

Temporality and Innovation in Digital Humanities: The Case of Papyri from Tebtunis

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Abstract. Temporal aspects of Design Thinking (DT) innovation processes have not yet received enough attention. This paper discusses their importance in complex design situations involving non-located, multi-disciplinary design teams. We focus on three aspects: 1) awareness of temporal trajectories in the process and how to bring continuity to an otherwise fragmented workflow, 2) temporality of learning through such processes and 3) discussing opportunities for DT concerning temporal aspects of the process. As a research case, we use a project from digital humanities that aims to develop an innovative proposal for *Virtual Tebtunis*, a digital research platform enabling effective cooperation across organizations in possession of papyri and other articles from the ancient city of Tebtunis. Four workshops were organized in three locations, with varied groups of participants to carry out the Design Thinking process. The timeline of orientation, incorporation, and identification phases was used as an initial time framework. In the aftermath of the project, we were able to identify a richer framework for engaging with temporal aspects of DT processes.

Keywords: Design Thinking; Temporalities; Innovation; Digital Humanities.

1 Introduction

This paper is concerned with temporal issues when Design Thinking (DT) approach to innovation is used, engaging non-located, multi-disciplinary design teams in the design process.

Designerly ways of thinking and working are increasingly taking hold in diverse domains, from digital educational research [1, 2] to strategy and management [3–5]. The way designers explore problems [6], and how they approach solving them, has been used as a basis for design-led innovation approach [7]. Within the scope of this paper, DT is understood as a design *process* that is user-centered in its core, based on multi-disciplinary design team work, and supported, at least in the initial phases, by diverse methods and techniques that promote effective ideation and idea visualization, fast learning, creativity, rapid idea prototyping, evaluation of ideas and prototypes, synthesis and a concept definition that sets the direction towards a solution.

DT processes also raise epistemological questions related to how and why novel concepts emerge, develop, grow or die over time [8]. The time and the temporal aspects of design processes have been understudied and perhaps not reported on

accurately [8, 9]. Langley et al. state that empirical studies of changes in processes versus in things may be more challenging to operationalize:

“The language humans use to talk about our everyday world is naturally dominated by nouns, with verbs associated with action and change taking a secondary role. This may be one reason why so many process studies retain, to some degree, the language and ontology of substance even as they explore activity, event sequences, the unfolding of practices, enactment, and the dynamics of change” [8].

Referring to temporality in interaction design, Huang and Stolterman point out that the way stories around interactions are articulated, there is a risk of omitting, possibly significant, smaller events:

“In many cases, interaction designers and researchers describe an interaction just like they would tell a story. When people tell their own story, they describe the story details as a sequence of continuous events. ... Those descriptions, however, focus often only on some major events (particular sessions) during an interaction” [9].

Through our work with DT-led innovation processes at the University of Oslo Library [10–12], we have noticed that design teams need time for orientation, incorporation and identification phases, especially so when they are new to design and DT. The orientation phase relates to the initial, sense-making stage of the DT process, where learning about the design context, learning to relate to other participants in the team, and ways to capture and frame opportunities for innovation are central [13]. The orientation phase is the time of uncertainty, creativity, and exploration, unfolding through broad and divergent ways of thinking. The incorporation phase starts when, from the messy creative process, clarity emerges and the pieces of design puzzle begin to fall in place. Rigour, precision, and analytical abilities are needed to propose a small set of jointly shaped concepts that have a potential to lead to an appropriate and meaningful solution. Loosely, the orientation and integration phases follow the divergent and the convergent thinking. However, from the time perspective, many other factors influence the time needed for orientation or incorporation, e.g., level of experience with DT teamwork, the expertise of participants, their communication abilities, mindset, motivation, and attitude. The identification phase has to do with seeing values of the final concept, holding responsibility for it, identifying with it and evolving it further, with a sense of ownership. Fig. 1 shows one possible unfolding of orientation, incorporation and identification phases of the process and their relation to a model of DT. These three phases also appear in the work of Karapanos, Zimmerman, Forlizzi, and Martens [14]. These authors reflect on user experiences of interactive products over time and describe temporality of use experiences with digital artifacts as a timeline crossing the orientation (becoming familiar with the product), incorporation (prolonged use) and identification (how the product becomes meaningful in one's life). Although the meaning of these phases in the DT process is different than in the experience of use, there is a relation between the two that can guide the design process. In addition, at the macro level, when an organization engages in DT-led innovation processes, the organizational changes can be described as a timeline across these phases. The organization gets exposed to DT (orientation), integrates relevant practices (incorporation) and finally, recognizes (identifies with) a set of new values shaping an innovation culture within the organization [15].

The temporal view of actions in DT processes is particularly relevant when carried out in distinct multi-disciplinary teams, across several locations. The three

temporal aspects of main interest for this paper are: i) awareness of temporal participation trajectories in the process and how the repeated participation can bring continuity to an otherwise fragmented workflow, ii) temporality of learning through fragmented processes and iii) opportunities for design thinking researchers and practitioners to open and apply temporal concerns in design processes in general.

Many academic libraries are looking at DT as a strategy towards a sustained innovation. Among them, several are exploring how to become knowledge hubs [16, 17]. The University of Oslo Library was directly inspired by the Stanford d-school model [18] and other organizations, public or private, that run similar hub-like, structured design processes. The case presented in this paper is a case of such engagement within digital humanities, supported by the University of Oslo Library. This way of working is still novel for the library and represents the direction that the library wishes to explore further.

The first author of this paper, in particular, has been engaged in seminars, workshops and design interventions that were organized as means of introducing Design Thinking, and later, supporting its integration with everyday work practices at the University of Oslo Library. Exploring DT in the hub-like setting was desirable from the library perspective, as the library could contribute in several ways, also by drawing in the appropriate human resources to discuss innovative solutions to problems of relevance for the academic community. Thus, when the first author got contacted by one of the two main investigators on the *Towards a Virtual Tebtunis* project, Design Thinking and a hub structure for organizing the project work were proposed to the investigator and accepted.

This paper describes what we learned about temporal aspects of DT processes, based on the case of *Virtual Tebtunis*. *Virtual Tebtunis* was a multi-disciplinary effort to use DT to propose an innovative digital research platform for studying artifacts from the ancient Middle Egyptian town of Tebtunis. The DT process was organized across three different organizations, aiming to propose a joint concept for the *Virtual Tebtunis*, to be further developed through the next collaborative project. Thus, we expected the orientation and the incorporation phases to cover almost the entire timeline of the project. We aimed to explore the interdependence of participation trajectories for selected participants and the timeframe for orientation and incorporation. The identification phase was to take place only towards the end of the project. The formulation of the proposal that is satisfactory for all participating research groups could lead to identification and feelings of ownership.

A time dimension could also be added to material findings, from the ancient times and life as it was in Tebtunis to the time that could be designed along very different principles within the *Virtual Tebtunis*. The material findings are predominantly papyri, but also other objects, such as vases, dishes, and jewelry. The Tebtunis site is still being excavated. Thus, as mentioned in [8], the project could be talked about both in terms of verbs (activities) and in terms of nouns (artifacts). We focused on the former, but the later emerged through the process organically.

The paper is structured as follows: In the next section, we provide the needed background for DT, dialogical space, creativity and digital humanities. In Section 3, we provide a short review of temporal aspects in interaction design and design thinking processes. In Section 4, we address the case of Tebtunis. Discussion on temporalities is presented in Section 5, which is followed by the conclusion.

2 Background

This section is divided into four themes: design thinking and innovation, dialogical spaces, creativity and digital humanities. These, together, set the stage for this work.

2.1 Design Thinking and Innovation

Design thinking has been defined in many ways, and there is still no universally accepted definition. The one provided by Brown is frequently used and describes design thinking as “a human-centered and collaborative approach to problem solving that is creative, iterative and practical” [19]. Noweski positions knowledge and change as more central concepts: “design thinking reproduces knowledge through action with the goal of changing existing situations into preferred ones” [20]. Rubin’s view of DT is that of a “model of design as a means of enactment in which norms are tested against the complexities of particular temporal situations” [21].

In relation to innovation, a series of successful examples of the use of DT have been mentioned [22], but how to adapt this approach for longer-term processes and particular kinds of situations, is little discussed. The innovation processes are usually seen as the alternation between different thinking styles, most importantly divergent (broad investigations) and convergence (the ability to analyze and focus), see Fig. 1.

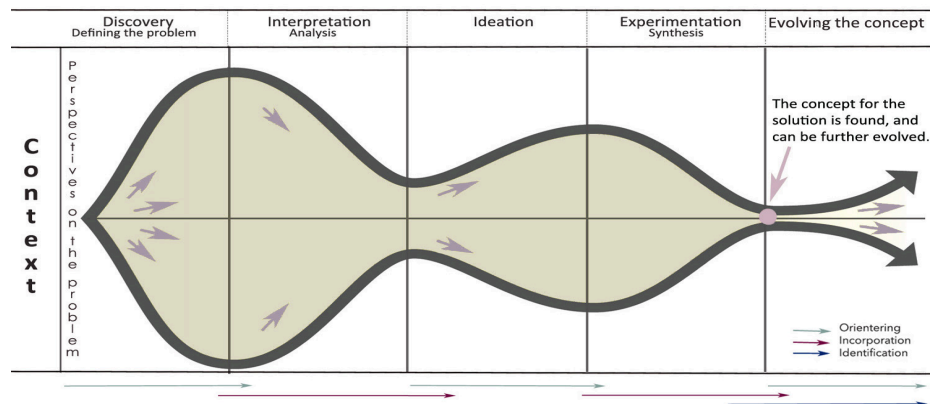


Fig. 1. Innovation using design thinking and alternating cycles of divergent and convergent thinking. The arrows at the bottom of the image show the phases of the process: orientation, incorporation, and identification.

When DT is introduced in organizations as an innovation strategy, a concept of innovation capability of the organization is often used [23]. As expressed in [24], it is the “preparedness of the firm, or its ‘muscles for innovation’.” According to Schreyögg and Kliesch-Eberl [25], organizational capabilities are close to the action and cannot be separated from acting and practicing: “They are brought about by social interaction and represent a collectively shared way of problem-solving”. While the organizational capabilities can be framed in different ways, we adapt Cristensen’s

model to a year-long work on a complex project like *Virtual Tebtunis*, in the context of the University of Oslo Library:

1. Available resources, seen as resources in people, their competence and knowledge, technological resources, networks, space, products and services, information, financial resources, and relationships with external partners that the project has.
2. The capability to organize processes, structures, people.
3. Values, norms, culture, and criteria used for decision-making.

Furthermore, Assink [26], speaks of adoption barriers to innovation within the organization. From the five main barriers presented (ibid.), we could, prior to the start of the project see how the following three could affect the outcome of the project: mindset barriers (towards leaving known areas of expertise at both the individual and the organizational level), nascent barriers (lack of skills and motivation for innovation, learning how to think like a designer), and infrastructure barriers (related to the feasibility of the technology).

2.2 Dialogical Spaces

Design thinking often involves teams of people working on a problem. It is thus, regarding capabilities (also barriers) highly relevant to use their skills and knowledge appropriately when working on a set of possible solutions to a given problem.

The type of competencies each of the participants has is essential and needs to be taken into account. In fact, while there is a general understanding of the dynamics of the teamwork, e.g. [27], we believe that time aspects here too were understudied. Using the DT approach in teams gives the participants new competencies, learning happens fast, and shared understandings are built over time. Moreover, creativity in teams [28] needs to be better understood within the DT approach, especially where most team members were novices to DT and non-designers, as is the case in *Tebtunis* project.

Scholarly knowledge exchange needs to unfold, [29]. The process of exchange needs to be arbitrated, facilitated or moderated to ensure that the participants are building on their collective knowledge and that they jointly define the meaning and values related to the project [30]. A common project language is usually created through this process [31]. As more than one dialogue can be taking place simultaneously within a team, we named a space for these exchanges a dialogical space. A dialogical space includes ways of articulating explicit, tacit, observable, and even latent knowledge of the participants.

During the design process, mutual learning happens, based on a team-reflexivity [32], hands-on engagement, careful articulation. Thus, forming teams, creating and cultivating a common project language, sharing and arbitrage of knowledge, making sense of the problem in a given context and meaning construction all belong to the orientation phase of the process, and demand both shared and individual time for catalyzing teamwork and establishing good conversations underway.

2.3 Creativity

Different phases of DT process are supported by different methods, including brainstorming, visualization, gaining of user perspectives, rapid prototyping, and evaluation. As mentioned earlier, the DT approach needs divergent ways of thinking, to allow a broad spectrum of insights. The convergent ways of thinking help to sort out less relevant ideas and allow the better derivatives to arise. Therefore the DT approach positions creativity as one of its core activities [33]. Both divergent and convergent thinking are necessary for the activity of defining and solving problems. Table 1 provides a list of typical ways in which divergent and convergent thinking are supported. Column one gives an understanding of the activities typically used to build a sensibility of the insights needed to define the problem area. How a person is more or less “*sensitive to problems*” [34] is a critical factor, and connected to the ability of participants in design activities to think outside their knowledge constraints. The aim of divergent thinking is to produce multiple and unexpected combinations, as doing several iterations of the problem definition, complement the problem solution effort [35]. Column two describes characteristics of convergent thinking. It requires an analytical and precise act, narrowing the possibilities using rigor.

Table 1. Characteristics of divergent and convergent thinking, based on [33].

Divergent Thinking	Convergent thinking
Being unconventional	Recognizing the familiar
Seeing the known in a new light	Combining what “belongs” together
Combining the disparate	Being logical
Producing multiple answers	Honing in on the single best answer
Shifting perspective	Reapplying set techniques
Transforming the known	Preserving the already known
Seeing new possibilities	Achieving accuracy and correctness
Taking risks	Playing it safe
Retrieving a broad range of existing knowledge	Sticking to a narrow range of obviously relevant information
Associating ideas from remote fields	Making associations from adjacent fields only

Addressing tension and the common alternation between the two ways of thinking, especially with participants who are non-designers, but researchers of high standing as is a case in *Tebtunis* project, some issues may occur. Firstly, the “fixations” may be encountered, where some ideas at first are simply blocked [36, 37]. Alternating divergent and convergent thinking may mitigate this issue. Alternating between radically new suggestions and conservative views is generally seen as beneficial to the process. For instance, “Seeing the known in a new light” requires a shift in perspective to foster possible new understandings. These characteristics are also relevant for the choice of participants, for example, selecting some participants with

domain-specific expertise (such as expertise on papyri in the case of Tebtunis, or in archeology) and some with expertise in design, ancient languages or technology may help with shifting perspectives, taking risks and the ability to retrieve a broad range of relevant, existing knowledge within the team.

2.4 Digital Humanities

As Monson and Taie point out in [38], only recently systematic attempts have been made at the site of Tebtunis to relate texts written on papyri to the archaeological contexts from which they came. The role of libraries and museums is interesting in this process since they have not only access to old items in their collection, but also quality checked information online. Often, libraries and museums need to deal with systems that combine their resources and different types of technologies designed for specific needs. Digital Humanities is a field that studies this kind of intersection with technology in humanities. However, solutions for digital humanities were, and still are, very often implemented by the researchers in humanities themselves, possibly with the help from an IT person working at the institution. The consequence is that the technology platforms developed in this way only loosely follow the epistemological path the researcher had in mind [39]. Recently, use of external IT consultancies became more commonplace in digital humanities projects, increasing the focus on technical aspects of projects [40]. *Towards a Virtual Tebtunis* is an example of a digital humanities project, where the researchers wanted to, together with others, bypass these problems.

3 Temporality in DT Processes

In [41], Lundgren and Hultberg propose to use temporal themes as thinking techniques. Although their interest was in exploring time as a design material, they outline several time-related themes to draw on in their explorations that can be appropriated as ways of thinking of time in the process organization. In this context, the unbroken or continuous time (the time that runs in unbroken intervals, but its speed can be altered), sequential time (implying the chronological order of events), fragmented time (shuffled in time, making random sequences in relation to chronological time) and juxtaposed time (overlapping sequences of time) can all be of importance. In [42], the authors propose to distinguish between the 'feeling' or perceived time and the real-time, Chronos and Kairos. In [43], Velt et al. explore the use of trajectories in Human-Computer Interaction (HCI) literature, focusing on their use, and exploring the potential of trajectories to form a 'native' HCI theory. These papers are all highly relevant for understanding the temporal aspects of DT processes.

3.1 Finding out how DT Practitioners and Researchers Think about Time

As we could not find much relevant literature on DT and temporal influences on the process, we decided to try to understand the relation between time and both

capabilities and innovation adoption barriers in relation DT processes by inquiring how other researchers and design professionals deal with temporal issues. To that end, we organized a workshop to explore this theme. We wanted to find out from those working with design thinking how they think about time in DT processes, learning and acquiring skills and mindsets needed. The workshop had seventeen participants, including interaction designers, social media researchers, librarians from academic and public libraries implementing DT in their organizations, design consultants, product designers and design researchers.

The participants were asked to use post-it notes and describe their design thinking projects regarding time (short, intermediate, long), reflecting on what was done in that time. Alternatively, they could place methods on the timeline and point to how much time was need to implement them correctly, see the top image in Fig. 2. As can be seen from the middle image in Fig. 2, the vast majority of participants engaged in short time activities, the few examples on the long side had to do with the use of products or services and their evaluation. A more thorough analysis of this workshop findings is outside the scope of this paper. It suffices to say that it helped us to become more aware of time aspects in design processes, but we still did not know how to instrumentalize this.



Fig. 2. The participants, in groups of 3-4, placed post-it notes on a DT timeline. The top two images feature the workshop with researchers and designers and the bottom one is from the session with librarians. Source: authors.

3.2 Finding out how Librarians Think about Innovation and Time

Subsequently, we organized a second workshop, with six participants, three of them librarians that were to innovate services within a library. They were asked to reflect on organizational capabilities and time, see the bottom image in Fig. 2. They considered organizational changes to take a long time, changes in culture were deemed to be mid-range, while value changes, economy, and technology were viewed as more variable and shorter-term changes.

In general, the two workshops helped us to empirically confirm what the existing literature states: time and temporality are underused, and our participants, in general, were not engaged with temporal concerns, many times not at all beyond the time management and process planning. Moreover, if they were, it was because temporal issues were in the forefront already, e.g., they worked with scheduling problems, the design of collaborative tools, or notification services.

4 The Case of Tebtunis

The project was first proposed by the Center for the Tebtunis Papyri at the University of California, Berkeley and The Papyrus Collection project of the University of Oslo. These organizations possess the most significant assemblages of Greco-Egyptian papyri in their respective regions (North America and Scandinavia) and are internationally recognized leading centers for papyrological research and instruction. Nearly the entire Berkeley collection and a significant part of the Oslo one come from the Middle Egyptian town of Tebtunis. Tebtunis is one of the best-documented settlements from the ancient Mediterranean world due to the tens of thousands of texts and other archaeological objects that the site has yielded. Moreover, objects continue to be unearthed each year in ongoing excavations. In particular, the site's temple dedicated to the crocodile god Soknebtunis has generated the most interesting papyri library to survive from Antiquity. Tebtunis has been subject to extensive illicit excavations, and as a result, objects from the settlement are literally scattered across the globe: beyond Berkeley and Oslo, they are to be found in Ann Arbor, Berlin, Cairo, Copenhagen, Florence, Lund, Milan, New Haven, Oxford, Padua, Peterborough (Ontario) and Turin. Access to these collections is not always easy, and the fragments are difficult to collect. Besides, papyri are written in difficult scripts. The number of people possessing the philological and paleographic skills necessary to work with these papyri is rather small, and experts are not present at some of the institutions holding the texts. The aim of *Towards a Virtual Tebtunis* is to overcome these difficulties, that is, to begin the work necessary to realize Tebtunis' unique potential as an object of historical inquiry. Researchers at papyri considered digitalization, an appropriate digital platform, as a possible solution towards this end. Many of the Tebtunis papyri are already available in various forms (texts, images) through digital resources (papyri.info, tebtunis.berkeley.edu, and Oslo Papyri Electronic System). Much work remains, however, e.g., over 10,000 Berkeley papyri are entirely "off the web," and electronic access to other archaeological objects is significantly behind the papyri.

Taking the DT approach to engage with the project like *Towards a Virtual Tebtunis* implies organizing teams and the process workflow, based on the needed expertise. We started the process by forming a core group of researchers for the project. This group included two principal investigators (papyrologists), authors (researchers on DT), and a subject librarian responsible for the papyri collection. Methods were proposed for discussing themes related to what *Virtual Tebtunis* could be, the feasibility of existing technological solutions to support the *Virtual Tebtunis* proposal, and how it could be opened to audiences beyond researchers. It was decided that a preparatory workshop would be conducted in Oslo. The expertise of teams, workshops lengths (in relation to innovation potential), tools and techniques were to be tried in preparation for the three main workshops in locations possessing a substantial amount of Tebtunis papyri: Berkley, Oslo, and Padua. Workshops were to be similar in all three sites so that findings could be related to overarching goals, and generate solutions, including the digital platform, that all involved institutions would be willing to use and collaborate across. For most participants, this project was the first meeting with design thinking, and for others, even if they had exposure previously, designerly ways of thinking and working were still not familiar grounds. The time allocated for the project was one year, but the workshops were conducted within four months.

4.1 The preparatory workshop

The preparatory workshop, held in Oslo, engaged ten participants: two librarians, two design researchers (the authors), a papyri subject librarian, two papyrologists, a research assistant on the *Tebtunis* project, a web-editor and a researcher in Egyptology. Only four of the team members were having a direct interest in the project itself. The others were chosen based on perspectives they represented, their potential to contribute towards the goals of the project, time availability and an open mindset and interest to partake in a workshop using DT [10, 44].

The workshop started with a brief introduction of the DT approach, as well as the *Towards a Virtual Tebtunis* project and its goals. The technique to set everyone thinking about the design was based on cards (At One cards [45], and a set of 28 self-produced ones to discuss Tebtunis artifacts, languages on papyri, and technologies, or games such as Minecraft, that could be of interest), see Fig. 3. Further, exemplars of papyri, post-it notes, and pens were provided. As an ice-breaker, each person was invited to take a card that they relate to their current understanding of the project. In turn, participants explained how they could engage with the project, and explained the choice of the card. Subsequently, two groups were formed, one with focus on the perspective of museums and libraries (papyri owners), the other on the research perspective. The groups were encouraged to create user's journeys on the future platform. What could users do with a platform (as researchers, visitors, or interested papyrology armatures)? Some ideas that emerged were to make online representations of ostraca (writings on pottery pieces) on all sites and allow people to collate them together. The collated pottery could help the scholars to place the findings both in time and place. Variation of this idea involved the 3D printing of ostraca pieces and constructing a physical puzzle.



Fig. 3. The use of cards during the preparatory workshop, examples of papyri. Source: top and bottom images, authors; the middle images are from the OPES collection, used with permission.

Suggestions emerged on how to combine existing sources of information, like papyri.info (a large textual database with images of papyrus), with other databases. This, it was argued, would allow for richer and more innovative ways to work with existing data. One of the ideas was to combine geocaching [46], with advanced scholarly systems. As one of the scholars pointed out, “*we should be allowed to pin papyri data on a map*” using the textual information of the papyrus to locate the place where the item was found. Enriching map spots with relevant metadata, including library information about different types of publications, could be a valuable new resource for scholars. Several suggestions were based on a combined insight from different participants and their competence areas. The workshop took approximately two hours.

In summarizing what we learned from the workshop, we could say that group composition and competencies of participants worked well in the sense that different perspectives were really used in the discussion, and participant’s knowledge and skills contributed to broadening the design domain. The activities were experienced as creative. We could also observe that participants did not push own ideas to the point of the group becoming fixated on one idea prematurely. The new understandings and co-created meaning of the project that started to emerge appeared to be based on a ‘fair’ (equal) participation. Epistemologies of different research fields that were represented were discussed. Also, the participants engaged in the discussion of how and what the technology can potentially contribute towards the desired outcome of the project. The new framing of the problem space was agreed upon, and new language was learned (e.g., concepts from DT, concepts related to the technology and

interaction). For example, two participants shared their own experiences with digital humanities and how they learned that it was necessary to reflect over the connections between their understandings and experiences and the process that was unfolding at the workshop. From this, we could say that a dialogical space was being formed, and had a potential to be further evolved. We could also see the seed of innovation capabilities.

The summary on time. We experienced that people we asked to participate in the workshop were willing to commit two hours of their time. More time was hard for some. However, materials on design thinking that we sent in advance were not read by anyone. The motivation to learn about DT and find time for reading, was not present before the workshop. After the workshop, the interest in the methodology increased, and several participants came back with further questions related to the approach. We found that, overall, the workshop was too short. Most of the time was spent on orientation (what is design thinking, establishing what knowledge and skills were available, how to communicate across disciplines, how to understand the design domain and on ideation). A small amount of time was used on the incorporation of discussed ideas, mainly through preparation for in plenum presentation of the group work. Referring to the Fig. 1, the workshop timeline covered the discovery phase.

Post-workshop, a rapid prototype of a Tebtunis site was made in the Minecraft application [47], loosely based on the real map of Tebtunis. This was done to discuss the potential that the collaborative environment building offers, including a possibility of using the gamification approach, see Fig. 4.



Fig. 4. Tebtunis prototype in Minecraft - a tool to think about how to represent places where artifacts were found, possibly including gamification, on the one hand, and crowdsourcing the building of the site on the other.

4.2 UC Berkeley Workshop

This workshop was conducted at the Bancroft Library, at UC Berkeley, only days after the preparatory workshop in Norway. For the first time, the two principal investigators, the Norwegian and the American professors in papyrology, the core group members, participated. Given that most of the time in Oslo was spent on

orientation, we wished to shorten the time it takes to introduce DT. Therefore, two meetings were scheduled and held before the workshop, one with the papyrology professors, and the second one with the librarian from the Bancroft Library, with expertise in digital humanities, and specifically, metadata. In both meetings, DT was briefly explained. Subsequently, the epistemological trajectories [39] were discussed in relation to the creation of new knowledge and innovation in both research and technology.

Given the experience from Oslo, a whole work day was scheduled for the workshop. Participants, from the core group, were the two papyrology professors, the subject librarian, and a design researcher. The new participants were a Ph.D. student of design history from Norway, a design researcher, two Ph.D. students in papyrology and the metadata librarian. The participants were divided into two groups, the first focusing on papyrology research and new opportunities created by technology, and the second one considering other possible contributors to the research.

This time too, the ideation phase was exciting for all participants. A rich set of ideas was proposed. For example, Google Street View with the 'time machine' slider was proposed for Tebtunis. This idea was liked and presented an option to be considered for the new platform. By moving the slider, one could see how the 'street' view was changed in time. The items discovered at a specific time could appear and then fade as the time changed. This idea was based on the concept of a timeline and historical trajectories. This was also a beautiful example of temporality in 'nouns' as discussed in the introduction.

Some participants were inspired by The London Street museum App [48], as an additional option for the *Virtual Tebtunis*. Users could collate photos, maps, and positions on the maps. It was suggested that it would be cool if users could, for example, toggle a building, switch to a 3D mode, walk inside the building. Several conversations were started around different approaches to help the person in situ. Furthermore, ideas included two-dimensional aspects of the future *Virtual Tebtunis*, such as the Minecraft based one, or, accessing Flickr images of buildings, enriched with narratives related to specific places. In conjunction with the user perspective, a navigator was proposed for referencing people whose names were found on papyri. Their names could be pinned on the Tebtunis map. This was an expected input since UC Berkeley was working on a prosopography project [49]. A sort of the 'Library mode' was discussed, e.g., a text search could show articles and books on the map, introducing or discussing different items. Other ideas included making the site function as a peer-reviewed journal, making a closed user group for adding relevant metadata. Solutions for engagement of interested amateurs were partially based on the ones from the preparatory workshop, but new ideas were added. For instance, placing a museum artifact into the context of Tebtunis was desired. A possible solution was an app that could render a 3D image from the photo of the museum object and place it in the *Virtual Tebtunis* site. Many rapid prototypes were made, including mascots for the service, video streaming from the excavation site, and various apps.

What we learned, in summary, is that with more time, it was natural to engage hands-on. Participants constructed and visualized representations of high-level user journeys articulated their knowledge well and used the cards as a tool to construct and cultivate an adequate common project language and the dialogical space. We could observe all characteristics of divergent thinking listed in Table 1. Analysis of data

gathered through this workshop shows how new participants added new inputs into the process and in doing so, used more creative, unconventional and out of the box approaches, e.g., the introduction of a mascot could be understood as quite unconventional, taking into account how highly classical the subject of papyrology can be. The workshop process was viewed by participants as engaging, and an overall positive experience. One of the principal investigators pointed out: “... *it helped me really to reframe my thoughts*”. The innovation capabilities demonstrated by this team during the workshop were excellent.

The summary on time. Even though the workshop took the whole day, time was experienced as just right. The workshop ended at the moment where all participant could project in time the vision of the future *Virtual Tebtunis*. They could envision real, possible, alternative, and achievable solutions. This time, the team went beyond the orientation phase. They prototyped and evaluated ideas, applied convergent thinking and synthesis to present a few concepts that they would want to continue to work with. Thus, the orientation and incorporation phases roughly followed the arrows at the bottom of the image in Fig. 1. Some participants also showed a tendency to identify with a few selected ideas that were not their own, thus also engaging, at least partially, in the identification phase.

4.3 Oslo Workshop

This workshop was carried out some months after the Berkeley one, and a few days prior to the Padua one. In total, ten participants were present. There were some repeat participants. The only newcomers, invited by one of the principal investigators, were an archeologist and a dramaturg, versed in ancient languages. Since many participants were now familiar with the methodology, the time for the workshop was reduced to half a day.

The participants, just like in Berkeley, were divided into two groups, with identical themes to explore. The memos from the Berkeley workshop were shared. We were unsure how this sharing would affect the process. The concern was that the participants could get too focused on the memo, thus, reducing the creativity. Alternatively, it could shorten the time leading to ideation. During the workshop, an archeologist showed how Autocad could be used to render ancient buildings using accurate data. A project from the Humboldt University was shown, where students had plotted in data to reconstruct a 3D representation of the Forum Romano [50], see Fig. 5. This was also an example of the use of technology otherwise intended for other purposes, and it could be used for Tebtunis. The technology gave more visually impressive results than Minecraft, Fig. 4, but Minecraft had the advantage that anyone could use it. The archeologist was interested in making 3D representations of smaller items that are typically found in Tebtunis as well. He had experience with Agisoft software that can combine several photographs of an archeological object, resulting in a 3D digital representation of the artifact. Minecraft and Autocad (Fig. 4 and Fig. 5), and ideas around timelines from Berkeley workshop were opening up many possibilities for synthesis and building on a combination of a portal for interested amateurs and a portal for researchers.



Fig. 5. Digitales Forum Romanum, an example of what can be done in Autocad. Source: [50].

The group working with solutions for other possible contributors to research on papyri came up with a broader range of audiences, from high school students to retired adults, using learning resources for schools, open lectures for the broader public, and papyrology games and apps for older adults related to possibly tedious research tasks. In this context, more general concerns around technologies for digital humanities were discussed, articulating the desire for a slower rate of changes in technology and less disruption, in particular, if older adults were to use the research platform over time.

What we learned, in summary, is that experienced participants did influence the outcomes positively. The findings from the workshop show that the work was more complex and richer in terms of bringing in new perspectives, as well as including technological aspects more explicitly.

The summary on time. Regarding the timeline phases, they were similar to the Berkeley workshop, with identification phase a bit stronger in relation to the potentially interesting idea of technologies for humanities that would change slower. This workshop clearly demonstrated that repeat participant trajectories not only shorten the time but enrich the outcomes, i.e., the more experienced team members were, the better time usage was possible. This is as expected, but very clearly demonstrated.



Fig. 6. The image shows how the memo from Berkeley, digital and paper maps, cards and digital tools such as Autocad were used in this workshop. Source: authors.

4.4 University of Padua Workshop

Workshop at the University of Padua had four core team members (the papyrology professors from UC Berkeley and Norway, the subject librarian from Norway, and one of the authors) and two other participants who attended one of the previous workshops. Although researchers from Padua had no representation in the core team, they were an essential stakeholder in the process. Therefore, several informal meetings before the workshop were held, so that all three research groups could exchange concerns related to the project. The University of Padua, besides papyri from Tebtunis, has an extensive collection of objects, as well as excavation images and other data. Therefore, new participants in Padua besides archeologists, papyrologists, a design researcher, included representatives of museums that owned papyri, and other objects, a total of eight persons. The workshop time got extended to a full day again so that there will be enough time for orientation, incorporation, and identification. Post-workshop, a meeting with the core group and researchers from Padua was scheduled to synthesize observations, ideas, concerns – both the methodological ones and those related to the technology.

The process during the workshop was the same as in the previous ones. However, the group distribution was determined by senior researchers, that decided to work together. Thus, one group had all the senior researchers in papyrology, archeology and the museum field, while the other group gathered together young researchers, librarians, and designers.

The first group brought forth concerns regarding copyright of artifacts that were not yet studied and their representation in the *Virtual Tebtunis*. The group also engaged in rapid prototyping of user journeys using cards. Many ideas emerged, some inspired by cards, and others by situated knowledge. For example, the possibility to export 3D representations of the virtual city to other formats engaged participants in a discussion of issues related to the accuracy of digital reconstruction. Similar to Oslo workshops, other more profound and more difficult questions emerged. This time, for example, how to cope with museums' sometimes bureaucratic conduct. Finally, problems with competing values regarding artifacts, when researchers were from different fields (archeology vs. papyrology), showed the complexity of issues one needs to deal with to find solutions. This was a positive experience for participants since the group was then able to identify possible future problems and note that these need to be solved.

The second group generated a record number of ideas, 26, ranging from conferences in the *Virtual Tebtunis*, to securing the sustainable development of services for the site. The second group generated a record number of ideas, 26, ranging from conferences in the *Virtual Tebtunis*, to secure the sustainable development of services for the site.

The participants also this time were very positive regarding their experience of the workshop. Comments like “*This was a change in how we think and the way research can be done*” were given.

What we learned, in summary, was that even though the approach used was very similar to that of previous workshops, the experience of this one was very different. It allowed for deeper rooted issues between the research fields to emerge. The particular division into groups and similar seniorities of researchers perhaps enabled a more in-

depth and heated debate. They also influenced the amount of time needed to reach some form of consensus. However, the workshop indicated significant innovation opportunities also affecting museums.

The summary on time. Concerning the project timeline that the core group had in mind, this workshop was to be the one that would end in one or two possible proposals for the *Virtual Tebtunis* that all three research groups could identify with. In other words, our aim for this particular workshop was to pass through all three time-phases. However, although we could claim that orientation and incorporation phases were present, the identification phase was clearly absent. Many factors could have contributed to this situation, and some do not have to do much with time.

The most important lesson from this workshop for our research was that we need to address time and temporal issues in a richer and more holistic manner. Also explicitly engage design teams with this material.

5 Temporality lessons from the *Virtual Tebtunis*

Our thinking about temporal aspects of design processes, at the start of the project, were related to very simple concerns about the use of time in the workshops, and how much time was needed to properly time-manage the DT process for innovation in digital humanities. Specifically, we were interested in three aspects: 1) awareness of temporal trajectories in the process and how to bring some continuity to an otherwise fragmented workflow, 2) temporality of learning through such fragmented processes and 3) discussing opportunities for design thinking that arise in conjunction with temporality concerns.

5.1 Trajectories, Continuity and Segmented Time

The nature of the project was such that we had a sequential, yet fragmented process because main stakeholders were not co-located. They also had different academic cultures even within the same field (papyrology). Thus, our concern was how to provide some continuity in the otherwise fragmented workflow. The solution that we found was to use the notion of participant trajectories and their orchestration [43]. Those were interleaved in such a way that one papyrologist, one DT researcher and a special librarian were present at all workshops. The core group, except the preparatory workshop, was represented by four participants in Berkley, Oslo, and Padua workshops, see the bottom five trajectories in Fig. 7.

Furthermore, the intentional similarity in conducting workshops was to provide an opportunity to juxtapose the workshop activities and lengths of time they required for different phases of the process. This was to help analyze both emergent similarities and differences. Similar ideas and concerns, we reasoned, could facilitate articulation of the proposal for the *Virtual Tebtunis* that all stakeholders would feel the ownership over. Differences could show ‘pain’ areas to address, such as the quality and ‘reality’ of cooperation. However, we allowed for variations, as can be seen from descriptions of the workshops, e.g., sharing of information (Berkeley memos), use of digital tools,

the length of workshops, and from Fig. 7, which shows differences in numbers of participants and participant's profiles. Still, even if not applied with rigor, awareness of different times (continuous, segmented, and juxtaposed time, [41]) was helpful.

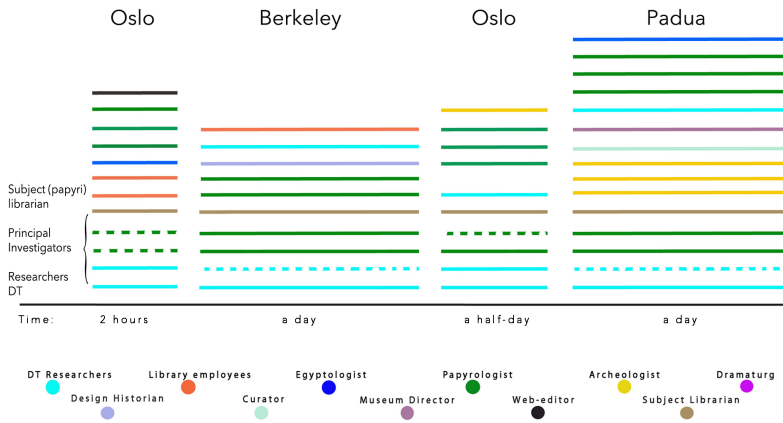


Fig. 7. The image shows the workshops and profiles of the participants in each one. The bottom five trajectories of participation represent the core project group.

Even more valuable were reflections over noticed similarities between the timeline concepts (orientation, incorporation, and identification) and the DT process outline from Fig. 1 with divergent and convergent thinking. This led us to a much more explicit engagement with time, that subsequently, allowed us to think in terms of temporalities, both in concrete and project relevant terms and regarding theoretical concerns that led to establishing a framework for temporal aspects of DT.

First, the concrete repercussions. As is common, everyone involved was having an intensive workload. While for the core group, the time put in the project was directly useful, all others involved came to share their expertise in the hope that it could be of good use, but they also were curious about DT. As described in the preparatory workshop paragraph, we have first tried to have people read material tailored to the needs of the project. This did not work, but using a hands-on approach within a clearly defined time interval, worked well. DT researchers often report that rapid learning happens, but just how much time would be enough for this in a project where most participants were novices to the approach? The two-hour period used in the preparatory workshop showed that for the project of this scope, that time interval was not sufficient. Thus, the strategy for learning and informing about DT changed from trying to have participants read about it, to short face-to-face meeting with key persons before the workshop. This worked well. As long as the key participants were on-board, mastered basic vocabulary and understood the process, the remaining participants were indeed able to learn fast and use their skills and knowledge in dialogs, as well as ideation, interpretation, and synthesis of ideas.

The creativity of the process, in conjunction with the difference in relation to the habitual work practices, made the time 'appear' to pass faster (Chronos, perceived time [42]). As described, we have also made efforts to reduce the real participation

time (Kairos) as much as possible, in appreciation of participant's otherwise busy schedules and without compromise in the quality of workshops. What we could experience then, about temporal structures of the DT process, are different timeframes:

1. The underlying layer of a timeframe for the whole project
2. Timeframe for scheduling of workshops
3. Timeframes of different experiences of engagement in the workshop (e.g., orientation, incorporation and identification)
4. Timeframes between workshops (when other kinds of work took place, such as networking, prototyping, e.g., Fig. 4.)

Our understanding of the temporal structures became richer, and we derived the framework that we intend to explore further, see Fig. 8. As the figure indicates, the horizontal basis is about attitudes and mindsets, where the vertical basis for temporal work is the awareness of time – real time, but also all those other time concepts like continuous time, segmented time, individual time, shared time and more. Questions like how to represent time, what it means in the process, for who is this time, what can be done in this time, how to extend the time, consequences of too short or too long time allocated are natural questions to ask.

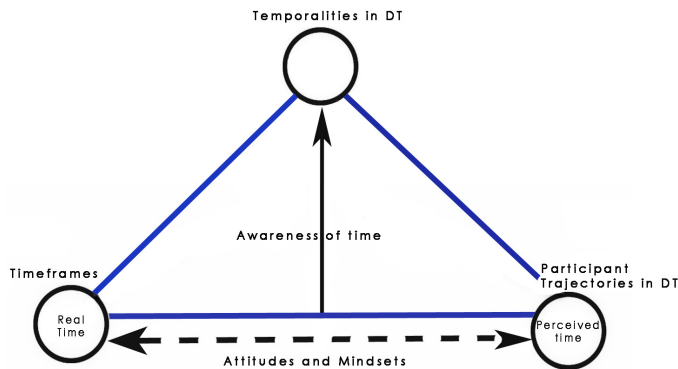


Fig. 8. Temporality framework for DT processes.

5.2 Learning Trajectories

The temporality of the learning process was interesting. Our previous experiences with applying DT were often related to projects involving computer science students and projects. One of the main issues in those context has always been a desire to ideate only until a reasonable solution was identified, and then solve the problem. This experience has been different. As described in individual workshops, different workshops focused on different issues, but they never converged prematurely and did not exclude potential future problems or philosophical discussions, e.g., the rate of change in the technology field and its impacts on digital humanities. Many participants have commented in the aftermath of workshops that they gained some new skills that they can now apply in their work, including both principal

investigators and the subject librarian. Learning in this sense was the most valued outcome of participation. We have facilitated rapid learning that, according to the participants, will be long-lasting and used again in the future. In line with [13], we argue that the frequency of repetition plays a role in integrating DT as a skill and ability to apply it in regular work. We have observed qualitative differences in applying DT among core members across time and repetitions of DT in various workshops. After the initial introduction to the methodology, they needed little time for orientation as they were familiar with the context for design, and curiosity and time to find out things were mostly related to the platform choices and opportunities for lifting the research.

The reason for accepting DT approach to making a virtual representation of the ancient city of Tebtunis was, according to the two principal papyrology researchers, precisely the opportunity to gain a closer understanding of the space between their knowledge and technologies that are feasible to use as a support for their research practices. In other words, they were seeking a closer entanglement with digital humanities, through new means (learning trajectories).

5.3 Opportunities temporal aspects provide for DT processes

We argue that understanding time and learning about time offers new possibilities for DT processes. The DT approach was new for most participants in Tebtunis project. We believe that our focus on time has made it a better experience in practice for all participants.

For us, as DT researchers, the involvement in the project has helped us to grow our understanding of how time can be used (creatively, critically and theoretically) in DT processes, much inspired by the empirical work described and by articles within HCI, such as [43, 51, 52]. We list some examples.

Firstly, it allowed a closer look at time aspects required to accomplish activities related to the initial phases of DT. We have allocated a rather short time to the preparatory workshop (just two hours). It was enough time to understand what DT is about, how the context is approached and experience broadness of inquiry. However, there was not enough time allocated for incorporation phase and either deeper or rigorous analysis of the problem space.

Secondly, dialogical spaces needed to be supported better, and that needs to allocate live time [41]. When so many researchers are involved, clear communication, articulation of views, reaching consensus and making decisions that satisfy all becomes difficult. Especially so when many good researchers are involved in the process, as was the case in *Virtual Tebtunis* project. The exchange of knowledge is crucial [9], and needs to be addressed accordingly. Some pre-analysis of how the combination of competences could unfold under the actual run-time of the event is important. We argue that arbitrating knowledge in the context of the DT process is a key factor for the success. The creation of knowledge [39, 53], where technology and the humanities are more integrated, should be based on solutions that “*require the combined expertise of technical, professional, and scholarly personnel*” [54].

Thirdly, while the *orientation* phase could be shortened by making sure that core competencies are represented, the *incorporation* phase was supported by interleaving

participant trajectories for the core group of researchers and other key participants. In general, some simplifications of the process could not be avoided when people are novices to the methodology, and also come from different academic fields. Only with deeper understandings, the perspectives can be fluently changed, shifted and explored. This is a point that offers possibilities for further research on how to use timeframes to make the process more efficient.

Fourth, the interaction between researchers in humanities and technology is important. Discussing and showing diverse platforms and technologies has been very important for the process as well as the development of digital prototypes as shown in Fig. 4 and Fig. 5, although it did require time that was potentially wasted.

Fifth, we could, in the last workshop notice some socio-temporal manifestations, shared in a social group with similar academic status. The group worked on their own subjective time, sometimes unstructured and unrelated to the workshop time or the clock time. This led to both depth of emerging themes, while also including tensions that needed to be sorted out. This aspect of time is certainly not subject to the linear scheduling of activities, but demands its own, unpredictable, evolvment in time. We did not have a prior understanding of what the effects of this could be, so this was a new finding for us as researchers, and also a potential direction for further explorations.

Sixth, as could be expected given that a connection between the past and present needed to be established through the *Virtual Tebtunis*, many suggestions were focused on a timeline [9], and how to best visualize and utilize timelines.

Seventh, although explorations we did with other DT professionals shown in Fig. 2, were made within the context of the library as a hub for digital humanities innovation, the research process around different temporal frameworks and patterns, serving as analytical and critical perspective at the end of the project, has been crucial. While the workshops are in the short-term range here too, processes that need to be integrated take longer time and vocabulary that we adopted as this project evolved has been very valuable. This vocabulary was relevant for addressing dialogical spaces, knowledge exchange, values, and common meaning. For example, working with timeframes can help discern levels of importance of some tasks and phases of the process. However, the time should not be imposed. In other words, if, e.g., ideation and opportunities for innovation are seen as the top priority, time should actually not be assigned to activities (as much as possible) that generate these. Preferably, the activity should be allowed to go on for as long as relevant new ideas and thoughts are unfolding.

Eighth, working with participant and other trajectories opens possibilities for planning and analyzing processes, in particular when things do not work out as planned (Padua workshop).

In proposing this framework, we certainly do not wish to create a *procedure* for working with temporal aspects in DT. We intend to support reflections around time, towards increasing flexibility in processes, along with the lines of organic processes [55]. Treating time as a design material in DT innovation processes, gives some new ways to talk about participation in innovation processes, interventions during the process, oscillations between different modes of thinking and working.

6 Conclusion

In conclusion, for DT processes, the influence of time and timing is important especially when insights from different efforts need to be integrated into a coherent whole. Also, the DT approach itself, traditionally, incorporates design practices and explorations to a great extent, the relationship to theoretical perspectives can be strengthened. This paper, thus, suggests an initial framework for including issues related to temporalities explicitly in the DT process and working with timeframes and trajectories (in our case only participant). The case of Tebtunis offers an account from our empirical and practical work, showing how temporal aspects emerged. More research into temporal aspects of DT is needed. We consider our work to provide a step in this direction. How temporal issues affect innovation capabilities is left for the future research.

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