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Considering the Inclusion of Worth and Values in the Design of Interactive Artifacts

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ABSTRACT
The development and design of computational artifacts and their current widespread use in diverse contexts (from work/task oriented to ludic applications) needs to take into account end-users needs, likes/dislikes and broader societal issues including human values. However, the fast pace of technological developments highlight the acknowledgment that the process of defining the computational artifacts not only needs to understand the user but also engineering and designers creativity. In order to take into account these issues, we have been exploring the utilization of a framework to guide our own development efforts. The Worth-Centred Design (WCD) can be seen as a conceptual framework that intends to facilitate the process of making explicit the connections between high level concepts related to desired ends/worth/values and simple/basic/atomic features composing an (or to be) artifact [1, 2].
In this paper, our insights as a heterogeneous design team regarding the use of the WCD framework are presented. More specifically, two on-going cases studies are considered: (a) one concerning the on-going development of situated digital public displays and (b) the development of games to assist therapists of children with emotional and cognitive impairments to conduct their daily therapeutic activities. The utilization of the framework definitely improved our understanding of the relationships between features and high-level interaction goals. The representational tools and the process of constructing them helped making explicit the design alternatives and the design team assumptions regarding artifact use. However, there are hurdles to conquer, in particular, the creation of common ground within the team in relation to the definition of the terms employed and assuring that the emergence of common ground does not hide fundamental differences regarding the meaning of the design elements uncovered. Furthermore, more research is needed in order to understand how to elicit values related to the artifact from the different stakeholders of a particular social context.

INTRODUCTION
Recent trends concerning the creation of digital artifacts for diverse contexts of utilization and fruition is a process that should go far beyond the definition of its form and functionality. For example, it should also consider the way in which that artifact is going to fit into the larger context of daily life and into the eco-system of already existing services and artifacts. In addition to the technological challenges that are involved, designing digital artifacts requires a thorough understanding of the social milieu that the system is meant to integrate and a clear view of the respective value proposition [3].
An important consequence of such inclusive perspective is that the design will have to be

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conducted with incomplete information. The broad range of elements that may affect the design process and the large number of individual characteristics that may be considered, necessarily forces the designer to make a judgement on which data to include in the process and how to value it [see for example, 4].

Another important point is that there is no such thing as a general purpose design that can be used like a formula for creating a new system – no size fits all kind of answer. Even small variations in the purpose of a system may lead to different design approaches. Furthermore, any context of utilization and development represents a challenge of its own bringing all sorts of implications to the design process. Therefore, the design process will have to ground itself on a careful definition of the ultimate purpose of the system and on a thorough understanding of the specific social setting for which it is being created.

However, thoughtful analysis concerning the design process and the outcomes of it will suggest similarities, for example systems that share similar purposes and are designed for similar social settings [4]. An understanding of these similarities can provide parts of the design map that inspire each new design process.

BACKGROUND

The aim and scope of Human-Computer Interaction (HCI) and its sister discipline Interaction Design have been changing, reflecting closely the developments of technology and society. In its beginning, HCI was mostly concerned of what was termed usability, in particular, usability of stand-alone computers. The next major change reflected the fact that people started using computational artifacts to work in groups and communicate, emphasising networking and involving the understanding of the social instead of just focusing on perceptual, cognitive and motor processes related to solo activities. Furthermore, this stance also highlights issues concerning people's appropriation of technology in their rich social contexts [5-7, 8, for some reviews of the theoretical and conceptual evolution of the domain]. But the current broadening of utilization and domestication of digital artifacts, expanding beyond the merely functional, has been provoking the emergence of new challenges to the field. Sellen et al [3], for example, identify five major challenges: the end of interface stability, the growth of techno-dependency, the growth of hyper-connectivity, the end of the

ephemeral and the growth of creative engagement with technologies. Moreover, following the conclusion of the Microsoft report concerning the future of HCI, they also argue that human values need to be at the heart of the researchers and practitioners concerns [3]. However, the authors also rightly point out:

"...values are not something that can be catalogued like books in a library but are bound to each other in complex weaves that when tugged in one place, pull values elsewhere out of place." (pag. 61).

Furthermore, understanding human values means not only taking the perspective of the individual but also looking at other levels of social organization, like groups, Institutions or even societies. Different human values might be particularly cherished by distinct agents at specific points in time and space. The design of interactions and technologies, in this sense, needs to be aware of the different balances and make choices [3]. Although the authors propose a new stage of the design cycle especially concerned with the referred to issues, it is still quite open how to proceed in terms of methodologies and methods. Furthermore, broadening the scope will, most surely, involve bringing into design teams people with diverse backgrounds. The challenge then becomes to create some kind of *"lingua franca"* that facilitates focus, transfer of knowledge and understanding.

Human values in the design cycle of digital artifacts

Inquiring about the ethical implications of computer technologies is a relatively new concern [see for example,4, 9, 10]. As stated above, though, how to include these concerns into the design cycle is an even more recent topic. Reflecting these issues we have been exploring the possibilities of utilizing the Worth Centered Design framework in order to progress within this problem space.

Worth centred design framework

The Worth-Centred Design (WCD) can be seen as a conceptual framework that intends to facilitate the process of making explicit the connections between high level concepts related to desired ends/worth/values and features composing an (or to be) artefact [1, 2, 11, 12].

The framework is based on six principles that guide the unfolding of the development: commitment, receptiveness, expressiveness, inclusiveness, credibility and improvability.

By making the design team reflect on the connections of worth/values and design elements the different paths/threads from wished issues to actual products can be highlighted avoiding pitfalls of product reification (centring the attention on the product features and not on the supporting human activities) and false starts on usability issues to be tackled. Furthermore, the framework can also be seen as a way to provide common ground between results obtained from marketing research and the actual translations of the findings into product requirements and specifications [see, 13, regarding the difficulties of translating market research into product specification].

The WCD framework does not strictly postulate a specific methodology or set of methods. However, it does propose a set of design principles and tools to encapsulate the perceived connections and foster reflection on the design.

Design Principles. Let us now provide a brief description of the proposed six design principles:

- Commitment, concerns the need to champion human value.
- Receptiveness, involves picking up the initial ideas regarding the uncovering of sensitivities and try to flesh them out through research and usage studies.
- Expressiveness, considers the need for the externalization of the connections between values and product features (including in-between layers that the author identifies, see below).
- Inclusiveness, argues that the views of all stakeholders should be taken into account.
- Credibility, involves reflecting on the feasibility implied by the connections established.
- Improvability, considers the need to provide metrics that show progress towards accounting of the alternative designs under scrutiny.

WCD approaches. WCD approaches are a set of techniques tailored specifically for the process of WCD. They support the key principles of the WCD design and provide a practical framework around which the different design activities can be organised.

Worth maps are a network type diagrams, adapted from the hierarchical value models (HVMs) used in the consumer psychology area. The worth maps try to make explicit the different means-end chains (MECs) that a certain initial idea and/or artefact might suggest and are the centre piece of the framework structuring the design processes. The worth maps are composed of:

- Design elements:
  - Materials: are system subcomponents sourced from elsewhere, with at most some parametrizing or forming. To tell whether a design element is a material rather than a feature or quality, use this field spotting question: Can you put it in the bin (trash)? Material selection is inspired by previous designs, current needs/opportunities and technological trends.
  - Features: are system components composed from materials. To tell whether a design element is a feature rather than a material or quality, use this field spotting question: Can you point at it, and if so, is it a combination of more than one parameterised or formed material? Features have to be parts, (or non-exhaustive groups of parts).
  - Qualities: are primarily people's immediate feelings about things. To tell whether a design element is a quality, use this question: Can no-one point at it anywhere 'in' or 'on' the product, but instead sense it immediately on encounter, before extensive use? If so, it is a quality (if undesirable, it's a defect). Qualities and defects are expressed as abstractions. Some may be revealed to a designer's judgement or 'good taste', but some are empirically measurable. They are sensed at the onset of experience.
- Value elements:
  - User experiences: include issues usage, perceived and thought value regarding the artifact by the people experiencing it. It implies considering first encounters and long term appropriation.
  - Outcomes: are enduring changes within people or in the world that outlive an interaction. These are reportable, observable, or both. Worthwhile outcomes are the happy endings in a worth web (see below). One can generally, for any proposed outcome, come up with a more abstract end to which an outcome is

really a means. However, this could be unobservable, or impossible to ground in actual experience for informants/participants.

Two other important concepts of the WCD framework are Element Measurement Strategies (EMSs) and Direct Worth Instrumentation (DWIs).

The EMSs intend to clearly address the issue of having concrete measures for evaluating the elements present in a worth map. Thus, it associates instruments and measures with distinct element of the worth map. Another central idea of this concept is that evaluation cannot be restricted to immediate usage issues. The evaluation must go beyond traditional usability testing and include assessment of the worthwhile outcomes. This inclusion implies the need to track the wider context and see/measure the consequences of the system/artefact utilization on the far side of immediate interaction (in a broad sense, which means it also covers the enduring memory/experience traces people create).

The DWIs are a reflection of the EMS and demands the creation of appropriate operationalizations of the things to be measured/captured, even if this involves the creation of instruments "outside" the developed application/system (taking the broader view as referred to above). According to Cockton "The motivation is always to measure what matters, and not what is easy to measure".

Stages and methods. As already referred to above, the WCD framework does not postulate a strict set of stages or specific methods to inform the creation of worth maps.

However, Cockton suggests the following in relation to the actual construction of worth map diagram: (a) the design team should start with fairly open brainstorming session in order to inquire about the team's assumptions regarding technical and human sensitivities, (b) the next step involves translating the elicited sensitivities into concrete design elements, taking note of their origin and displaying them appropriately in layers to serve the actual construction of the diagram; (c) in the last step the diagram's elements should now be in place and the design team will need to reflect and make explicit the different connections and chains.

In relation to the methods to generate the relevant information for the construction of the diagram, brainstorming sessions and workshops with the inclusion of potential end users seem to be a worthwhile investment. Another strong possibility is the use of scenarios, where stories are created about the users and their interactions with artefacts in a specific context [14-17]. Scenarios allow the exploration and discussion of contexts, needs and corresponding requirements. Conducting group and individual interviews to potential end-users is also a valuable tool to inquire and elicit ideas about worth and value.

Summarizing, for the moment one cannot postulate a concrete recipe for success. As a rule of thumb researchers and practitioners need to be aware of the design situation, the particulars of the envisioned product/service, the end-users and stakeholders and make an informed decision regarding the most appropriate methods to collect information for the worth map and respecting the design principles considered.

THE CASE STUDIES

The two on-going case studies presented here are quite distinct from each other. However, there is, at least, one common characteristic: in both cases it was the design team that approached the stakeholders with the proposal to create a new artifact to enhance/ their activity and not the other way around. In other words, although the design team was confident that something worthwhile could be produced people involved in these particular contexts did not seem to be actively engaged in looking for a solution to specific a problem.

Such framing poses challenges concerning the initial definition of what can be requirements and methods to elicit them.

We should also point out that this present work is still work in progress in the sense that the overall projects continue and we expect to progress beyond the issues referred to in this paper. More specifically, all the data collected and the analysis done will enable us to more confidently approach the creation and implementation of the EMS and the DWI. Furthermore, we will produce new prototypes to be deployed and evaluated.

The settings and other contextual factors

Case study 1. This case study involves the on-going development of a digital public display for a teachers' common room in a secondary school. The teacher's common serves around 120 people, which can be considered our primary users. The room not only provides a space for socializing but is also an access point to collect the classes´ administrative forms and be informed about the school procedures. These

characteristics make this common room a very busy passing space.

Two distinct displays show information about the school: formal notifications from the school administration, information about unions and training projects. There is also a particular corner of the room where cultural initiatives and informal notes are displayed on a table.

The potential "users" of the digital display under development comprises the actual teachers and other stakeholders that regularly send information to the displays (for example, board of Directors, official information from the Ministry of Education, other educational organizations with connection to the school, the unions etc).

Specific people are in charge of authorising the posting of information in the official displays. Furthermore, the person who actually posts the information needs to manage the available space and update the display accordingly.

Figure 1 – View of the common room and main public display

It seems that a well defined structure is in place and known social rules govern the display of information in this common room. The design of the digital display will need to be aware of these issues and consider the overall impact of the artifact (who contributes, who is willing to contribute, how authorisations are carried out, who will benefit and who sees an increase of his/her work).

Case study 2. In this case study the aim was to develop digital artifacts to support classroom activities for children with cognitive and emotional impairments. Furthermore, we also wanted to explore the possibility of creating artifacts that could be brought home, to encourage some kind of transfer between the distinct settings – school and home.

A particular charity was approached to be a partner in our design effort, giving insights about the possibilities of potential ideas and allow studies to be carried out with prototypes. This charity, APPACDM-Braga, is an organization founded by parents and sponsors and provides care for children with a wide range of cognitive and emotional impairments. The activities developed involve daily care, including regular school teaching, teaching of social competences and playing.

In relation to the targeted "users", our current perspective views children, therapist and other carers as primary users. Children because they will "use/play" with the artifact. Teachers and carers because they, most probably, will use the artifact to manage on-going interactions establishing it as a mediator. The role of the artifact as a mediator should be emphasised since it is not our goal to design something that replaces any kind of activity. Our aim is to see if something can be created that facilitates the therapeutic processes and, at the same time, provides a pleasurable experience for the children.

THE INTERACTION DESIGN PROCESS FOLLOWED AND INSIGHTS COLLECTED

Case study 1. *The design team* in this case study was composed of two researchers and one Master's student. The Master's student is a teacher at the school where the study was taking place.

The first step – meetings of the design team. Firstly we conducted a series of *meetings of the design team* to discuss general features of the digital display and to reflect about our assumptions concerning use. It should be noted that our research group is actively developing expertise in the field of situated digital displays and, obviously, our experience of other projects we conducted was influential – we were not starting from scratch regarding the design of digital displays. Thus, based on our previous knowledge and the understanding of the specific context coming from the experience of the Master's student, we decided we to conduct semi-structured interviews with teachers.

The aim of these *interviews* was to complement our understanding regarding the use of the place. The interviews were centred around the following questions:

- What is the first thing people do when entering the common room?
- Which places draw their attention within the room?
- What kind of things did people suggest in order to make the place more pleasant?
- What do they use the place?

Second step – interviewing teachers. In the second step, five initial individual interviews with teachers were conducted. The interviews were run by one of the researchers and the Master's student. Notes of the interviews were taken on spot and reviewed. *The analysis of the interviews* was fairly qualitative and allowed the emergence of the following main *themes*:

- Looking for official school information on the main display is a top priority when entering the room.
- Attention to the other display and informal corner of news and activities needs saliency.
- People seem to regard the place as too formal and wish it could be less so.
- The teachers use the place to work, be updated of news and socialize.

Step three – designing the first worth map and defining the first prototype. Based on the analysis of the interviews the design team discussed the findings and draw *the first worth map* (see Annex 1). Four main issues shaped our framing of the problem space:

- Teachers would like to be reassured that they were not missing important information – *being informed of relevant news is important*.
- The common room as viewed as too formal – *the common room needs to be less formal and probably new artifacts should foster this aspect*.
- Considering the nature of the digital display and its flexibility on showing content, implementing distinct time cycles for the different types of information could improve people's feeling of keeping informed and, at the same time, provide content for informal conversations.
- The update of information would need to reflect its formal and informal nature – *the design of the digital display needs to be aware of the organizational specificities*.
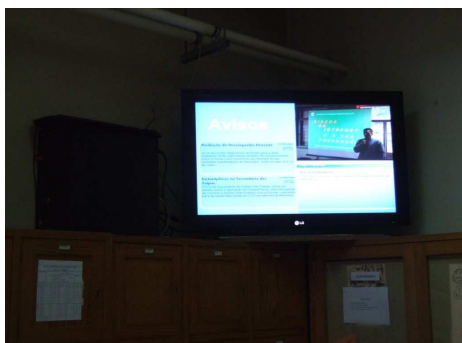

Figure 2 – Photograph of the prototype developed

The layout of the display is organized taking into consideration three areas: a) one main area where official information is provided – left side; b) on the top right side there is an area where photos(using Flickr) and written contributions from teachers can be visualized (using blogs and twitter etc); c) on the bottom right side general news are displayed.

Step 4 – deploying the prototype and conducting follow-up interviews. In step four *a prototype was deployed* at the teacher's common room for ten days*.*

A preliminary analysis of the system's logs concerning the teachers' contributions to the display suggest that people were not too keen on actively writing content. In same cases, the Master's student, teacher of the school, was the main provider of content and was approached by colleagues to write some news and updates. Furthermore, anecdotal evidence points to the fact that some of his colleagues also seemed unaware of the possibilities open by the utilization of Flickr and Twitter and thus did not take advantage of such.

Three individual interviews were once again conducted by the same elements of the design team. This time, however, the focus of the questions was on people's first impressions of the digital display and ways to improve it.

All the three interviewees noticed the display when it was deployed at the common room. They also agreed that it seemed to be a good idea and could facilitate their search for new information. Clearly, the digital display was seen as a complement to the traditional forms of information dissemination already in place and not as a replacement.

They also enjoyed the mix between formal and informal information, but were not clear regarding their role in updating the informal news channel. It seems they were aware of the social context and of the different "groups" present. Initiatives seem to be more group bound instead of individuals.

One of the interviewees noted that some of the school's infra-structure could be adapted to feed the formal information channel and regarded this aspect important and beneficial. One other pointed out that more time was needed for appropriation and that these type of display could be used to foster communication between students and teachers.

Finally, one of the interviewees made a specific design contribution. He basically draw our attention to the fact that the current design was not giving any indication of the actual number of important news circulating. In other words, if

there were too many news to be displayed at a particular moment the person was kept unaware of the ones not being currently displayed making it annoying to wait to see the whole cycle or missing something relevant.

Case study 2. The *design team* was composed of the same people as in case study 1 plus one Bachelor's student responsible for exploring the technological possibilities and developing the prototypes.

Step one – the initial design team meetings. As in case study 1, we also started with a series of meetings within the design team. This time, however, we were aware that we did not have enough information to form a clear picture of what could be the context of use. Our initial assumptions were:

- The artifact needs to be affordable and durable – *cost is important if we want to extend use to the families and other Institutions*.
- The functionality of the artifact should be easily customisable by teachers considering that different children will have very distinct needs. *The artifact needs to be easily customisable and its customisation should reflect therapeutic needs*.

Step two – Initial meeting with two teachers. The second step involved setting up a meeting with two of the teachers so they could inform us of some general requirements and describe in each contexts they envisioned the artifact's to be used. However, we also considered the fact that these professionals are not used to contribute to this type of design activities. Common ground had to be nurtured in order to break the initial barriers of communication and understanding. In order to facilitate the process we chose to present a specific technical solution and construct three scenarios where this solution seemed plausible. Our initial challenge to the teachers was to enhance our scenarios or even construct new ones.

Curiously the teachers were enthusiastic about the demonstration but we were not successful in eliciting further insights for the refining of our initial scenarios. Basically, the two teachers considered that the introduction of this new artifact would definitely change their classroom activities and wanted more time to discuss thoroughly the implications with other colleagues.

As a result of the meeting we proposed to the teachers for them to flesh out possible scenarios on their own and provided a guiding template for them to explore.

Next steps. The teachers are now conducting their own initiatives regarding the construction of plausible and desirable scenarios. Further meetings are already being scheduled in order to continue with the design process. This is a strong indication that teachers are actively involved and willing to collaborate with us in the design process.

CONCLUSIONS AND FUTURE WORK

The design process followed and the particular externalization of ideas, assumptions and design alternatives helped reflection. The exercise of explicitly stating the connections between features, qualities and higher-level constructs about use fostered critical thinking and search for alternative design solutions. Curiously, we believe that the design process also made adherence to the design principles referred to easier. In fact, it seems to us that a virtuous cycle is in place: somehow the design principles seem to be encapsulated in the design cycle envisioned while adherence to the design principles makes the design process and corresponding methods meaningful.

We are aware that EMS and DWI were not fully fledged and implemented up to the moment. However, the knowledge gathered up to now, especially for case study 1, is extremely valuable in order to proceed confidently with its construction and implementation. The following topics seem relevant:

- Are teachers better informed with the public display in place? Do they feel better informed? How do other stakeholders consider the worth of the system?
- Is the system able to foster a more informal setting? Does the display of blogs, photos and twitter postings contributes to this?
- Does the system reflect the needs and organizational constraints of the school? Can formal information be easily fed to the systems without creating work overload to someone within the organizational chain?
- To what extent can the system improve the awareness of the on-going projects and work between teachers and students? Can this same concept be considered for an enlarged community an include other schools and Institutions in a network of public displays?

Agreeing with the terms of the framework is not easy in the beginning of the process and people should expect some initial struggles regarding meaning and scope. However, after the first steps we think common ground emerges. Nevertheless we also believe that more research is needed in order to understand what is the best way to elicit worth and values from end users. We are actively exploring different types of interviewing techniques and for sure this will be one of our next steps.

Finally, regarding the specific methods employed, concrete technological solutions were actively introduced in the two case studies but at different points of the design cycle and with distinct purposes. While on case study 1 the idea was to "confront" people with the artifact and inquire about acceptance, with case study 2 the aim was to foster reflection upon context and help define scenarios usage.

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ANNEX 1
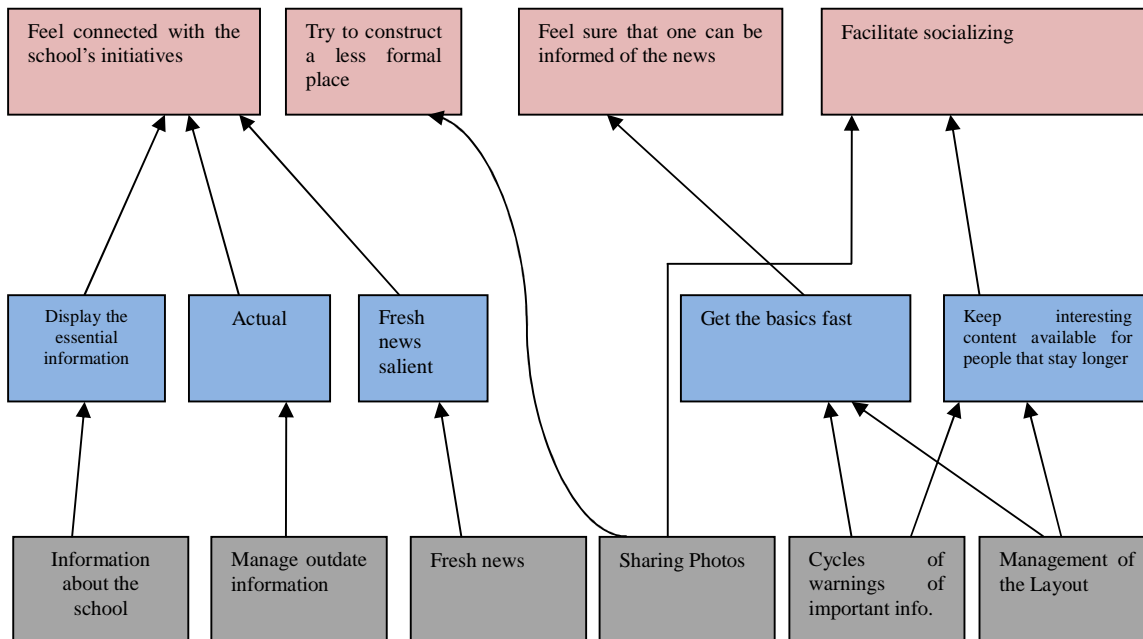
WORTH MAP OF THE PUBLIC DIGITAL DISPLAY

Figure 3 – Initial worth map for the teachers' common room digital display. First row of boxes corresponds to features, the second row to qualities and the top row to higher level themes like values or worth