Medical Informatics Europe 2002
G Surján et al. (eds)
IOS Press 2002

Activity Theory and Medical Informatics: Usability, Utility, and Copability

Egil BOISEN[1], Ann BYGHOLM[2], Ole K. HEJLESEN[1]

[1] *Dept. of Health Science and Technology, Aalborg University, 9220 Aalborg, Denmark*
[2] *Department of Communication, Aalborg University, 9220 Aalborg Oest, Denmark*

Abstract. Working with health care today also means working with IT-systems. 'Human Factors' or 'user-friendly design' has been renowned as key factors for the development of safe and successful systems in many industries, not least in the IT-business. Likewise in the computerization of health care, the concepts of 'usefulness' and 'usability' will become key issues in the daily life (and death) in health care context at hospitals, at the GP's office, and in the home of the patient.
Though it is a pressing problem, the literature is still very scarce on how to meet this challenge. Inspired by activity theory, this paper sets out to coin a term for an important way to ask questions when determining the usefulness of a medical IT-system. We normally ask two types of questions: 'How usable is the system?' (usability), and 'How functional is the system?' (utility). But most important, we will also have to ask: 'How well does the user cope with the new situation?' As a concept for the latter way of asking questions, we will suggest the term 'copability'.

1. Introduction

Human Factors is a discipline that seeks to improve the safety of IT-systems and their usefulness by means of hardware and software design that is compatible with the needs, abilities, limitations and work environments of the user population. Historically, Human Factors can be traced to early efforts by industrial engineers and psychologists to streamline manufacturing operations and equipment for better worker efficiency. As the advent of the personal computer brought software products into use by the wider community, Human Factors became vital for systems success. The result was the emergence of the academic field of Human-Computer Interaction (HCI). During the nineties, the growing momentum of the IT-industry created a huge market potential for consultants like 'human engineers', 'interaction designers' and 'information architects'. Working with the usefulness of IT-systems, this 'business' has been under heavy influence by a commercial offspring of HCI known as 'usability'.

In these years, more and more IT-systems are being introduced in the health care context. In Denmark, the health authorities have made the development of Electronic Patient Record systems (EPR) a focal part of a strategy to accelerate a pervasive computerization of health care activities, both inside and outside of Danish hospitals [1]. In addition to this, lay people are creating their own revolution by using the Internet and WWW in ways that challenge the conventional health care system profoundly [2]. And as the growing health care expenses have put preventive medicine on the agenda, IT-based systems are expected to have a great potential, not only to save money, but also to enhance the life-quality and to prolong the life expectancy of the patients [3].

Yet, in spite of the exponential growth in medical informatics, many medical software organizations have a very limited understanding of Human Factors [4]. Only a few studies have been published concerning Human Factors within medical informatics, and only a fraction of these have dealt with methodological problems that arise in this context. What is clear, though, is that 'usability consultants' are facing new and difficult challenges. To name a few: One problem is that most health professionals are under a heavy work load constantly facing critical problems, which makes it difficult for them to find time for IT-consultants. The systems designers on their part need to have substantial insight into the medical context in order to acknowledge the special demands in terms of security, ethics, and standards; in order to know where to stand and how to behave when carrying out work-flow analysis; in order to notice and to fully understand the users' comments when testing a system; in order to know how to handle the risk of a trade-off between utility of the systems and security for the patient etc. [4, 5, 6]

Here, we will look at some of the fundamental challenges arising when introducing classic usability methods in the development – and use of – medical informatics. First, we will take a look at the concept of 'usability'. Here, we will point out that the way this concept has been developing during the last decade indicates a profound methodological problem that no system is complete until it meets praxis. Next, we will take a step back and look for a way to describe this dynamic relationship between man and technology. Here we will present the growing tradition of Activity Theory. On these two pillars being the legacy of 'usability' and the legacy of 'Activity Theory', we will then present the concept of 'copability'. Finally, we will discuss the benefits of this new concept as a supplement to 'utility' and 'usability' when determining the 'usefulness' of an IT-system in health care.

2. Usability and utility versus copability

2.1. Usefulness, usability and utility

A key figure in usability thinking is Jakob Nielsen. One of the basic tenets in his thinking is that good utility is not enough for a new system to become successful. 'Usability' is crucial, as a new system needs to relate to user expectations and past experiences in order to become useful. In the early nineties, he thus presented the model shown in figure 1 to illustrate the many aspects of system acceptability. Another key figure within HCI, Jenny Preece, recently characterized 'usability' as being focused on 'information navigation' by supporting the needs of the intended users, by being informative, and by supporting navigation through a menu system being consistent in terminology, layout and typography [8]. Here, it seems that the term 'usability' is being used in a wider sense, as 'supporting the needs' and 'being informative' arguably is a part of the *utility* of an information system.

This development in the use of the term 'usability' indicates a fundamental problem. The usability aspects stated by Nielsen can be measured in a controlled setting or in a *usability lab*, by presenting users with a number of tasks to complete with the system to be tested. But outside of the usability lab, utility and usability becomes heavily interrelated, especially when it comes to the design and use of an information system in a dynamic social context. For such an information system to be 'efficient to use', it needs to relate to the user's current task and cultural background, as much as to his cognitive abilities and limitations. Most of the initial work in HCI was focusing on the latter under heavy influence by a trend in cognitive psychology and cognitive science to understand the 'user interface' as being comparable to the interface between two computers where the output of one was the input to the other [9]. Thus, one of the main criticisms of this approach in HCI research is that it

does not provide an appropriate conceptual basis for understanding computer use in its wider organizational context [10]. Instead, many HCI-researchers have been looking for another conceptual model that better suits the dynamic aspects of the relationship between man and technology. Currently a lot of interest is being drawn to Activity Theory, as it provides a model of humans in their social and organizational context [11].

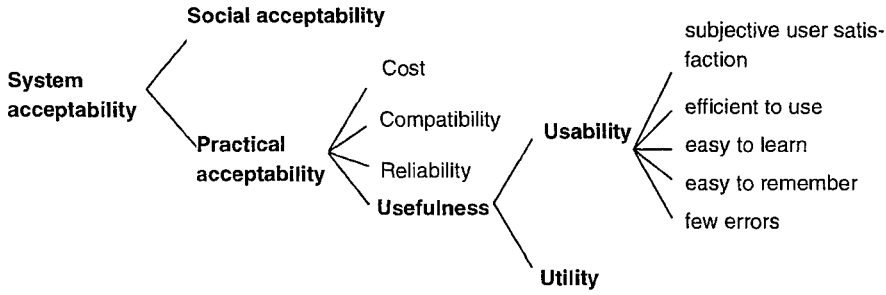

Figure 1: Adapted from Nielsen, J. (1993, p.25) [7]

2.2. *Activity Theory*

Activity Theory has its roots in the work of the Russian psychologist Vygotsky and the cultural historical psychology of Russia in the early 20th century. Central to Activity Theory is the concept that the basic unit of analysis of all human endeavour is 'activity' and that all human activity is mediated through the use of tools. In this perspective, a human being is more than just a 'subject'. It is also facing a 'case' (an objective or a challenge) that it approaches by making use of a 'system' (see figure 2).[1] This approach avoids the dichotomies between thought and action, between human and tool, and between individuals and society that are prevalent in western thinking. An 'activity' is the minimum meaningful context for individual human actions and unless the whole activity is the unit of analysis, the analysis is incomplete. As described by Hasan [13], political rivalry and conflicts over "data ownership" can lead to the failure of a system being implemented into an organization. Likewise, Activity Theory demands that activities are always studied in their actual context, taking into account the political, economical, social and cultural realities. No system is complete until it meets praxis.

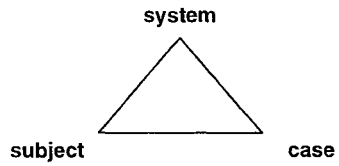

Figure 2

[1] In the discourse of Activity Theory, other terms would normally be used like 'object' and 'instrument', instead of 'case' and 'system', respectively. In recent years, the model has been enhanced, most prominently by the Finnish educational psychologist Engeström who extended the model to cover collective activities [12]. As the purpose of this paper is to present the concept of copability, we will only look at the basic model, even though the enhanced model is also relevant for the medical context.

2.3. Copability

If we combine Nielsen's two concepts about usefulness ('usability' and 'utility') with the model in figure 2, we can label two of the relations illustrated by the sides of the triangle. The relation between 'subject' and 'system' could be labelled 'usability', by using this term for describing how well a subject is able to approach a system. And by using the term 'utility' to describe how adequate the system (potentially) is in a case, we could add this label at the opposite side of the triangle. Used this way, the two terms that Nielsen uses to describe 'usefulness' will leave the third relation without a label. However, we suggest the term 'copability' for the remaining relation, describing how well a subject is able to cope with a case (see figure 3).

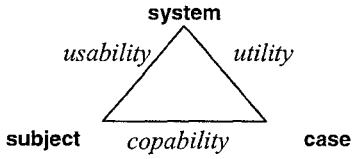

Figure 3

3. Discussion

In the thinking of usability, there is more to usefulness than utility. The mere fact that a system potentially is able to satisfy a user's needs, doesn't tell us whether the user will actually be able to use it. The introduction of the graphical user-interface is a case in point. In principle, it didn't change the functionality of the PC. But is made it much easier to make use of the functionality.

Now, given the inspiration from Activity Theory, we are able to point out that there is more to usefulness than usability and utility. Even though a system might satisfy a user's needs and be easy to use for this person, we will still not know whether this person will actually be able 'to cope'. The PC made it easier to write, but it didn't make it easier to write well – on the contrary, some say, arguing that it made people write de-focused, babbling, and much too long reports. The introduction of 'expert systems' is another case in point. Even though we were able to create a machine that was smarter than us, it is not given that we would ever dare to put it in charge. There is a philosophical reason for this. If we asked the system whether it would advise us to make use of its advise, we wouldn't know what to do with a 'No!'

One important point here is that the conceptual model from Activity Theory implies a longitudinal perspective. It is important to take into account how the user relates to *real life usage* of a given system. What does it mean for a user *to become a user* of a given system? A key question in copability-thinking is how a user relates as a person, and not as a mere 'user', to the 'case' for which a given system is built. Some might argue that a thorough 'usability-analysis' ideally would answer this question. Here, we would point out that a thorough usability-analysis never ends but continues all through the life-cycle(s) of a system. This is one of the tenets of the concept of copability. But at the same time we would hold that such a thorough 'usability-analysis' would include an up-dated utility-analysis, our point being that the term 'usability' would then be misused. Further, we would argue that there is more to this question than a thorough utility-analysis, as we are not able to foresee how the dynamic interplay between 'subject', 'system' and 'case' unfolds.

In order to demonstrate the benefits of the concept of copability and its underlying conceptual model, we will take a look on how it applies to the growing field of IT-supported disease management. Obviously, compared to a patient, a medical doctor has a lot of insight into the nature of the given 'case' of the patient. But whereas utility- and usability-analysis would normally relate to this 'ideal' definition of the 'case', the concept of copability implies that this is not enough. If the patient does not agree with the doctor's view, we are likely to end up with a case of non-compliance in which the system is not likely to be used, at least not in the intended way, and in which the patient will be likely to feel unhappy with himself or the doctor. Asking about 'copability', we will begin to make these state of affairs explicit, as the concept empathizes that it is important to take into account how the 'subject', being the patient, relates to the 'case'. In addition, the conceptual model underlying the concept of copability can help to sketch out a number of strategies how to handle a situation of non-compliance. The patient could be 'educated' to comply with the doctor's view of the 'case'. Alternatively, a dialogue between the two views could begin. Finally, our conceptual model will promote a longitudinal perspective and a continuous evaluation as an integrated part of the treatment.

In conclusion, a thorough analysis of the usefulness would have to look at the dynamic relations between 'subject', 'case' and 'system', having utility, usability and copability as three perspectives complementing each other. The addition of the copability perspective to the concepts of usability and utility will promote a clarification of these concepts and their dynamic interrelations, while the copability-perspective will focus on specific aspects which are important to make explicit in order to have a thorough usefulness analysis. It is a common philosophical insight that having a concept strengthens the awareness of phenomena, which can be described by this concept. Hence, the copability-enhanced usefulness analysis studying the dynamic relationship between the 'subject', his 'case' and 'system', will also be looking for long-term usage patterns and side-effects, coping strategies and changes in Life Quality, as well as changes in self-identity. But whereas the utility and the usability perspectives have long traditions of studying the task of the user when dealing with the 'case' (utility) and for developing a user-interface that suits the user's abilities and limitations (usability), we are still in need to study how these traditions apply to medical informatics. In addition, we are in need of studying how to survey dynamic interplay between 'subject' and 'case' when employing the 'system' in the copability perspective.

References

[1] Sundhedsministeriet (1999): National strategi for IT i sygehusvæsnet 2000-2002. København, Nov.1999.
[2] Rice, R.E. (2001): 'The Internet and Health Communication. A Framework of Experiences.' In: Rice, R.E. & Katz, J.E (eds.): The Internet and Health Communication. Sage Pub. London 2001, pp.18-29.
[3] Hejlesen, O.K., Plougmann, S., Ege, B.M., Larsen, O.V., Bek, T., and Cavan, D.A. (2001): Using the Internet in Patient-Centered Diabetes Care for Communication, Education, and Decision Support. In: Medinfo 2001, IOS Press (eds. V. Patel et al.), pp. 1464-68
[4] Gosbee, J. & Ritchie, E. (1997): 'Human-Computer Interaction and Medical Software Development.', In: Interactions, July + August 1997, ACM 1072-5220/97/0700, p.13
[5] Jacko, J.A. et al (2001): 'Framework for usability: Healthcare professionals and the Internet.', *Ergonomics* vol. 44, no.11, ISSN 0014-0139, Taylor & Francis 2001, pp.989-1007.
[6] Terazzi, A. et al (1998): 'How can usability measurement affect the re-engineering process of clinical software procedures?' *International Journal of Medical Informatics*, vol. 52, Elsevier 1998, pp.229-34.
[7] Nielsen, J. (1993): Usability Engineering. AP Professional, Boston 1993, p.25
[8] Preece, J. (1999): What Happens After You Get Online? Usability and Sociability. December 22, 1999 iMP Magazine, http://www.cisp.org/imp/december_99/12_99preece.htm
[9] Card S, Moran T. and Newell (1983): The Psychology of Human-Computer Interaction. Lawrence Erlbaum, Hillsdale 1983

[10] Hasan, H. (1998): 'Integrating IS and HCI Using Activity Theory as a Philosophical and Theoretical Basis, URL: Http://www.cba.uh.edu/~parks/fis/hasan.htm, Nov. 4, 1998.
[11] Nardi, B. A., ed. (1996): Context and Consciousness. Activity Theory and Human Computer Interaction. MIT Press 1996
[12] Engeström, Y (1987): Learning by expanding: an activity-theoretical approach to developmental research. Helsinki, Orienta-Konsultit 1987
[13] Hasan, H. (1995): Organisational Issues and Implications of EIS, Proceedings of ACIS95, Perth 1995, pp. 207-218