

End-User Development: From Creating Technologies to Transforming Cultures

Gerhard Fischer

Center for LifeLong Learning & Design (L3D)
Department of Computer Science and Institute of Cognitive Science
University of Colorado, Boulder USA
gerhard@colorado.edu

Abstract. In a world that is not predictable, improvisation, evolution, and innovation are more than luxuries: they are necessities. The challenge of design is not a matter of getting rid of the emergent, but rather of including it and making it an opportunity for more creative and more adequate solutions to problems. *End-User Development (EUD)* provides the enabling conditions for putting owners of problems in charge by defining the technical and social conditions for broad participation in design activities. It addresses the challenges of fostering new mindsets, new sources of creativity, and cultural changes to create foundations for innovative societies.

Grounded in the analysis of previous research activities this paper explores (1) *conceptual frameworks* for EUD (including: socio-technical environments; meta-design; and cultures of participation), (2) *models* guiding and supporting EUD (including: the seeding, evolutionary growth, reseeding process model; and richer ecologies of participation). These frameworks and models are briefly illustrated in one specific application domain.

The paper concludes by articulating new discourse concepts and design-tradeoffs to shape the future of EUD being understood as a *cultural transformation* rather than only as a technology in creating software artifacts.

Keywords: socio-technical environments, meta-design, cultures of participation, personally meaningful problems, control, participation overload, future research agenda for EUD.

1 Introduction

In a world where change is the norm, EUD is a necessity rather than a luxury because it is impossible to design artifacts (including software systems, socio-technical environments, and learning environments) at design time for all the problems that occur at use time. The co-evolution of systems and users' practices requires socio-technical environments that can evolve and be tailored continuously. An important objective for the EUD perspective articulated in this article is that design as a process is tightly coupled to use and it continues during the use of the system [1]. It sees the "unfinished" as an opportunity (by extending design time indefinitely) rather than as an

obstacle or as something to be avoided. Figure 1 provides an overview and illustrates the structure of this paper that tries to articulate a theoretically-guided and empirically-supported vision for the future of EUD as a cultural transformation rather than only as a technology to create software artifacts.

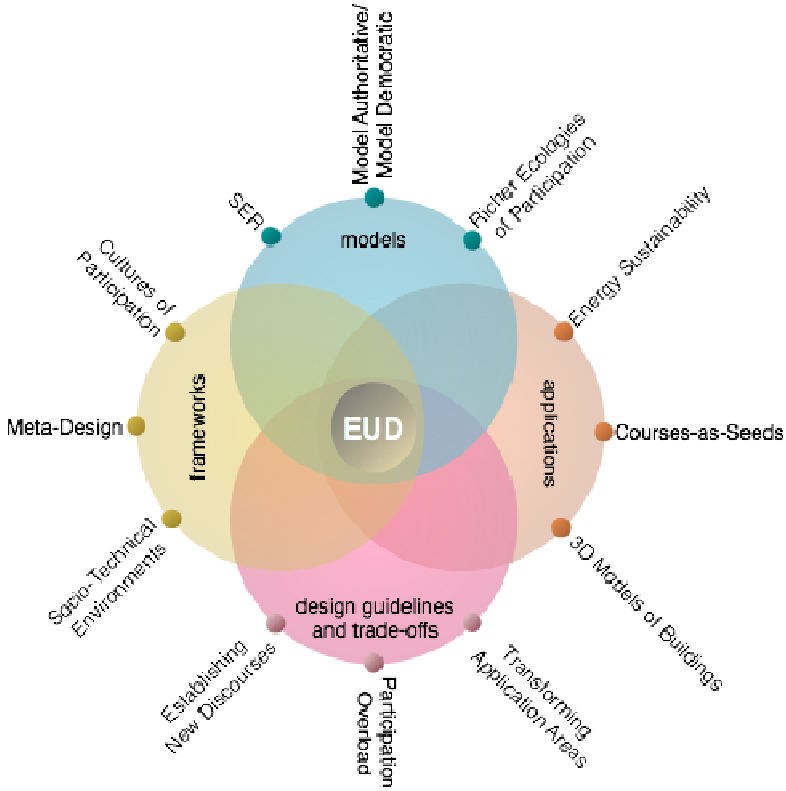


Fig. 1. Conceptualizing EUD as Cultural Transformation

2 EUD: From Creating Technologies to Transforming Cultures

EUD is instrumental for the ability to create, reformulate, externalize and share new knowledge rather than simply to comprehend existing knowledge. It appeals to diverse audiences by supporting them in designing and building their own artifacts by situating computation in new contexts, by generating content, and by developing tools that democratize design, innovation, and knowledge creation [2]. This broad vision of EUD complements and transcends a technological perspective of EUD [3] derived from *End-User Programming (EUP)* and *End-User Software Engineering (EUSE)*.

Addressing Important Problems. A cultural transformation perspective of EUD includes technological developments as essential components but transcends them

with additional objectives addressing requirements derived from the following fundamental problems [4]: (1) problems of a *magnitude* which individuals and even large teams cannot solve thus requiring the contribution of all interested citizens; (2) problems of a *systemic nature* requiring the collaboration of many different minds from a variety of backgrounds; and (3) problems modeling *changing and unique worlds* supported by open and evolvable systems based on fluctuating and conflicting requirements.

Inspirations, Perspectives and Influences for Conceptualizing EUD as a Transformational Culture. An early inspiration for conceptualizing EUD as a transformational culture was articulated by Ivan Illich with *convivial systems* envisioned to “give each person who uses them the greatest opportunity to enrich the environment with the fruits of his or her vision” [5]. To cope with the unattainable challenge of fully anticipating or envisioning use before actual use takes place, *participatory design* (“design for use before use”) needs to be complemented with *meta-design* (“design for design after design”) [6].

Related Research Efforts. The conceptualization of EUD as a transformational culture has been explored by a number of research activities including: (1) the *Software Shaping Workshops* environment [7]; (2) the *hive-mind space (HMS) model* [8]; (3) the exploration of meta-design in *virtual worlds* [9]; and (4) the impact of *different relationship between design and use* [10].

3 Frameworks and Models for EUD as a Transformational Culture

Our research over the last decade has articulated and assessed different conceptual frameworks and models providing foundations to explore, to foster, and to support EUD as a transformational culture, including:

- *Socio-technical environments* [11] are focused on the systematic integration of two sets of design requirements: (1) *technical* components (computers, networks, building materials, and software substrates) and (2) *social* components (people, procedures, laws, collaboration, and communication policies).
- *Meta-design* is “design for designers” [12]: (1) allowing systems to be flexible and to evolve because they cannot be completely designed prior to use and (2) empowering end-users to drive the evolution.
- *Cultures of participation* providing all people with the means to participate and to contribute actively in personally meaningful problems [4].
- the *Seeding, Evolutionary Growth, Reseeding (SER) Process Model* is a descriptive and prescriptive model for creating the social and technical infrastructures in which new forms of collaborative design (designing seeds that can grow rather than complete systems) can take place that best fit an emerging and evolving context.
- *Rich Ecologies of Participation* break down the strict designer-user distinction. For cultures of participation to become viable and be successful, it is critical that a

sufficient number of participants take on the more active and more demanding roles. EUD research needs to analyze the necessary requirements associated with the more active roles, and develop social and technical interventions to support participants in their *migration paths* towards more demanding roles.

These developments support moving away from a world in which a small number of people define rules, create artifacts, make decisions for many consumers towards a world in which everyone has possibilities to actively participate by creating widely accessible artifacts.

4 Application: “Courses-as-Seeds”

The conceptual frameworks and models articulated in the previous sections have been explored (1) in a large number of major applications (including: open source software, Wikipedia, YouTube, Instructables, etc.), (2) by other members of the EUD research community (see section “Related Research Efforts” above), and (3) in our own work [4, 12]. One specific application illustrating the cultural transformation perspective of EUD is teaching courses at a university. Providing learners of all ages with the means to become co-creators of new ideas, knowledge, and products in personally meaningful activities presents one of the most exciting innovations and transformations in education with profound implications in the years to come.

Courses-as-seeds [13] is an educational approach that explores EUD in the context of fundamentally changing the nature of courses taught in universities (a large number of them being available at: <http://l3d.cs.colorado.edu/~gerhard/courses/>). It complements the currently increasingly popular approach of Massive Open Online Courses (MOOCs) with their promise and hype that online learning will give millions of students access to the world’s best teachers. The goals of courses-as-seeds are (1) to overcome the impoverished conception that a course provides a learning experience in which an all-knowing teacher tells or shows unknowing learners something they presumably know nothing about; and (2) to foster *cultures of participation* [4] by providing all students with the opportunity to contribute.

5 New Discourses and Design Trade-Offs

EUD: Establishing New Discourses. EUD can and should establish new discourses, including an exploration of the following concepts:

- *Motivation:* Human beings are diversely motivated beings acting not only for material gain, but for psychological well-being, social integration, connectedness, social capital, recognition, and for improving their standing in a reputation economy. The motivation for going the extra step to engage in cultures of participation is based on the overwhelming evidence that people are more likely to like a solution if they have been involved in its generation; even though it might not make sense otherwise. Creating something personal (such as hand-knitted sweaters,

home-cooked meals, etc.) even of moderate quality, has for many people a different kind of appeal than consuming something of possible higher quality made by others.

- *Control*: EUD supports users as active contributors who can transcend the functionality and content of existing systems. By facilitating these possibilities, *control* is distributed among all stakeholders in the design process. EUD erodes monopoly positions held by professionals, educational institutions, experts, and high-tech scribes. Empirical evidence gathered in the context of the different design activities indicates that EUD is less successful when users are brought into the process late (thereby denying them ownership) and when they are “misused” in fixing problems and in addressing weaknesses of systems that the developers should have taken care of themselves.
- *Changing Human Behavior*: Technology alone does not determine social structure nor does it change human behavior, but it can create feasibility spaces for new social practices [14] and can persuade and motivate changes at the individual, group, and community level.

Design Trade-Offs. There are numerous trade-offs to consider in establishing a EUD culture. Two important ones are:

- *Division of Labor versus Empowerment of Individuals*: Democratizing design by putting owners of problems in charge does not mean that there is no place for professionals in the future. By arguing for the independence of owners of problems from high-tech scribes, a legitimate question to ask is whether this will reverse the division of labor that has been a major driving force in advancing our societies. Professional designers play an important role in our society: most people are not able to and nor want to build their own houses, design their own cars, or write their own software systems or sorting routines. People do not have the time to participate equally in all aspects of human life in order to become fully engaged and informed, and therefore they rely on intermediaries to act in their interests.
- *Participation Overload and Personally Meaningful Problems*. Information overload has been discussed as a fundamental problem for the information society. Participation overload will be one of the most serious problems for EUD societies. Two pitfalls should be avoided: individuals (1) should not be forced to act as active contributors in situations where they want to be consumers (this is mostly the case in the context of problems and activities which are irrelevant to people); and (2) should not be restricted to consumers when they want to be active contributors and decision makers (this is mostly the case in personally meaningful situations).

6 Conclusions

EUD has moved from nonexistent to center stage. EUD perceived as a cultural transformation will create new social realities: public and private media will co-exist and blend together and professional and amateur contributions will complement each other. Providing all citizens with the means to become co-creators of new ideas, knowledge, and

products in personally meaningful activities presents one of the most exciting innovations and transformations with profound implications in the years to come. This objective characterizes the vision behind EUD as a cultural transformation.

Acknowledgements. The author thanks (1) the members of the Center for LifeLong Learning & Design who have made major contributions to the frameworks, models, and systems described in this paper, and (2) Daniela Fogli, Monica Maceli, Julie Zhu, David Diez, Ben Koehne, Stefano Valtolina, and Tony Piccino who provided insightful comments and suggestions to an earlier version of this paper. The research was supported in part by several grants from the National Science Foundation. The writing of this article was facilitated by the support of a “Chair of Excellence” fellowship granted to the author by the University Carlos III of Madrid.

References

1. Henderson, A., Kyng, M.: There’s No Place Like Home: Continuing Design in Use. In: Greenbaum, J., Kyng, M. (eds.) *Design at Work: Cooperative Design of Computer Systems*, pp. 219–240. Lawrence Erlbaum Associates, Inc., Hillsdale (1991)
2. von Hippel, E.: *Democratizing Innovation*. MIT Press, Cambridge (2005)
3. Burnett, M.M., Scaffidi, C.: End-User Development. In: Soegaard, M., Dam, R.F. (eds.) *The Encyclopedia of Human-Computer Interaction*, 2nd edn. The Interaction Design Foundation, Aarhus (2013)
4. Fischer, G.: Understanding, Fostering, and Supporting Cultures of Participation. *ACM Interactions* XVIII(3), 42–53 (2011)
5. Illich, I.: *Tools for Conviviality*. Harper and Row, New York (1973)
6. Binder, T., et al.: *Design Things*. MIT Press, Cambridge (2011)
7. Costabile, M.F., et al.: End User Development: The Software Shaping Workshop Approach. In: Lieberman, H., et al. (eds.) *End User Development*, pp. 183–205. Springer, Dordrecht (2006)
8. Zhu, L.: *Hive-Mind Space: A Meta-design Approach for Cultivating and Supporting Collaborative Design*, PhD, Dipartimento di Informatica e Comunicazione, Università degli Studi di Milano, Milano (2012)
9. Koehne, B., Redmiles, D., Fischer, G.: Extending the Meta-design Theory: Engaging Participants as Active Contributors in Virtual Worlds. In: Costabile, M.F., Dittrich, Y., Fischer, G., Piccinno, A. (eds.) *IS-EUD 2011. LNCS*, vol. 6654, pp. 264–269. Springer, Heidelberg (2011)
10. Maceli, M.G.: *From Human Factors to Human Actors to Human Crafters: A Meta-Design Inspired Participatory Framework for Designing in Use*, Ph.D. Dissertation, Drexel University (2012)
11. Fischer, G., Herrmann, T.: Socio-Technical Systems: A Meta-Design Perspective. *International Journal of Sociotechnology and Knowledge Development* 3, 1–33 (2011)
12. Fischer, G.: End-User Development and Meta-Design: Foundations for Cultures of Participation. *Journal of Organizational and End User Computing* 22, 52–82 (2010)
13. dePaula, R., et al.: Courses as Seeds: Expectations and Realities. In: Dillenbourg, P., et al. (eds.) *Proceedings of the European Conference on Computer-Supported Collaborative Learning*, Maastricht, Netherlands, pp. 494–501 (2001)
14. Benkler, Y.: *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. Yale University Press, New Haven (2006)