

User perceptions of effects of training: In search for qualities in use

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Linköping University Electronic Press
Linköping, Sweden

<http://www.ep.liu.se/ea/cis/1997/008/>

*Published on August 29, 1997 by
Linköping University Electronic Press
581 83 Linköping, Sweden*

**Linköping Electronic Articles in
Computer and Information Science**

ISSN 1401-9841

Series Editor: Erik Sandewall

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Typeset by the author using FrameMaker.

Formatted using étendu-w style.

Recommended citation

*<Author>. <Title>. Linköping electronic articles in
computer and information science, Vol 2(1997): nr 8.
<http://www.ep.liu.se/ea/cis/1997/8>. August 29, 1997.*

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Abstract

Within HCI and Interaction design we have tended to overlook the potential in people adapting to technology, rather than the other way around. What learning contributes to usability, remains largely a white space on the map. Such knowledge could enable the development of more usable systems, and help focusing software developers and the after-market of software on the same set of qualities; qualities in use.

Fourteen interviews with word-processor users at a medium sized Swedish marketing company were analyzed in search for categories on quality-in-use. The categories are related to Ehn and Löwgrens (1997), as well as Bannon and Bødgers (1991) notion of quality-in-use.

The contribution of the analysis presented here is first and foremost that it is grounded in the users' own views. Thus, the theoretical aggregates give a hint on the extent of what can be studied.

It is found that the following qualitative statements are formative for usability and quality-in-use.

- rationalizations play a vital role in the use of software
- there are different use strategies which users change between
- there are different situational factors of use that tint their use.

It is also noted that existing conceptions of qualities in use need to be cautiously applied.

The development of support-products for temporary collaborative learning, and persuasive help-facilities, are suggested with a potential to strengthen important qualities in use.

Executive summary

A longitudinal study on users' perceptions of the effect of training was carried out during 1995 and 1996, through interviews with 14 users (8 women and 6 men) of a common word processor. Among other things it was observed that the way they sought help, the strategies of use they employed, and four situational factors, influenced the quality of use.

Surprise as a possibility for learning

Users point out two kinds of reactions to breakdowns, which differ significantly from each other. In one case they get surprised, in the other they get confused. Still, both are variations on the same theme, tightly coupled to the user's strategy of use, and thus hard to detect outside that use.

They express surprise because they succeeded in doing something they did not expect, but which gave the result they wanted. In this case they want to know how they achieved that result. Expressed in terms of time, this is a backwards directed knowledge interest; a historical view.

They express confusion, either because they do not succeed, or because something unexpected and unwanted happens. In this case they would like to know what they should do to achieve the correct result. Also expressed in terms of time, this is a forward directed knowledge interest; a futurist view.

The historical view has received attention through the undo command. The futurist view has received attention as, e.g., the focus on support for

recovering from error situations. Both the historical and the futurist view are opportunities for learning. See "*Changing use strategy*" on page 9.

Support temporary collaborative learning

In actual use the strategy most preferred by the users for getting help, was to ask a colleague. The on-line help facility was seldom used, even though it is claimed by the software producer to be contextualized. This is not surprising.

Moreover the on-line help is, maybe undeservedly, not mentioned by any user as one of the preferred ways of getting help. The users seem to want an even higher degree, or even a totally different kind, of contextualization. They want, e.g., cook-book solutions for often-sought results. By referring to the ease of asking a colleague, and the language of the on-line help not being the language of their own and thus hard to understand, they motivate their choosing not to use the on-line help. The users seem to want a personal touch, and therefore ask their colleagues.

It is obvious that within strategies for seeking help of this kind one would rather not invest in software with on-line help facilities for all users. There seems to be a place for on-line help systems that are persuasive enough to be used. For the users in this specific case, to develop help facilities, or supporting systems, for users getting and giving help could be an improvement. See "*On the eve of training*" on page 5.

Situational factors

It is nothing new that there are factors other than the constructional aspects of software at play in the use of software. Interplaying factors which the users themselves bring examples of, and speak in terms of, need to be considered when designing for actual use. Such examples and terminology reveal the culture into which the software will be put.

Users found that the organisation brings meaning to their use. The goals and visions of the organisation provides them with a system for evaluating the results of computer use, and the process of use itself.

They also found that there is a learning environment that is supposed to stimulate and support them in

learning. This learning environment is a concern during actual work as well as during formalized training. During actual work it surfaces as an environment when they need to learn something new in order to be able to achieve the desired result. In a formalized training situation the environment is separated from productive work, a situation where the primary task is that of learning. In both cases the learning environment influences their use.

Not surprisingly they also find that the environment of use, i.e., the hardware and software, and their work-tasks influence their use. It cannot be given enough emphasis; context is king. *See "Situational factors" on page 10.*

1 Introduction

Efforts of making information technology usable is traditionally focused on adapting technology to humans. A large amount of good results has been achieved and as technology continues to develop we see even more progress. It remains to be seen which development that, after the graphical user interface, will be coined revolutionary. In parallel to this, people are adapting to the new kinds of technology. The computer, or a piece of software, become a part of most people's being-in-the-world.

We have tended to overlook the potential in people adapting to technology, rather than the other way around. What learning contributes to usability, remains largely a white space on the map. Such knowledge could enable development of more usable systems, and help focusing software developers and the after-market of software on the same set of qualities; the resulting actual usability in system usage.

In order to gain knowledge of these qualities, a shift of focus is needed, from the artifacts as objects, to artifacts as objects-in-use. In making this shift we will be able to gain knowledge on the quality-in-use.

The analysis presented here is a preparation for a larger scale study, aiming at a normative model of usability as a quality-in-use.

Training end-users has become vital when investing in information technology. More than four times the investment in software is spent on training users. According to Strassmann (1990), Landauer (1996) and Keen (1991), it is difficult to show that investments in information technology pay off, without looking at the use of IT.

The use of information technology has been established as a key to make information technology pay off. We need methods describing the use of information technology that can be related to the development of software products as well as the development of user competence, i.e., learning. If there can be observed no contribution of learning to the use of software, even more efforts need to be spent on the development of usable software. Assuming that learning, and training, makes a difference in the use of information technology, there is yet another way of making even better use of information technology.

1.1 Background

In 1995 a longitudinal descriptive study was carried out on end-user training. The aim was to observe any differences in subjectively experienced usability of a piece of software (Holmlid 1995a, Holmlid 1995b). The

study was performed with the SUMI instrument, a validated and thoroughly developed quantitative questionnaire (Porteous, Kirakowski and Corbett 1993). Participants filled out the questionnaire before, directly after and two weeks after the training period. The training was performed by a professional end-user training company in Stockholm, one day a week, over a period of seven weeks. In addition to the questionnaire, semi-structured interviews were made two weeks after the training period. They were made in order to get a richer picture of the expected changes in subjectively perceived usability. The users worked at a market-analysis company and were receiving training in using Word 6.0.

The results from the survey in Holmlid (1995a) were that the quantitative data could not give more than partial support to what had been expected; that usability would change with training. Furthermore the most reliable criteria did not give any support to that expectation. Interestingly, though, the qualitative data seemed to tell another story. In the qualitative data end-users expressed that the usability of the software product had increased through training. Even so when the SUMI measures for that specific person showed the contrary; that subjectively perceived usability had dropped. The main contributions were that training influences usability, and that usability can serve as one evaluator of training, and most importantly that there is need for "...reconsideration of the theories that are the groundwork of usability." (Holmlid 1995, p 74). That is, shifting the focus of HCI and interaction design towards quality-in-use.

In the follow-up in Holmlid (Holmlid 1995b) some in-depth analysis were performed with focus on the quantitative data, but no really thorough analysis was made of the qualitative data. The main contributions were first that usability has a potential of being used as one instrument to indicate if transfer of training has occurred. Secondly that subjectively perceived usability is affected by users' self-conception. Third that subjectively perceived usability can be used to assess whether the task/learning loop (Busch 1994) has been entered.

1.2 Contributions

The contribution of this study is first and foremost that it is grounded in user's own views. Thus, the theoretical aggregates from this retrospective study gives a hint on the extent of what can be studied. It is found that the following qualitative statements are formative for usability and quality-in-use.

- rationalizations play a vital role in the use of software
- there are different use strategies which users change between
- there are different situational factors of use that tint their use.

It is also noted that existing ideas on qualities in use need to be cautiously applied. To be able to draw more precise conclusions there is a need for further empirical grounding.

1.3 On reading this report

This report is the collection of my experiences from a grounded theory analysis (Strauss 1987, Glaser 1978). First the grounded theory analysis is described, sections 3 through 8. Secondly sections 9 through 11 discuss and elaborate upon two ideas on quality-in-use. Third suggestions are made for future work.

The survey (Holmlid 1995a) and the follow-up in Holmlid (1995b) combines into a richer picture of how usability is influenced by training together with this retrospective analysis. The main contributions were presented as a poster at CHI 97 (see “Executive summary” on page -1-0), together with a preliminary plan for the continued study (Holmlid 1997).

2 Method of analysis

The material used for the grounded theory analysis consists of 14 interviews with users recently trained in Word 6.0 (6 male and 8 female informants). The interviews were semi-structured and circled around the usability of the software, and the changes which may have occurred from before the users were trained.

To find out what was common denominators and descriptions of the users experience of the change through training, grounded theory (Strauss 1987, Glaser 1978) was chosen for the analysis of the interview material.

3 The flavour of coding

The first interview which was analyzed generated eleven fullwritten pages of notes, in a mixture of open and axial coding. Strauss (1987) stresses that the two coding strategies are to be performed separately, but that they both are essential. According to Glaser (1978) it is important to separate

TABLE 1. Generated codes

User support	Marketing strategy	Program attributes
Intention of interaction technique	Deputize	Homomorphism
Strategies for support during use	Conception of work group	Need of competence
Mental preparation	Quality criteria product	Interest
Object	Quality criteria process	Driver of learning
Development of competence	Relation	Adaptation
About	Marketing	Result
Conception of development	Usefulness	Target group
View on knowledge	Goal fulfilment	Borderland
Preconception	Individual differences	Effectivisation of work
Projection	Tempo	Control
Techniques for word processing	Wording	Surprise
Levels of learning	Learning strategies	

substantive coding and theoretical coding, and in his terminology open as well as axial coding are substantive coding strategies.

The names which were given to indicators after the analysis of the second interview can be found in TABLE 1.

To give a flavour of what lies behind these names, TABLE 2 contains a sample of the indicators that gave rise to these names. Notice that the names are given within a context, e.g., »object» is generated within a context of »mental preparation», and answers for what was mentally prepared.

TABLE 2. Codes and indicators

Code	Indicators
User support	<i>...the documentation, ... the on-line help, ... the tip of the day...</i>
Intention of interaction technique	<i>...never looks in the documentation, and almost never uses the on-line help, but generally reads the tip of the day...</i>
Strategies for support during use	<i>... looks in the documentation, and ... uses the on-line help,... reads the tip of the day...</i>
Mental preparation	<i>... expectation ... not to learn a lot...</i>
Object	<i>...expectation on the course was...</i>
Development of competence	<i>...not to learn a lot ... but to gain a deeper understanding</i>

TABLE 2. Codes and indicators

Code	Indicators
About	...a deeper understanding about Word...
Conception of development	...learned more than expected...
View on knowledge	...tables is an example of what was learned...
Preconception	...through Write and other peoples judgements of Word...
Projection	...is the way the picture of Word is built...
Techniques for word processing	...that picture said that Word was better than Write...

There were some names which corresponded to a number of different indicators, and also equal indicators which had generated different names. Discrepancies of that kind contributes to the coding with prolonging the process of maturing. Glaser (1978) points out that it contributes in later steps of coding to the fit of generated theories, as long as it is paid due attention.

4 On the eve of training

Users express many kinds of »expectations»; expectations on themselves, on the course, on the software, on a specific function's result, etc.

With expectations follows the lack of expectations; a sought for result is achieved when one does not expect it. Expectations presuppose a lack of knowledge without being totally without knowledge. Expectations also presuppose that the situation is such that the person values already made experiences for the evaluation of experiences to come.

Expectations are »projected» onto a specific object and its use in a specific situation. The expectations are built upon previous use of the software or similar software products; "Write is a joke compared with Word", what their colleagues have told them; "I have heard that Word is very good and that Write is ancient", and by the internal marketing performed by the computer experts responsible for the purchase and installation of the new software. Expectations is sometimes expressed as the ranking of similar software products.

I don't think Write has been a super software ... Word, I think, is a better program.

Users also tend to use different »strategies for getting help» during use. Most commonly people ask their colleagues for help. An informal net-

work of semi-experts had been established; “... they ask me about tables, somebody else for equations...”. Other »strategies« used are trial and error, use of personal notes or learning material, the on-line help, or the manual, roughly in that order.

... have never looked in the manual, very seldom uses the on-line help, but generally reads the “tip of the day”...

It seems that the methods of help provided for by the software producer are used inversely to their »power of contextualization«. The most easily accessible is used the most, and the most traditional is used the least. “The on-line help says nothing” or rather cynically “We have manuals”. At the same time the methods favoured are those which are the most »personalized«; colleagues, personal notes and training material. “It is easier to ask someone sitting right beside you.” The expertise of the colleagues are appreciated, both in relation to the software and to the work tasks; it is easier with contextualized and personalized help. In the personal notes, and the training material, the user herself have made some »personal investment«, and partaken in activities around the material.

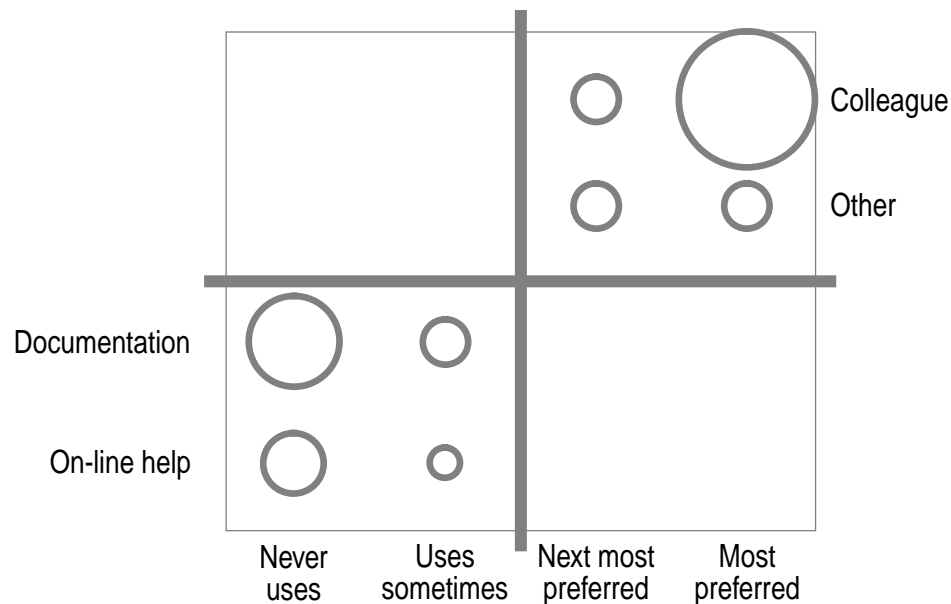


FIGURE 1. *Proportions of number of users' preferences and frequency of use of different methods for getting help*

5 During training

During training the relation between user and software seems to undergo some alterations.

The users express this relation in several different ways, some which have a direct connection with the user, some with a more direct »relation to the software«. Among the former some are expressed in terms of »knowledge«, “... learned a lot ...”, in terms of the »perceived usability«, “... the software was more usable than I expected ...”, “... easy to learn ...”. Among the latter some are expressed in terms of the »expectations on the functionality« of the software, “... could do more things than I expected it to ...”, “... advanced at first, but then ...”, the way users »depicted the software«, “... saw Word as a type-writer ... now Word has so many more functions ...”.

6 After the training

All users conclude that after training they have some need for learning more. Some say they need regular »teacher led training«, others that they need to »practice« what they have learned to be able to apply it at work. Yet others identify a need for »continuous training« at the workplace or »training on demand«.

... it is easier to learn as you need to use the software for something ...

Whether this is an indication of the success or the failure of the training is not readily available in the data material.

7 Categories on value

The software’s greatest contribution according to the users is the improved layout and »graphical quality« that is possible to obtain; “...it is easier to make good-looking documents...”. Writing good-looking documents is a way of »cultivating market relations«, according to several users.

Several users believe that they will be more »efficient using« the software when knowing how to use it; “... I can accomplish my work faster and more efficient...”. Having learnt how to use the software they also believe it will be »easier to use« the software.

8 Clusters of categories

8.1 Rationalization

»Experiences» of computers and computer use creates »expectations». These expectations in turn are »projected» onto the software in question. This creates what could be called a »rationality»; an understanding of the software from which coming experiences will be explained. Additional experiences will contribute to the explanatory power of this rationality, and will add to the expectations.

The »rationalization» also predicts something about the coming experiences, and thus is ground for the forming of expectations. The expectation and the predictions will inevitably influence the experiences. In turn these experiences yield results that are influenced by the expectations; if we expect ourselves to use a piece of software confidently, we will be more likely using it confidently. Support for this can be found through discussions on self-efficacy (see Busch 1994). The results of the use of the software, combined with the expectations, the rationality, and the predictions creates a ground for valuing and evaluating the interplay between the expectations, the rationality and the predictions. Evaluation reshapes the rationality, and the new rationality is used to explain whatever experiences there were and the results of that experience. See FIGURE 2.

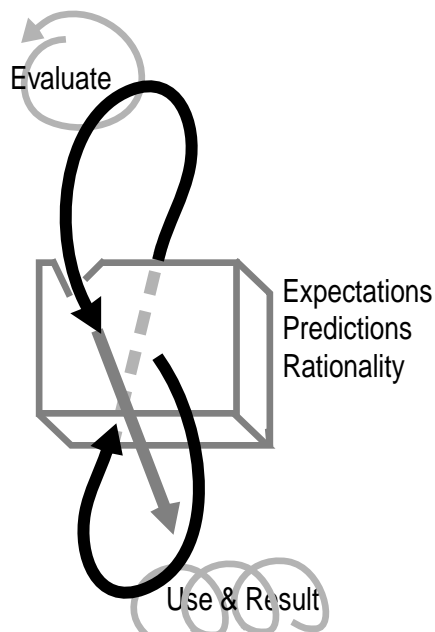


FIGURE 2. *Schematic framework circling around rationalizations*

8.2 Changing use strategy

The users describe a complex relationship between some categories. Those relationships uncovers »strategies of use«, and »descriptions of what happened« and »how to do«, as central aspects of use. The network surrounding the change of use strategies can be found in FIGURE 3.

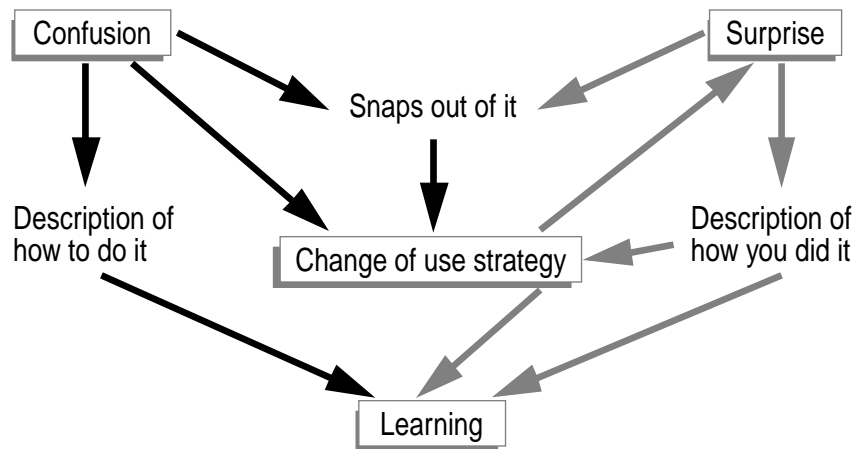


FIGURE 3. *Two sides of changing use strategies, and their relation to learning*

»Confusion« and »surprise« are similar to each other. They could be the result of the same process, but with different values of the result; confusion as being negative, and surprise as being positive. They are both consequences of something »unexpected« that happens, or that an expectation (or rather the belief that something should happen) remains unfulfilled.

They are both influenced by the strategy of use employed at the moment. In the case of »confusion« it might be a goal-directed strategy not yielding the correct or expected result. "... You know how it looks, but do not know how to get there ... You feel that there is always another way of doing things ...". In the case of »surprise« it might be a temporary strategy, e.g. a trial and error strategy or an explorative strategy, that yields what was intended as a result of a previous strategy. "Suddenly you get it the way you want it, without knowing how you did it". The difference between those two is a question of attitude, and a question of the user's relationship to the wanted result.

Material supporting users in the two different situations would be of different kinds. The surprised user wants to know what happened; a »description of how you did it« is needed. The confused user wants to

know how to get to a specific result; a »description of how to do it» is needed. The knowledge interests differ in important ways, as does the learning opportunity. The direction of time is different, one historical and one futurist. The need of immediacy is different, the futurist knowledge interest often demands immediate learning and success. Also the time available to be spent on learning differs between them.

Another aspect of this is the more traditional confusions on what to do next, and breakdowns (Winograd and Flores 1987). In the end of these processes there are a potential of learning, and could thus be subject of design as a micro level learning environment.

8.3 Situational factors

The categories divides into a few fields, the »attributes» and »behaviour of the software product», the »user», the »use to which the user puts the software», and the »situation in which the software is used». The »situation...» is composed of the »personal working environment», the »organizational environment», the »learning environment», »relations», and probably yet another few.

Holmberg (1996) deals with three different aspects of a *learning environment*; the environment as such, the *design of the environment* and the *learning* that is the result of that environment. The learning environment occurs both in the material analyzed here and from Holmberg. Holmberg's *learning environment* also includes aspects of the »personal working environment», the »organizational environment» and the »user». The *design of the learning environment* is mentioned in some of the comments on the »learning environment», and might be assessed indirectly through preferred and implemented solutions. It is fairly easy to see that *learning* as such has to do with the »user», but also with the »use to which the user puts the software».

Holmberg, from a wider perspective, suggests that there are three different environments that act as a compound, consisting of the *learning environment*, the *system environment* and the *organizational environment*. The *system environment*, in contrast to the »attributes and the behaviour of the software product», incorporates a portfolio of soft- and hardware products, as well as other ways of solving a work task. The *organizational environment* is wider than the »organizational environment» found in this context, including, e.g., aspects of the uses to which a user must put a system.

The differences displayed here demonstrates what the data analyzed in this retrospective study has not had the capability of covering. They also point to the fact that the knowledge interest which underlies this study and Holmberg's differs in important aspects. The retrospective study focus quality-in-use, while Holmberg's focus is learning environments. Holmberg complements this study, by uncovering an intricate interconnectedness between the categories of this study.

As a preliminary framework, from this comparison, is suggested clusters around »work tasks», »environment of use», »learning environment» and »organisation».

9 Relating to existing ideas on quality-in-use

There are already some conceptions of quality-in-use. They find a heavy and contemporary heritage in Heidegger and the later Wittgenstein, but also in Vygotsky and mediated action, or Leontjev and activity theory.

For the purpose of adding insights from the retrospective study to notions of quality-in-use, and finding support for categories found, I will briefly discuss two notions, Ehn and Löwgren's design for quality in use, and Bannon and Bødker's activity and artifacts-in-use. I will summarize each, make a brief reflection and finally write a paragraph relating them to the work described in this report.

10 Designing for quality-in-use

The more recent is a position proposed by Ehn and Löwgren¹. Ehn and Löwgren see the quality-in-use perspective as a joining element between HCI and informatics (Ehn and Löwgren 1996, 1997, Ehn 1995). Quality-in-use in their view is the combination of constructional qualities, ethical (or functional) qualities and aesthetical (or formal) qualities. The framework is lended from the Roman architect Vitruvius framework strength, utility and grace. Susan Lambert (1993) remarks on the influence of Vitruvius

... a Roman architect of no special significance were he not the author of the only architectural treatise to have survived from antiquity.

Lambert 1993, p 7

1. see the exhibition of artifacts in use of Kvaliteket (<http://qualitheque.ics.lu.se/>).

Variations on Vitruvius' theme has reverberated throughout history; Alberti proposed unity, proportion and suitability in 1452; Choisy proposed commodity, firmness and delight in 1909 (Lambert 1993); and in the 20th century we find echoes of Vitruvius in structure, function and form (Ehn 1995).

Ehn (1995) interprets Vitruvius in a non-trivial way using Habermas' concepts communicative action and knowledge interests.

The structure of a system is its material or medial aspects. ... The functional aspects of a system concerns its actual, contextual purpose and use. ... the form of a system expresses the experience of using the system. ...

Ehn and Löwgren, 1997, p 21

The framework is meant to be used as a framework for evaluating and analyzing the use of software, rather than the system as an object.

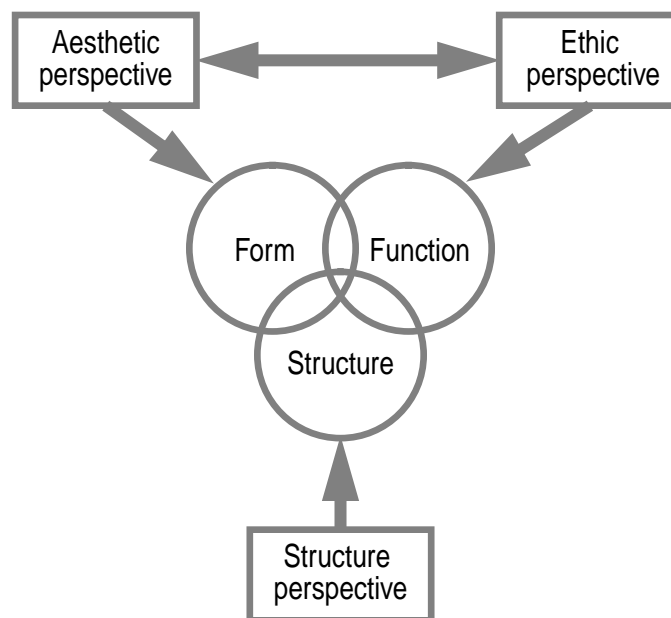


FIGURE 4. *A model of the artifact and quality-in-use, adopted from Ehn (Ehn 1995).*

Ehn and Löwgren (1997) propose to evaluate quality-in-use from three perspectives. First the constructional quality of a system in terms of correctness, performance, robustness, maintainability and portability. Secondly the ethical qualities of a system in terms of whether it is used in the right way. Third the aesthetical qualities of a system in terms of an aesthetics. The three perspectives have to be dealt with in a holistic manner to successfully address qualities in use; "...the integrated treatment of all

three perspectives are needed for a proper understanding...” (Ehn and Löwgren, 1997, p 22).

Ehn and Löwgren (1997) points out two implications for system development of a quality-in-use perspective. First, they mention the emergence of information technology criticism. Second, they mention design ability as a central skill for a systems developer.

10.1 Reflection

It is fairly easy to sort any qualitative statement on an artifact both in Ehn and Löwgren’s aspects as well as in Vitruvius. They both lend their theories to that kind of distinctions, because what we deal with is seemingly a single artifact. But when using their theories in that way one is opening the arena for critique on the separation of, e.g., form from function.

Ehn and Löwgren avoids the inclusion of known critique against general doctrines, such as “form follows function”, and other analytic categorizations in architecture and design, two fields upon which they heavily rely. This said not implying that it is possible or even desirable to transcend form and function. At the same time it is not possible or desirable to single out ethical quality from aesthetical quality, function from form. It is important to relate to the debates around this from the last century (see e.g. Lambert 1993). Discussions from the more mature fields would have been helpful in highlighting the irreducible tension between the different aspects Ehn and Löwgren proposes. The different existing postures regarding whether “every function has to take on a form, as well as every form will be ascribed a function”, have the power to introduce discussions on these matters from a common ground of known critique instead of opening a new arena for a repetition of the same or similar critique in a neighboring domain. Asplund (1980) presents one such within architecture. The reluctance to include known debates from the originating domains, such as art, literature and architecture, might show to be more harmful than fruitful.

Another way of using Ehn and Löwgren’s categories is to ask oneself; What kinds of constructional qualities is an *implication of* »help-strategies» for a word-processor? What kinds of constructional qualities is a *prerequisite for* us to use »help-strategies» for a word-processor? Finding a constructional quality, e.g. a support structure with a search facility and a degree of adaptivity and contextualization, one immediately needs to consider the aesthetical qualities of such a constructional claim. This brings forth a certain use of a system, which in term presupposes an arti-

fact (or a cultural tool) and a user (or an agent). Interpreting the holistic view, as defined by Ehn and Löwgren, means that an evaluator always already has one perspective looking at the odd aspects; looking at formal aspects from the ethical perspective, constructional aspects from the aesthetic perspective and so on. The evaluator cannot have super view of quality-in-use; that would be another quality perspective. This misconception is not argued against in Ehn and Löwgren's notion of integration and holism, They therefore run the risk to imply such a transcending quality perspective. It is absolutely crucial that the three-part definition is not used as a way of separating the three perspectives from each other, but used as a means for highlighting different aspects of one and the same use, and one and the same qualities-in-use.

Ehn and Löwgren's categorization also easily lends itself to criticism of not taking into account the differences of the originating domain and the new application domain for the categories. The qualities of activity and dynamicity will be pointed out here. On a continuum from static to dynamic objects, architecture is by virtue closer to the static end than is system development. On another scale the use of architectural objects in most parts is passive, but in some parts interactive as well as pro-active, while the use of software, by definition, is interactive and pro-active, and only seldom passive. These differences in dynamics and activity cannot be disregarded.

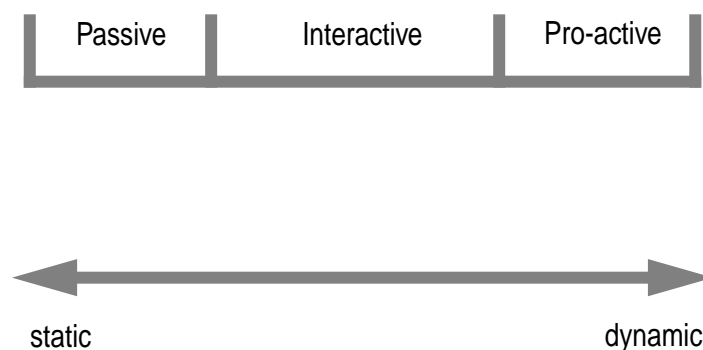


FIGURE 5. *The quality of activity and the quality of dynamicity*

It is not clear why we should choose an architectural framework as a model for interactive information systems. Furthermore it is not clear why we should choose the modernist accounts of architecture, with its heavy heritage from the Renaissance. All too often examples, be it for pedagogical or other reasons, are collected from the greatest modernists, e.g. Corbusier or Mies van der Rohe. These are not merely architects, they do handicraft, they are artists with an architectural expression. For example Asplund (1980) provides a thorough critical treatment of the modernist movement, which have ruled the Swedish architectural scene from the thirties until the seventies. We need to be able to clarify why architecture is a better model than the other design disciplines, than music, theatre and film-making, than joinery and happening/performance art. It might not be fair to make an analogy between film making and interaction design, even though the object of the design work is more similar, because of the differences between them giving a user/viewer possibilities to interfere with the ongoing telling of the story (neatly expressed through the user/viewer distinction). The uniqueness of the interactive material is its boundedness to time, the material has a time-dynamic form; interactions. The analogical assumption of using an architectural framework for interaction design can not be disregarded. The concern is not so much if it is wrong using an architectural framework, but if it is wrong *trying* to do so.

The main points made here is 1) that the analytic framework provided by Ehn and Löwgren carries a tradition which is not incorporated in its new environment and carries a metaphysics resting unreflected, which needlessly diminishes the analytic strengths of the framework, and requires of its users to be familiar with that rich tradition. 2) that the integration of and holistic use of the qualitative perspectives is not thoroughly treated by Ehn and Löwgren, which does not focus the reader on the irreducible tension between the quality perspectives of the framework. 3) that the treatment of differences between the objects for design between architecture and IT-design and their prospective influence on qualities-in-use are not discussed, which unfortunately makes the framework questionable on ontological and epistemological grounds.

10.2 Relation

It is fairly easy to sort the categories of this study both in Ehn and Löwgren's aspects as well as in Vitruvius. The categories expectations, help-strategies, artifact boundaries, knowledge and rationalizations will be used

to high-light the relationship between Ehn and Löwgren's framework and quality-in-use.

Surprise and confusion are both aesthetic quality perspectives. But they are dependent on the user's strategy of use (or sequence of such strategies). These might be an effect of or a reaction on formal aspects, but also of functional and structural aspects. Or, the strategies might be seen as an ethical quality perspective. Nevertheless, this corroborates the conclusion that it is not possible to transcend the different aspects or quality perspectives but that there is an irreducible tension between them.

Expectations can be created through the active use of power, through personal experience, through taking part of a culture, etc. The expectations can be directed towards oneself, the software, an activity with the software, the results of using the software, a coming experience of the software etc. The person with the expectations can know or be unknowing of the expectations, the origin of the expectations, the reason and motive for the creation of the expectations, etc. In Ehn and Löwgren's framework expectations would be treated as »form» and »function», and as an aesthetic and ethic quality perspective.

A person, e.g. a manager, has the power to create certain expectations on an IT-artefact for the benefit of herself, productivity, or the added value the company creates. The expectation given to the users can be one of modern equipment giving them more possibilities and freedom (instead of less time spent on tasks, tighter coordination, etc.), a better working environment (rather than a higher degree of debitable time, etc.). As such expectations become a complex quality of use, presupposing that the ethical and aesthetical quality perspectives are irreducibly intertwined. But the room for a user's expectations on herself, such as self-efficacy, is hard to find in a simple artifact model excluding the user.

Expectations might also be based on a non-use. With a model for quality-in-use, the non-use is presupposed. Thus, non-use also becomes a quality-in-use. Expectations based on non-use can be, e.g., the result of a person's will to achieve a certain result of the use, which would not be possible without that specific expectation. The quality-in-use is then dependent on the non-use of the user, and the idea of use of the manipulating person. Also, the non-use non-manipulated expectation a user builds until the situation or time of use results in a non-use based quality-in-use. A model of quality-in-use need to open up for the inclusion of expectations. As a result of that, we need to admit that such a position presupposes expecta-

tions and the lack of expectations not connected to usage. It will not be possible for users to enter a situation of use non-expectant. In fact, as expectations in use are partially based on non-use expectations and expectations constructed before use, one might say that every IT-artifact is always already made use of, pre-used (*swe. för-brukad* e). Any IT-artifact's pre-use (*swe. före-bruk*) is also a quality-in-use.¹

In this study of quality-in-use we find that colleagues, personal notes, third-party training and training material, on-line help and manuals all take part in the use of the system. Colleagues, as a strategy for getting help, is a quality-in-use, but cannot be modelled through the different quality perspectives proposed by Ehn (1995) with less than extending the *artifact* to include colleagues, which is not uncontroversial. Extensions of the human-computer interface has been suggested by other authors (Grudin 1993, Lewis and Riemann 1993). Ehn and Löwgren (1997) incorporates organizational dynamics in the functional aspects of a system, leaving the help of colleagues as an indirect or relational property of a system.

According to this study knowledge is a quality-in-use. As such it neither can be classified as structure, form, or function, nor is readily described by the different quality perspectives proposed by Ehn and Löwgren. Knowledge can be of different types; subjective, objective, personal and certainty (Tell 1997). In the cases where we need to say that the basis for knowledge is the user, we are forced to realise that not only the artifact but also the agent is a part of the use, and thus is a matter for considerations of quality-in-use. In Ehn and Löwgren's model the user is reflected in the relational aspects form and function, but otherwise ignored. A prerequisite for quality-in-use is the irreducible tension between user (agent) and artifact (cultural tool).

A revised framework for quality-in-use based on this discussion can be found in FIGURE 6. It detaches the quality perspectives from specific

1. The play with language cannot be made justice in a translation. The meaning of the Swedish word "förbrukad" is *consumed*, as well as *used before* or *already used*. This is made explicit through the defamiliarizing effect of the hyphen "för-brukad". That is, before we use a piece of software we have already consumed it in some way, as well as it is consumed during use.

aspects of the artifact, and incorporates the frame within which the user utilizes the IT-artifact, such as a social, cultural or organisational frame.

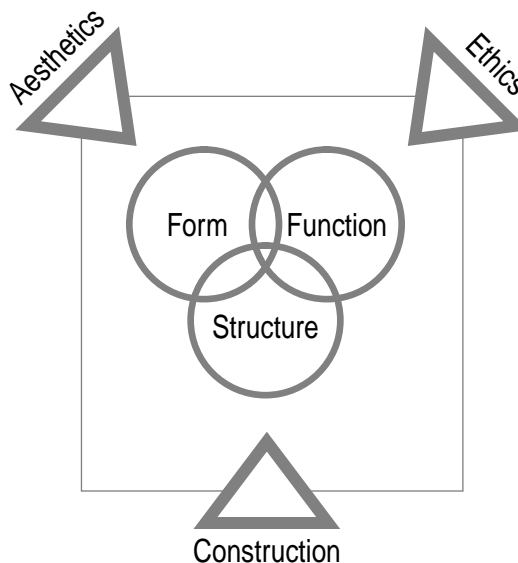


FIGURE 6. *A slightly enhanced model of qualities-in-use.*

11 Activity and artifacts-in-use

Turning to activity theory, the second notion of quality-in-use treated here (Bannon and Bødker, 1991), implies that we need to look at software and its qualities in the light of users *operating* information technology.

These operations, which allow us to build houses or do nursing without thinking consciously about each little step, are often *transformed actions* – that is, we conduct them consciously as actions in the beginning. Through learning we transform them into operations, but in encountering changed conditions, we may have to reflect on them consciously again, and thus make former operations once more into conscious actions.

Bannon and Bødker 1991, p 242

Thus the qualities that arise in use are manifested most often, and maybe most desirably, through operations, but also through conscious actions. These two disparate situations demand that we develop software that shows high quality in both. This implies that we might have to work with different sets of qualities for different situations, which both are prevalent at the same time. The most significant situation is then when something »unexpected« happens. The user wants to get back into operating the system, and at the same time learn about that new situation and whether that can be avoided, is a better way of operating the software, etc. The context

in which the operation or the conscious action appears is an important aspect to investigate in pursuit of the qualities that matter in use.

Activity is what gives meaning to our actions, though actions have their own goals, and the same actions can appear in different activities.

Bannon and Bødker, 1991, p 242

We might never understand that a piece of software is inefficient to use if we just look at the software out of its context. Exactly because the user might not use it differently from the intention of the designers. The software has been thoroughly evaluated and developed toward this intention.

In order to be able to penetrate this we need to look at the praxis of the user, because that praxis is the main shaper of our way of seeing computer applications, as opposed to individualistic needs and understandings. We need to do more than just psychological analysis; integrating social relations, division of work, etc (Bannon and Bødker, 1991). This puts evaluations of customer satisfaction and usability in quite a different light. It also provides the value-based definition of quality (Garvin, 1984) with means of establishing and evaluating what is valued.

Artifacts, in a human activity framework, have a double character: they are objects in the world around us, which we can reflect on, and they mediate our interaction with the world, in which case they are not themselves objects of our activity in use.

Bannon & Bødker 1991, p 242

11.1 Reflection

There is a risk, when focusing differences between practices as Bannon and Bødker does, to miss out on similarities between artifacts in different practices, and thus act conserving. But it puts forward the user in every situation of use, and thus forces us to formulate a conception of the user both in general as well as in particular.

Bannon and Bødker also root their position in mediation and toolness. Quality-in-use in those cases easily ends up discussing break-downs and transparency.

11.2 Relation

Bannon and Bødker mentions the physical conditions, the handling conditions, and the operational conditions, as ways of focusing on how the computer application appears to its user in use. In this study we find these three kinds of conditions, but we are left with the assertion that all other

categories are either a part of a praxis, or an activity within a praxis. This implies that there is a more or less established praxis which lends itself to descriptions through social relations, division of work, etc. Through arguments similar to the ones in the last section, regarding expectations and knowledge, we reach the same conclusion; the mediated action consists of an irreducible tension between user and IT-artifact, which does not lend itself to transcendence through concepts such as praxis or activity.

Surprise and confusion are both aesthetic quality perspectives. But they are dependent on the user's strategy of use (or sequence of such). These might be an effect of formal aspects, but also of functional and structural aspects. Or the strategies might be seen as an ethical quality perspective. Nevertheless, the conclusion must be that it is not possible to transcend the different aspects or quality perspectives; there is an irreducible tension between them

12 Back to empirical studies

Although having provided a lot of insights the material collected clearly has its limitations. The data is collected after the actual training, so references to circumstances before training are impossible to distinguish from hindsight wisdom. The data is collected in a situation separated from the actual use of the computer, so all talk about use stands unverified.

At least the intellectualization is done by the users themselves. It is their view of the matters discussed. Thus the different aspects presented here are grounded in their experiences of use, and less in the investigator's preconceptions of what matters in that use.

12.1 Tentative questions

Several topics pointed out in this report are worth more research and attention. Some of the topics are listed here loosely structured in six categories.

On help-strategies

- Assuming that newer help facilities have incorporated known critique of the traditional help-systems, are more modern on-line help systems used more?
- Is there a difference in total product usability with regard to usage of on-line help, between the products Word, and Words on-line help.

On expectations

- What is the role of expectations, especially self-efficacy and other expectations with a degree of self-consciousness, when trying to establish usability and quality-in-use?

On changing use-strategies

- The similarities and differences in surprise and confusion in relationship to usability; is surprise increasing usability whereas confusion is not?
- The similarities and differences in surprise and confusion in relationship to the learning opportunities; how should learning material be designed for the different situations? How can we detect the situations separately? Does a surprised user learn better than a confused?
- The model of changing use strategies is rather undeveloped, by more formal approaches the model might be more enhanced.

On situational factors

- Further study is needed on the different situational factors and how they influence the use of IT.

On designing for quality-in-use

- Is the revised model of quality-in-use meaningful for a designer of interactive information systems?
- In order for a design perspective to be fruitful there is need for the study of what the interactive materials are, and the form of interactive information systems.

On activity theory

- What are the different implications of activity theory and mediated action on usability and quality-in-use?

12.2 Future work

The theoretical aggregates from this study give a hint on the extent of what can and need be studied. To be able to draw more precise conclusions on qualities in use there is need for further empirical grounding. In the years to come I will focus on aspects of the interactive material, and

qualities-in-use as they relate to learning how to use an interactive information system.

The guiding questions are what qualities-in-use there is, how they can be described, and how they change with users learning how to use a system. The aim is to describe a method for designing learning environments which aim at increasing qualities-in-use and usability, for the benefit of instructional designers and system developers.

This will be done in two steps. First an explorative case study will be performed. The focus is how learning affects the use of software. In collaboration with a training company this study will be performed at one of their customers'. Data will be collected through studies of use before, and a few months after the training. For an early version of the design of such a study see my CHI 97 doctoral consortium contribution (Holmlid 1997).

Secondly a validating action study will be performed in cooperation with a training company. The intervention will focus on designing and giving training that increases identified qualities-in-use of a piece of software. A method of designing training will be developed, used and evaluated in a real-life training situation.

The research thus focus on designing and giving training that increases identified qualities-in-use of a piece of software. Among them aspects of the interactive material as well as aspects of usability.

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