deliver novel features and methods. Software tools that are used should support such novelty and implement the necessary mechanisms. We are often already aware of some features that should certainly be implemented by the tool, such as the creation and curation of resources, searching, browsing, and so forth. Instead of implementing everything from scratch, one ought to try and find an open source tool that can be applied to the research domain and that provides the required functionality. The focus should be on an implementation of any missing features, either in the tool, as

---

46 For example, persons, places, events or organizations identified by users during their research and annotated in their notes.
47 Boukhelifa et al. 2015.
48 Adopting good engineering practices such as continuous testing, integration and builds, is a prerequisite for any software development. This aspect is well known and will not be addressed further here.

an add-on or through the integration of an existing service that supports them. If necessary, several tools should be used. The development of all features and methods from scratch should, as far as possible, be avoided.

5.2   Lack of Integration of Stakeholders in the Development Process

In the DH, different stakeholders often have conflicting ideas about the success of a developed tool and the significance of usability in achieving success. On the one hand, there are service providers and funders of digital tools who want to increase user acceptance and usage of tools. A high number of users could mean more and better networking scenarios within the specific research area and better statistical and heuristic analyses of the tool and its components. There is also the need to justify funding and to explain the additional benefits of developed tools and digital methods. On the other hand, there are scholars who are often considered to be mere users, having little influence on the design and development process. A deeper involvement of the scholars can lead to them being trailblazers of new methods and tools in the humanities and thus further advancing the field.

5.2.1   Assemble a Cross-Functional Team that Works Closely Together

It is vital for the whole development team to understand the scholars' needs, their vocabulary and research practices. Conversely, scholars should also have the chance to understand the reasons for limitations on the implementation side. A potential solution could be to build a team that comprises all parties involved, works closely together and shares their respective experiences as early as possible. The methods described above are examples of exactly such practice. The involvement of researchers in tool development is necessary from the very beginning. If possible, the team should be situated in the same location.

5.2.2   Understand the Users' Needs and the Project Goals

Innovative projects – especially large international projects – are often based in different locations. There is therefore a high risk of misunderstanding the goals and the requirements of the project due to a lack of communication, especially when it comes to diversity of scenarios that

need to be supported. Developing a common "language of understanding" is not an easy task. Communicate often and communicate openly. Start with the features of high-risk first. It is necessary to practice agile and innovative methods to help understand different aspects of future solutions and new developments and priorities[49].

5.3   Project-driven Development

Tool development in the DH is often driven by projects with strictly limited resources. These research projects often aim at developing tools that support new methods justifying the funding for further development of the field. A sustainable development of tools with a long-term perspective is often not the primary goal of such projects and usability considerations are often seen as the finishing touch – also in heavily funded projects. Even when funding is available to study the user experience, time or resources are lacking for an implementation of the results.

5.3.1   Document Everything – People Might Move On

Irrelevant of the duration of the research project, in many cases there are difficulties in hiring people. There are a few variations of this phenomenon: positions cannot be filled in time, people find other positions to pursue their research during a research project, newly hired people master completely different technology than the one already used in the project, and so on. Not only do these slow down the whole development process, it directly affects the user experience aspects of the project. Due to insufficient documentation of the work already done, additional time is required to understand the needs of the researchers who already expect a working solution, to adapt to changing goals, to introduce new members to the working environment, and so forth. In order to reduce the negative effects of such changes, one ought to use common components and apply common standards, keep the code clean, maintain a sufficient level of documentation and preserve project artifacts (e.g. design workshops, brainstorming outcomes, notes and meeting memos).

49 Hohmann, Luke: *Innovation Games: Creating Breakthrough Products Through Collaborative Play*. Addison-Wesley Professional, 2006. http://proquest.tech.safaribooksonline.de/0321437292; Luchs, Michael G., Scott Swan, Abbie Griffin: *Design Thinking*. John Wiley & Sons, 2015. http://proquest.tech.safaribooksonline.de/9781118971802.

5.3.2 Take Small Steps and Iterate

It is important to decide carefully about the prioritization of the user experience related development. For example, writing a one-time script to upload data may have little impact on the user experience in comparison to a web application for data entry or data annotation. In order to test what is acceptable before any implementation, one should practice at an early stage agile and innovative methods to address user experience by using several low-fidelity prototypes.[50] One should not try to model everything upfront. Instead, one can make many smaller-sized implementation iterations, thus reducing the risk of a larger part of the work being left unfinished.

6 Concluding Remarks

Juxtaposing the different aspects that influence practices and methods of usability in the DH has shown that the reasons for disregarding user experience can be manifold. Although there is awareness in projects of the importance of usability, results from studies are rarely taken into account during development. To increase user experience, however, one can start with very simple things when developing tools: even little usability is better than none. And it can easily be achieved by providing sample data or good documentation, which helps users in becoming familiar with the tool. With this presentation of user-centered design practices and the recommendations above in this article, it is hoped to narrow the gap between usability in theory and usability in practice.

Autoreninformationen

Klaus Thoden
Max-Planck-Institut für
Wissenschaftsgeschichte
Boltzmannstraße 22
14195 Berlin
kthoden@mpiwg-berlin.mpg.de
orcid.org/0000-0003-0434-3951

Juliane Stiller
Berlin School of Library and Information
Science
Humboldt-Universität zu Berlin
Dorotheenstraße 26
10117 Berlin
juliane.stiller@ibi.hu-berlin.de
orcid.org/0000-0001-8184-6187

Natasa Bulatovic
Max Planck Digital Library (MPDL)
Amalienstraße 33
80799 München
bulatovic@o2mail.de

Hanna-Lena Meiners
University of Göttingen
Göttingen State and University Library
Papendiek 14
37073 Göttingen
meiners@sub.uni-goettingen.de
orcid.org/0000-0001-7499-9345

Nadia Boukhelifa
UMR GMPA
AgroParisTech
INRA
Université Paris-Saclay
nadia.boukhelifa@inra.fr
orcid.org/0000-0002-0541-8022

---

50 Check some tools and resources for prototypes and mockups available at https://balsamiq.com/products/mockups/, http://www.axure.com/, https://www.build.me.