

# Design Trade-Offs for an Inclusive Society: Frameworks, Examples, and Challenges

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## 1 Introduction

The digital age of the future is “not out there to be discovered”, but it needs to be “designed”. The design challenge has to address questions about how we want to live, work, and learn (as individuals and as communities) and what we value and appreciate, e.g.: reflecting on quality of life and creating inclusive societies.

An overriding design trade-off for the digital age is whether new developments will contribute to increase the digital divide or will create more inclusive societies. The *digital divide* [17] has often been discussed as the difference between owning and having access to modern information technology or not. Although access is necessary, it is *not sufficient*. For example, putting every school on the Internet or providing a smartphone and/or laptop for every learner may be necessary to achieve certain objectives, but it is not sufficient to improve learning and teaching. The discourse about new information technologies should not be restricted who has access to these technologies but it should be focused on how people of all ages and all abilities can exploit information technologies for personally meaningful activities.

## 2 Brief Description of our Research Activities Creating More Inclusive Societies

The core research objective of the Center for LifeLong Learning & Design (L3D) was to create *socio-technical environments* serving real human needs specifically by addressing challenges to create more inclusive societies in the following domains:

- empowering *cognitively disabled people* to be more independent by complementing their weak internal processing capabilities with external support [2] (remark: if time allows, a 5 minutes video will be shown about this work at the workshop);
- offering lifelong *learning opportunities for people of all ages* [8];
- engaging owner of problems in interest-driven, self-directed, personally meaningful learning opportunities by supporting them in becoming independent of high-tech scribes with the support of *meta-design* and *end-user development* [10].

These three research activities will be described briefly.

## 2.1 CLever Project: Empowering People With Cognitive Disabilities

Anatomy and cognitive abilities are not destiny. Eyeglasses have refuted the belief that anatomy is destiny by putting forward the idea that our minds as well as our bodies are improvable [15]. The Cognitive Levers (CLever) project [4] was grounded in the basic assumption that *all humans* have limitations and that the development of new media and technologies has been driven forward by extending our biologically endowed capabilities (for example: reading and writing were invented to address the limitations of our short term memories). Today, as we live in a world of ubiquitous technology, intelligence and cognition are not located within the individual human mind but are distributed within complex socio-technical environments providing opportunities to improve the life for people with cognitive disabilities (Figure 1 illustrates the major objectives that we have pursued).



**Fig. 1.** Different Aspects Contributing to Social Inclusion.

The socio-technical environments that we have developed

- support persons with cognitive disabilities to provide them with opportunities that they would not be able to accomplish unaided (e.g.: to have more choices, live by themselves, use transportation systems, interact with others, and perform a variety of domestic tasks);
- empower caregivers with a deeper understanding about the needs of those being supported.

The CLever Project *relied on distributed cognition* [12] as a theoretical framework for understanding what humans can achieve and how artifacts, tools, and socio-technical environments can be designed and evaluated to *empower human beings* and to *change tasks*. Applying this framework to people with cognitive disabilities in *design-for-all approaches* creates new and unique challenges and opportunities for more inclusive societies.

The relationships between humans and their artifacts can be seen as

- providing scaffolding supporting learners to become incrementally more independent of the tool (i.e. “tools for learning”) or

- changing tasks by distributing the activity between the human and the tool (i.e., “tools for living”).

This *design trade-off* is not a dichotomy, but represents a continuum with associated design implications.

The ultimate goal of successful design, specifically in the context of technology for improving cognitive function, is to improve the human condition. The success or failure of socio-technical environments will be judged by the opportunities created for independence, societal inclusion, and quality of life they provide to those who would otherwise be disenfranchised. Research and education on “*technology for improving cognitive function*” will have broad implications not only for people with cognitive disabilities but for extending the possibilities and capabilities for all humans.

## 2.2 Lifelong Learning: Learning Opportunities for People of All Ages

Conceptions of *learning* are often of a very narrow nature: it happens in schools, there is a teacher who tells learners what is important and necessary to learn, it is an individual activity, and it is experienced by learners as something they have to do. As the demands for learning undergo a period of profound transformation, there is a need for exploring innovative multi-dimensional aspects of learning. In order to make learning environments more inclusive the following aspects should be taken into account and supported:

- *Who Learns: People at different stages.* Learners may be students in different grades and institutions, persons working in industry, or curious citizens attempting to understand more about the world surrounding them. Some of the learners may be beginners and general and standard introductory courses will serve them well whereas other may have a rich knowledge background and very specific objectives requiring more individualized learning opportunities.
- *How to Learn: Learning in Different Ways.* Learning in today’s world should be conceptualized as an inclusive, social, informal, participatory, and creative lifelong activity. Many problems (specifically design problems) are unique, ill-defined and wicked and the knowledge to address them does not already exist but needs to be created requiring contributions and ideas from all involved stakeholders.
- *When to Learn: At the Right Time.* Information overload and the rapid change of our world have created new problems and new challenges for learning and education. People will have to keep learning new knowledge and skills throughout their lifetimes as their lives and jobs keep changing. New approaches (e.g.: learning on demand) are needed to circumvent the unsolvable problems of *coverage* and *obsolescence*.

### 2.3 Digital Fluency: Making People Independent of High-Tech Scribes

In the middle ages, most people were dependent on “scribes”, who helped them to write down their thoughts, ideas, and stories, as well as to read the material written by other people. Many people today are in the same situation with respect to digital media: they are unable to express themselves, explore problem spaces, appropriate tools, and act as designers in personally meaningful tasks. They have to rely on “high-tech scribes”.

Fluency with IT for all people will contribute to more inclusive societies by supporting people expressing themselves creatively and appropriately, and allowing them to produce and generate new information rather than simply to comprehend existing information.

To make fluency a realistic goal, computing needs to be deprofessionalized [13]. The monopoly of highly trained computing professionals acting as “high-tech scribes” should be eliminated. This does not mean that there is no place for professional programmers and system designers in the future; it does mean, however, that one of the most important objectives of the professional computing community should be to create end-user development systems that will put owners of problems in charge [10].

## 3 Design Trade-Offs

Creating socio-technical environments for social inclusion is not an easy and straightforward task but requires the exploration of *design trade-offs* [9]. The problem domains briefly described in Section 2 are wicked problems for which there are (1) no perfect designs, (2) no decontextualized sweet spots, and (3) no silver bullets.

Without a deep understanding of both the strengths and weaknesses of the technology (e.g.: when, where, why, how, for what, and for whom it is and isn't suitable), researchers and developers will not be able to act in the best interests of shareholders and may therefore (despite the best intentions) increase the digital divide rather than the social inclusion.

Some of the major design trade-offs that we have explored in our objectives to move towards more inclusive societies are

- in the context of cognitively disabled people:
  - tools for living versus tools for learning [3];
  - overreliance on external tools versus independence [7];
- in the context of learning opportunities for people of all ages:
  - curricula versus interest-driven learning [16];
  - basic skills versus niche interests [5];
- in the context of making people independent of high-tech scribes:
  - control versus participation overload [10];
  - permissive versus prescriptive environments [18].

## 4 Topics for Discussion

In addition to my personal presentation, I suggest that the AVI'2018 CoPDA workshop should schedule a discussion session among *all participants* to evaluate the past, current, and future CoPDA workshops. A few ideas for such a discussion session will follow.

### 4.1 Relationships between the CoPDA Workshops

The AVI'2018 workshop is the 5<sup>th</sup> CoPDA workshop (see Figure 2 for an overview). An important challenge for the researchers getting together in the workshop this year may be to explore the foundational idea(s) that these workshops have pursued and how they are related to each other. My claim: all of the workshops have identified basic research challenges derived from real problems. Such an effort could lead to the articulation of a coherent and important theme(s), an edited book, or a EU research project.

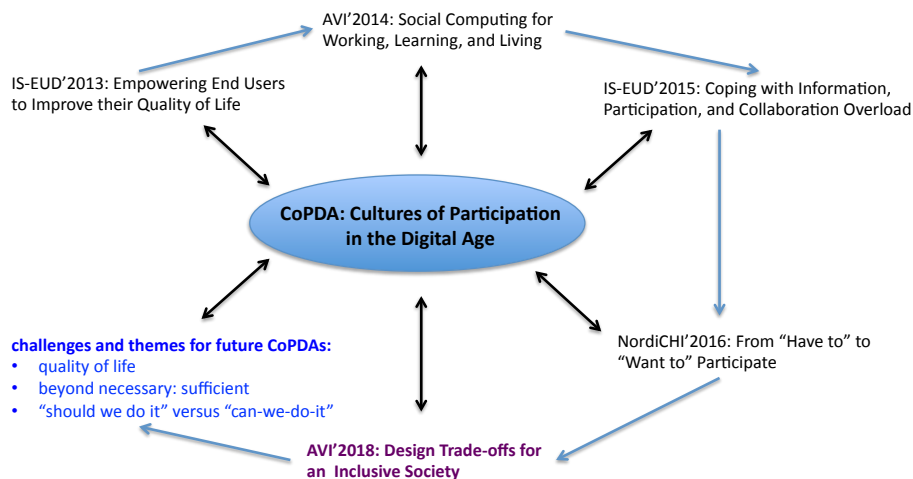


Fig. 2. An Overview of the CoPDA Workshops.

### 4.2 Challenges and Themes for Future CoPDA Workshops

As argued before: the themes of the current and past CoPDA Workshops have addressed a variety of wicked problems that have no ultimate answer. The identification of *design trade-offs* needs to continue for new developments because oversimplified solutions do not do justice to the complexities of real problems. We

need to overcome one-sided solutions and provide arguments, ideas, and evidence that lead to more inclusive societies instead to more polarization, filter bubbles [14], and an increased digital divide [19]. These efforts should include to search for informed compromises and new syntheses that result in new objectives by combining the strengths and reduce the weaknesses of the respective design trade-offs. I will mention a few specific challenges and themes for futures CoPDAs that I consider important (see Figure 2).

**Quality of Life.** By creating a framework for quality of life and social inclusion grounded in the identification and analysis of design trade-offs [9] and arguing that there are no decontextualized sweetspots, our research activities should position us between

- the critics of *postmodernism* (e.g.: Daniel Dennett [6] arguing: "*Postmodernism, the school of 'thought' that proclaimed 'There are no truths, only interpretations' has largely played itself out in absurdity, but it has left behind a generation of academics in the humanities disabled by their distrust of the very idea of truth and their disrespect for evidence, settling for 'conversations' in which nobody is wrong and nothing can be confirmed, only asserted with whatever style you can muster*") and
- the proponents of *antinomies* (defined by Jerome Bruner [1] as "*pairs of large truths, which though both may be true, nonetheless contradict each other*").

**Beyond Necessary Technologies:** Creating Sufficient Conditions with Socio-Technical Environments. Technological Innovations and developments such as (1) all schools being on the Internet [11] or (2) One Laptop per Child (OLPC) program (<http://one.laptop.org/about/mission>) were ambitious technological initiatives at the time — necessary to achieve certain educational objectives. But these technological innovations by themselves were not sufficient to solve complex social problems allowing learners of all ages to engage in personally meaning social practices.

**Complementing “Can Do Something” with “Should Something be Done”.** Technological developments facilitate activities that could not be done before (e.g.: (1) the Internet making MOOCs a reality to reach ten thousands or more people with a lecture, or (2) the development of self-driving cars (currently still mostly an envisionment), or (3) the very questionable objective to delegate decision about life and deaths to algorithm in automated warfare). As the technological developments have taken place or are explored, the question “should they be done” should be considered as the central question, requiring that issues derived from ethics, values, impact, control, and autonomy are taken into account.

## References

1. Bruner, J.: The Culture of Education. Harvard University Press, Cambridge, MA (1996)
2. Carmien, S., Dawe, M., Fischer, G., Gorman, A., Kintsch, A., Sullivan, J. F.: Socio-Technical Environments Supporting People with Cognitive Disabilities Using Public Transportation. *ACM Transactions on Human-Computer Interaction*, 12(2), 233-262 (2005)
3. Carmien, S., Fischer, G.: Tools for Living and Tools for Learning. In: Proceedings of the HCI International Conference (HCII), Las Vegas, July (2005)

4. Carmien, S. P., Fischer, G.: Design, Adoption, and Assessment of a Socio-Technical Environment Supporting Independence for Persons with Cognitive Disabilities. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '08). ACM, New York, NY, USA, 597-606 (2008)
5. Collins, A., Fischer, G., Barron, B., Liu, C., Spada, H.: Long-Tail Learning: A Unique Opportunity for CSCL? In: Proceedings (Vol 2) of CSCL 2009: 8th International Conference on Computer Supported Collaborative Learning, University of the Aegean, Rhodes, Greece, pp. 22-24 (2009)
6. Dennett, D. C.: Let's Start with a Respect for Truth — Dennett on Wieseltier V. Pinker in the New Republic, [https://www.edge.org/conversation/daniel\\_c\\_dennett-dennett-on-wieseltier-v-pinker-in-the-new-republic](https://www.edge.org/conversation/daniel_c_dennett-dennett-on-wieseltier-v-pinker-in-the-new-republic) (2013)
7. Fischer, G.: Distributed Intelligence: Extending the Power of the Unaided, Individual Human Mind. In: In Proceedings of the working conference on Advanced visual interfaces (AVI '06). ACM, New York, NY, USA, 7-14 (2006)
8. Fischer, G.: Supporting Self-Directed Learning with Cultures of Participation in Collaborative Learning Environments. In: Christiansen, E., Kuure, L., Mørch, A., Lindström, B. (Eds.), Problem-Based Learning for the 21st Century - New Practices and Learning Environments. Aalborg University Press, 15-50 (2014)
9. Fischer, G.: Design Trade-Offs for Quality of Life. ACM Interactions XXV.1 (January + February 2018), 26-33 (2018)
10. Fischer, G., Fogli, D., and Piccinno, A.: Revisiting and Broadening the Meta-Design Framework for End-User Development. In New Perspectives in End-User Development, F. Paternò and V. Wulf Eds. Springer International Publishing, Cham, 61-97 (2017)
11. Gore, A.: Should Schools Be Wired to the Internet? <http://www.cnn.com/ALLPOLITICS/1998/05/18/time/yes.html> (1998)
12. Hollan, J., Hutchins, E., Kirsch, D.: Distributed Cognition: Toward a New Foundation for Human-Computer Interaction Research. In: Carroll, J. M. (Ed.), Human-Computer Interaction in the New Millennium. ACM Press, New York, NY, USA, 75-94 (2001)
13. Illich, I.: Tools for Conviviality. Harper and Row, New York (1973)
14. Pariser, E.: Beware Online "Filter Bubbles" (TED Video), <http://www.youtube.com/watch?v=B8ofWfx525s> (2011)
15. Postman, N.: Amusing Ourselves to Death—Public Discourse in the Age of Show Business. Penguin Books, New York, NY, USA (1985)
16. Resnick, M.: Lifelong Kindergarten — Cultivating Creativity through Projects, Passion, Peers, and Play. MIT Press, Cambridge, MA (2017)
17. Schön, D. A., Sanyal, B., Mitchell, W. J. (Eds.): High Technology and Low-Incoming Communities. MIT Press, Cambridge, MA (1999)
18. Thaler, R. H., Sunstein, C. R.: Nudge – Improving Decisions About Health, Wealth, and Happiness. Penguin Books, London, UK (2009)
19. Warschauer, M.: Technology and Social Inclusion — Rethinking the Digital Divide. MIT Press, Cambridge, MA (2004)