WAW — an activity theory based tool for early web site usability assessment

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In recent years there has been a growing interest in ways to use activity theory as a tool for understanding computer applications in context. The work in this field has primarily focused on how to understand computer applications in a current work practice and how to improve existing computer applications. At the same time methods for web site inspection have been very pragmatic and a theoretic. In this paper we present an activity theory based tool for early web site usability assessment called Web site Activity Walkthrough (WAW). WAW is an attempt to build a cheap, predictive, and efficient tool for early usability inspection based on activity theory.

Keywords: web site activity walkthrough, activity theory, web usability inspection, WAW.

INTRODUCTION

For some years activity theory has gained increasing attention in the HCI community, mostly as a conceptual framework emphasizing aspects such as context, mediation and development. However, when it comes to practical tools for interface design and assessment, only few contributions have been made, e.g. *focus shift analysis* [6] and *activity checklist* [11].

Ideally, techniques for early assessment of the usability of a computer application should be made before the system is implemented. Mock-ups and prototypes are well known methods for involving users in the assessment before design, whereas purely analytical methods like heuristic evaluation [14] and cognitive walkthrough [13] bypass the need for users, letting the designer do the assessment by himself. From the point of view of activity theory, we might argue that such analytical methods are too limited, that they will never capture the richness of the real world, and that the involvement of real users doing real work is indispensable [1]. From the perspective of practical design, however, we might argue that we need all the tools we can get even if they are approximate and incomplete. In particular need cost effective tools, such as analytical methods helping designers stay on track and pruning out as many usability problems as possible during early design.

The cognitive walkthrough is popular and widespread due to its simplicity, and possibly because the inspector does not need to know a lot about the underlying theory of exploratory learning. All s/he needs is to identify some typical tasks, break these tasks down to a sequence of steps. For each step, s/he then judges if the appropriate action is obvious to the user, if the user can connect the correct action to the desired outcome, and finally if the user will get appropriate feed back [13]. The hard part of applying this method, however, is related to the fact that the method does not directly provide help in understanding tasks within concrete, relevant contexts.

The analytical tool proposed in this paper is an attempt to make an operational technique for early (analytical) assessment based on activity theory. We try to overcome the dilemma between conceptual frameworks not lending themselves to operational instruments, and operational approaches reducing their theoretical basis too much, and the dilemma between sensitivity to the real world complexity and the cost effectiveness of purely analytical methods. We do this within in the special case of a method for web site walkthrough called the Web site Activity Walkthrough (WAW). In WAW, an elaborate checklist appropriated the World Wide Web is used. In initial experiments with WAW, the method has been

used for evaluating an early version of a site presenting a new type of IT education to prospective students, the industry, the press, etc.

The fact that the WAW is a purely analytical method violates the basic tenet of activity theory to always ground analysis in empirical studies. In general it has been a challenge in developing the WAW to find a balance between exegetic theorizing and careless eclecticism. We believe that we have been able to strike a fruitful balance between these two extremes, in our attempt to bring activity theory to practical usability work.

The Web site Activity Walkthrough (figure 1) is composed of two parts. Firstly the web site is situated in use and use situations to consider are identified (step 1). Secondly, each use situation is broken down into a sequence of actions; each action is inspected (step 2) and solutions to identified problems are outlined (step 2 & 3)

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INSERT FIG 1: The web site activity walkthrough

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ACTIVITY THEORY

The basic unit of analysis in activity theory is human activity (e.g. work), that is, the endeavor of a group of people to realize some object. Activity is socially mediated by artefacts, i.e. division of labor, rules, social formations, language and instruments, e.g. [1, 2, 3, 7, 10]. Kaptelinin [10] summarizes the six most important aspects of activity theory in the context of human computer interaction as: the unity of consciousness and activity, object orientedness, the hierarchical structure of activity, internalization/externalization, mediation and development. Computer artefacts and web sites, like all other artefacts, mediate human activity within a practice. Human beings meet the objective world through outward acts. Thus, human knowledge and experience about the world is reflection obtained through activity, forming the basis for expectations, and desires about possible activities. Human activity can be analyzed as a three level hierarchy: activities are realized through chains of actions, which are carried out through operations (see figure 2).

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INSERT FIG 2: The hierarchical structure of activity

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At each of these levels the objective world is reflected through the activity. Human activity is always directed toward a material or ideal object satisfying a need. The subject's reflection of, and expectation to, this object characterizes the motive of the activity. Human activity is carried out through actions controlled by the subject's conscious goals. Goals are the reflection of the objective results of the action. Actions are realized through a series of operations; each determined by the concrete physical conditions of the action. These operations are performed without thinking consciously but are oriented in the world by a non-conscious orienting basis of the operation. This orienting basis is established through experience with the concrete material conditions for the operation, and is a system of expectations about the execution of each operation controlling the operation, in the process of the activity [12]. Engeström depicts human activity as a triangular systemic structure saturated with contradictions both internally (figure 3), and in its relation to its neighboring activity systems [7].

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INSERT FIG 3: The systemic structure of activity

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Contradiction is a basic, inevitable feature of an activity system and the basic source of development (for an example of the analytical power of the concept of contradiction see e.g. [4]). Primary contradictions are inside each corner of the activity. The secondary contradictions are contradictions between corners in the activity triangle: e.g. between the instrument used and the object of the activity. Tertiary contradictions are those between the considered activity and what it could possibly develop into. The

quaternary contradictions are those between the activity system looked at and neighboring activities: e.g. between the IT-university (the considered activity) educating candidate to match academic criteria and the IT industry (the activity consuming the products) needing to hire employees with skills enabling them to fill open jobs immediately. In the WAW we are mostly concerned with what Engeström [7] describes as secondary and to some extend quaternary contradictions.

Computer applications and web sites mediate human activity. According to Bødker [5] computer applications mediate use in three different ways: as being a system, a tool or a medium. Ideally, a tool is transparent (i.e. not in focus) in mediating the users shaping of some material. A medium is transparent in mediating the communicative relation between human beings. A system is not transparent to the user because the purpose of the system is placed outside the use context.

During the latest years, activity theory has gained increasing attention as a conceptual basis for HCI. However, as pointed out by Engeström:

”Activity theory is not a specific theory of a particular domain, and does not offer ready-made techniques and procedures. It is a general interdisciplinary approach, offering conceptual tools and methodological principles, which have to be concretized according to the specific nature of the object under scrutiny” [8 p.97].

Thus, the specifics of the domain of interest should be included in the analysis to benefit from the general framework. In the WAW we have incorporated knowledge about the specifics of web-technology and the culture of web-design to be concretize the general framework.

BASIC PRINCIPLES OF THE WAW

The WAW is an attempt to make a tool based on activity theory to identify problems on and in connection with web sites. The main idea of WAW is to contextualize the uses of a web site into possible use situations using basic principles of activity theory. These possible use situations can then stepwise be inspected for potential problems, and because WAW uses the activity theoretical framework to understand the use of a web site as a whole, the identified problems may concern the use context as well as the specific interface design of the web site. The core of WAW is derived from the checklist used for situating computer applications in use before doing focus shift analysis on video data [6].

WAW consists of three parts. First the web site is described and situated, secondly problems are identified, and finally, it deals with the identified problems.

The first part, the preliminary work in *describing and situating* the web site and its users, consists of an identification and contextualization of uses into possible use situations according to the design specification. The second part *identifies the problems*, and is worked out as a walkthrough where the possible use situations are analyzed and problems with their underlying contradictions are identified. Depending on the nature of the different identified problems, the problem is solved immediately in part two or just described so that *further problem solving and/or follow-up* is possible in part three.

DESCRIBING AND SITUATING THE WEB SITE

The starting point in performing a test is to identify and categorize uses of the web site. To identify the uses is a matter of realizing which uses the web site may be a part of depending of the uses the web site must support. The web site may have several uses with varying importance, and WAW uses this importance to help the inspector find the right solution to the identified problems.

WAW distinguishes between four kinds of uses – all of different importance (see step 1.1, figure 1):

- Necessary uses. Uses that the web site must support to fulfill its purpose/to justify its existence. E.g. an online bookshop must support users buying books – otherwise the site is useless!
- Frequent uses. Uses that are not directly “necessary”, but probably will be frequent. It is often a political (and economical) question to which extend the web site shall support these uses.

- Inexpedient uses. E.g. where a user tries to use the web site in an inexpedient way to achieve an object of a necessary use.
- Other uses. The inspector should consider use not covered by the three categories.

Putting uses into context – "contextualization"

The specified uses must then be put into a bigger context so the possible use situations can be identified, in line with [6], we use the term *contextualization.*

Several authors have shown that a computer application can be contextualized along several dimensions (or basic "principles") of activity theory [6, 10]. These dimensions are derived from activity theory, especially Engeström's work [7], and they let us understand the use of the application.

As a starting point in our work on developing WAW, we adapted Bødker's contextualization dimensions [6] by combining them with Kaptelinin's use perspectives and basic principles of activity theory [10, 11]. We thus obtained number of contextualization dimensions. Combining these dimensions with general characteristics of web sites (as described e.g. in [15]) we got the contextualization dimensions listed below. Initial tests showed that these basic contextualization dimensions *were* relevant in contextualizing the uses of a web site and that the dimensions did benefit by including the characteristics of web sites. The initial tests also showed that the initial contextualization dimensions were not adequate alone.

The distribution dimension

The examples in [6, 10, 11] included applications which could be observed/understood in a certain context with certain rules, division of labor etc., but because of the special characteristics about how web sites are distributed, the contextual components about division of labor, the community or the rules are hard to describe. A web site is most often used simultaneously in several contexts: the local context of the user, the context of the internet or in the context of the web site, and all these contexts probably have different characteristics. Therefore, we have added the "distribution" dimension to the contextualization which analyses the distribution of the web site by distinguishing between a *local*, an *internet* in general and a *web site* context.

The contextualization dimensions

The first contextualization dimension is about understanding *the web site and its future use*. This understanding is made by combining explicit as well as implicit ideas of users and future uses, content and purpose of the web site. This dimension may be compared to a design specification where the basic characteristics of a web site are described - yet in gross terms.

The second dimension is about *situating the web site and its uses*. This dimension examines experiences with the existing web site (if any), how the design is substantiated, and how the new design will influence existing work etc. This dimension is especially interesting, if the web site has a history - is it an improvement of an earlier version, a redesign or a completely new site? But if it has not, additional web sites with an equal purpose, use or users may have a history of interest. If e.g. the web site is an online email service, it might be necessary to include specific knowledge about the use of email and studies of similar services.

The next step is to understand *the mediation of the web site*, which implies a characterization of the web site in different uses as being system-, tool and medium. All three mediations are possible on web sites in various combinations, but currently a tool mediating web site is rare. Typically web sites can be understood according to the system- or medium-perspective. To paraphrase this dimension is about understanding the connection between user, web site, other users and/or the objects.

The web site may also be characterized according to the principle of *internalization* and *externalization*. This dimension comprises an assessment of how the web site supports learning and development in use. How does the web site support the user in transforming conscious actions with or on the web site into unconscious operations? In the opposite direction, how does the web site support the users unloading of

mental effort to the web site, e.g. by providing advanced features for formulation and storage of complicated search strategies?

The last of the initially dimensions is *situating the web site in its network of activities* and identifies in which activities the web site take part and how these activities are related. The main purpose of this dimension is to create sensitivity to the networks of activities rather than to make a complete and specific analysis. The web site is not the only instrument the user will interact with, and in many situations the web site will be shared between different activities, serving different purposes. Motives of potential activities are recognized by asking *why* the web site is used by *the* (various) *users* to do *something*.

Web sites are both part of the World Wide Web in general and subject to local use. The *distribution* dimension analyses the context of the web site by a distinction between *local* context, *internet* context and *web site* context. The *local context* of the website will in most cases be a regular activity system. Consider a secretary using a travel web site to order the best ticket for a service technicians' business travel. The local context is the company with its division of labor between secretaries and technicians, rules regulating travel expenses, etc. In the analysis of rules, community and division of labor of the local context, the inspector may need special tools, adapted from other sciences – e.g. marketing or organizational analysis. The *internet context* of the web site is not an activity system, but rather the culturally, and techno-historically developed basis for the web site. When the secretary uses the travel web site, she is able to interact with and through it because it triggers her web specific orientation basis; and she depends on a certain level of trust, based on general experience with e-commerce, when she purchases the ticket on-line. In describing the internet context the evaluator might analyze related websites to get an understanding of the established cultural norms and standards and how they influence users' expectations. The *web site context* is, the socio-cultural room constituted by the site and the actions of the people interacting with and through it. In some cases an on-line community emerges "on" the web site, being more or less ephemeral, ranging from regular activity systems to something better described as accidental meetings or what Engeström describes as knot-working. In all cases, users "go into" the room defined by the web site, and the success of their encounter with the site depends on their ability to align themselves with the "cultural norms" of that place. The secretary goes into the web site to book the travel; she understands that it is not possible to negotiate prices and book hotel rooms at the travel web site. The travel web site might also offer a on-line forum for regular costumers, here the secretary check the list of hotels recommended by other members, and when she does not find what she needs, she posts a question in the discussion room. The three contexts of the web site will be of variable importance depending on the purpose and structure of the considered site.

Possible use situations

By contextualizing according to the described dimensions, the inspector should have a sufficient impression of the activities that includes the web site. Since WAW is intended for analyzing a not yet existing web site defining possible use situations may not, depending on the contextualization, be done completely. Adequate information about users, objects, design, mediation etc. makes a more accurate contextualization. In other words, it is easier to define possible use situations of web sites with a limited, well defined and homogeneous target group and a few purposes.

Defining possible use situations is done by combining the specified uses and the contextualization. In practice, the inspector considers the motives underlying each specified use according to the hierarchical structure of activities by asking "why?". It is important that the answer (the possible use situation) is substantiated by the contextualization.

The answer to the questions combined with the contextualization is then used to outline the possible use situations according to Engeström's activity system triangle. These triangles are then used for the problem identification.

IDENTIFYING PROBLEMS AND SOLUTIONS

Identification of problems in WAW is designed as a walkthrough. By stepwise analyzing the possible use situations, potential problems are identified. The inspection of each possible use situation is carried out by outlining the systemic structure (the activity triangle) of the activity [7] (see figure 2) and analyzing the involved contradictions, to identify problematic ones. If any contradictions immediately appear to cause problems, the inspector examines the use situation for possible solutions that do not introduce new contradictions, and the solution is described. If the inspector cannot find any possible solution, characteristics about the contradiction and the problems it causes are described for later follow-up. After this, the use situation is inspected stepwise, action by action, the same way. If an action is unproblematic, the inspector continues to the next action.

When all possible use situations are inspected, the inspector has described the solutions to a number of problems and furthermore characterized the causes to another number of problems. Depending on the characteristics of problems a solution is decided:

- Ignoring the problem. If e.g. the use that caused the problem has a low importance (inexpedient or less frequent).
- Changing the design of the web site. If a problem can be solved immediately by changing a few components and this does not introduce new contradictions, this might be the right solution.
- Modifying the design specification. If it is a major problem or the problem can not be solved by changing the design and the use is "necessary", the problem might be *prevented* by modifying the specifications of users, target groups, purpose etc.
- Testing the problem. A problem might not be that actual or as important as first assumed. If doubt arises, consider performing an empirical investigation of the issue.

When the problems are solved and/or the specifications of the design and use of the web site are revised, the design may begin.

HOW TO USE WAW

WAW is a predictive *design* tool, which in this case means that it is designed for early web site usability assessment of not yet existing web sites and may be used without a product or a prototype. Nevertheless WAW requires reasonable and sufficient specifications and assumptions about target groups, uses, purposes and design. By "sufficient specifications and assumptions" we mean information enough to specify the uses of the web site and to contextualize these uses into possible use situations, e.g. a design specification.

"Sufficient specifications and assumptions" is variable, depending on the aim of the inspection (e.g. how specific the inspector wants the identified problems to be) and the characteristics of the web site. Typically, WAW would at least require information about the purpose of the web site (necessary uses), the history of the web site, the characteristics of major target groups and a number of different characteristics about the web site - e.g. the contents in great terms, the interface design, information structure etc. Since the process of using WAW shall be considered dynamic, WAW may show additional requirements for information during the process. E.g. WAW may identify that there is a possible contradiction between the division of labor of the user's context and structure of the information on the web site. In this case the inspector may need to gather additional information about these matters that was not initially considered "reasonable".

The typical procedure for WAW based inspection consists of the following major parts:

- Clarifying the requirements for the web site, which includes a definition of users, purposes, contents and design of the web site. This may not be the inspector's job. In many cases a requirement specification is the given starting point drawn up by the originators of the web site.
- Understanding the case and acquiring additional information. If the inspector and the owner of the web site are two different persons, it is important that the inspector understands the case very pre-

cisely. This may be ensured by making a case description that substantiates the new web site. According to the case description the inspector may find it necessary to acquire additional information about certain issues.

- Performing the WAW. When the required information is collected, the WAW may begin. WAW may show that certain information has to be acquired – this is done during the process.
- The subsequent data processing lists a number of problems and their solutions. If major changes in the design specification have to be done, a new WAW may be required. Otherwise the identified solutions are used for the following design process.
- Inspection during design. When the design process has started, WAW is used for iterative analysis of contradictions. If any component changes, the designers (or the inspector) should look for new contradictions and consider the consequences. Major contradictions may require a new WAW of the current design.

AN EXAMPLE OF WAW IN USE

To illustrate the flow of the WAW in use, we present a condensed version of the analysis of a specific web site during design. The example focuses on different important parts in performing a WAW – especially defining uses and use situations, the problem identification and the identification of solutions.

The analyzed web site is a redesign of a previous and rather similar web site that represents different IT educations externally - e.g. to prospective students and the IT industry. Because of new demands and expectations about the design and contents, the previous web site had to be redesigned. The new design should be more representative of the content and professional level of the educations, and should also create a positive impression of the students towards the industry. The content should be supplied with additional information about the qualifications of the students, the job opportunities of the students, the study environment and facilities etc.

Step 1.1: Identifying the uses

The first step is to identify and categorize the *uses* of the web site. In accordance with the description above, the following *necessary*, *frequent* and *inexpedient* uses were identified:

Necessary uses:

- To create an (positive) impression of the professional level and the qualifications of the students towards the IT industry and secondarily towards future students.
- To provide information about the educations, study environment, future occupation, contact persons etc. towards future students.

Frequent uses:

- As a reference for current students applying for job.
- For other target groups, e.g. the press, other universities etc., to obtain different information.

Inexpedient uses:

- As curriculum information for students.

Step 1.2: Contextualization

I order to identify possible *use situations*, the identified *uses* need to be contextualized. This is done by considering the questions in WAW, step 1.2.

The web site *and its future use* may be understood according to a number of purposes; to attract future students, to inform future students about the educations, study environment and future occupation, to create a positive impression of the professional level and the qualifications of the students toward the IT industry etc. This should be communicated by a creative, appealing and usable web site with a relevant and serious content.

The web site is *situated* as a combined redesign and further development of an existing web site. The existing web site was primarily designed for future students, but since the web site does not provide sufficient information about study environment, admission procedures, start of studies and later job opportunities, the web site was not really used. Instead of contacting the education supervisor or visiting the university, the web site should provide answers to frequent asked questions about studies, study environment etc. Furthermore the web site should be expanded to target the IT industry.

The *mediation of the web site* is primarily *media-like*. The site is a medium for communicating between the IT University and its prospective students, employers of candidates and the general public; and specifically between students and employers. A *tool-like* mediation occurs when the web site supports recruiting officers' work on the student database understood as material, e.g. by providing means for building custom classifications of the students. *System-like* mediation should ideally be avoided in this kind of web site, as it means that users have to perform actions not motivated within their own activity. However, system-like mediation cannot be completely avoided when it comes to user registration and login, and it might be necessary to force students to engage in system interaction to ensure consistence and completeness of the student database.

In the web site, support for *internalization* is primarily ensured by conformance to standards and visibility of novel possibilities. Since the site is not used on a daily basis by most of the users there is no point in putting a lot of effort into the development of non-standard features and interaction forms. *Externalization* might be supported by features of the web site for formalizing and refining e.g. search profiles as part of the above described tool mediation

Since students, teachers, administration, the press and other universities may all have individual motives for using the web site, the complete *network of activities* is difficult to identify. As described in step 1.1, the web site must support future students in finding information about studies, study environment etc., and the IT industry in getting a positive impression of the professional level of the students, so activities involving or influencing these uses must be taken into consideration. Other activities may involve the web site, but probably will not have any influence on the activities including necessary uses.

The *distribution* of the web site should be considered as *local*, and partly as *internet*. The user may typically use the web site within a local context where the local rules, community and division of labor influence the use situation. If the user often visits recruitment web sites or compares the content of the web site with other similar web sites, the rules and community of the internet context may influence the use situation.

Step 1.3: Identifying possible use situations

By combining information about the target group and the use of the first identified necessary use, it is possible to formulate the following question:

> *Why does **the IT industry** use the web site to create **an impression of the professional level of the students**?*

In accordance with the contextualization the answer to this question identifies the *use situation* (use situation #1) as:

> *The IT industry uses the web site to examine the possibilities for acquiring qualified labor in an easy way to solve a scarcity of labor and/or to improve the productivity etc.*

A complete inspection of a web site repeats this identification of use situations for each identified use (in step 1.1), but in this condensed example we will only focus on the just identified use situation.

In accordance with the contextualization of the use and the identified use situation, it is possible to identify the following instrument, subject, object and outcome of use situation #1.

- Subject: The user from the IT industry.
- Object: Different information about the qualifications and professional level of the students.
- Outcome: Employment of the right, qualified students.

- Instrument: The web site, the user's (from the IT industry) intuition, preferences and experiences from corresponding web sites etc.

Taking the characteristics about the distribution of the web site into consideration, the rules and community must be understood in a combined local and internet context. The company may e.g. have adjusted the rules and procedures of recruiting new employees to how it works on the internet. This leads to the following components:

- Rules: Procedures of hiring at the company and how it works on the internet in general. Usual ways to get employees via the internet is by recruitment web sites where companies place job adverts, by databases with CV's and profiles of people, or by CV databases at the recruiting companies.
- Community: Primarily, the community of the people hiring new employees at the company, and secondarily, the IT industry, the company in general and the internet.
- Division of labor: Identifying the scarcity of new labor, searching for new employees, hiring and job interviews may be done by the same or different persons in the company.

When the components of the considered activity are identified (object, subject, instrument etc.), it is possible to outline Engeström's triangle of the use situation.

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INSERT FIG 4: The activity system containing use situation #1

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This triangle is used in step 2 to identify problems, but first we have to identify a reasonable action sequence of the use situation. We do this by considering the identified use situation. Since the IT industry uses the web site to "solve a scarcity of labor", the initial step must be to identify the scarcity of labor, and afterwards to get the idea of looking to the internet for labor and acquiring the address of the web site. When the user enters the web site, the web site will be used to "examine the possibilities […] in an easy way", so the ideal use of the web site could be described as three steps – initially searching for information, secondly selecting the students and finally contacting the students. If the company has contacted one or more students, the next step would probably be a job interview and maybe employment.

So the complete action sequence of the use situation would probably be the following:

1. Identifying a (possibly) scarcity of labor.
2. Getting the idea to look the internet for labor.
3. Acquiring the address to the web site.
4. Searching the web site.*
5. Acquiring information about students.*
6. Selecting the students.*
7. Contacting the students.*
8. Job interview.
9. Employment of the right students.

* These steps involve the web site

Step 2: Identifying problems

The Engeström triangle (figure 4) and the listed action sequence is the basis for the problem identification by analyzing the contradictions of the activity triangle. Before walking through the action sequence, the contradictions of the triangle are analyzed; two contradictions immediately seem problematic:

1. The contradiction between the procedures of hiring (the rules) and the web site (the instrument); since the company usually employs labor through announcements – no headhunting! A solution could be to change the appeal of the web site or letting the companies announce job openings.

2. The contradiction between representing the students in text and graphics (the object) and craving for means for meeting the whole person face to face (the subject). No immediate solution could be pointed out.

After the immediate problem identification is done, the use situation is inspected action by action:

Action #1-3: The three initial actions do not involve the web site – we will ignore these actions in this condensed example.

Action #4: This action does not show any immediate contradictions, but draws attention to how the information is structured on the web site in relation to how information about personal qualifications is structured in the industry and on recruitment web sites (i.e. related to the whole network of activities).

Action #5: Acquiring information about the students includes a contradiction between the data about the students on the web site (object) and the usual design of a job proposal or what the user wants to know (subject). This may immediately be solved by either adding more information about the students (but this may cause other contradictions to other specifications of the web site) or adding an email address, so the user may contact the student and obtain the needed information.

Action #6: Selecting the students may contain a contradiction between how different people usually are involved in hiring new employees (division of labor) and what instruments the web site offers (instrument). If usually different people at the company are involved in the process, one recruiting officer using the web site may be a crucial contradiction. This contradiction seems hard to solve since it is mainly caused by the company. Nevertheless the presentation of information of the web site may be changed according to the preferences of the different people at the company, but this may introduce new contradictions.

Action #7-9: These actions do not seem to cause problems as long as an (email) address of the students is available. The job interview and the employment do not involve the web site in any significant way.

Step 3: Follow-up

When the walkthroughs for each identified use situation are finished, the problem solving begins by listing immediate solutions (identified in step 2) and deciding solutions to the not yet solved problems (as in figure 5). Since this example is a condensed version to illustrate the flow of WAW, we will not go into details with the exact identified problems and solutions, but as an example of how solutions are decided, consider the problem in action #6 of use situation #1.

Use situation #1 should be considered *important* because it's based on a *necessary* use. This means that this action cannot be ignored, neither can we do major modifications of the requirement specification. Thus, we have to change the design of the web site in order to eliminate the problem or possibly verify the genuineness of the problem by an empirical investigation. Follow-up solutions are recorded in a dedicated column of figure 5.

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INSERT FIG 5: Summary of actions, problems and solutions of use situation #1

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When all the solutions are decided and listed for each use situation, WAW is finished and the re-design of the web site may begin.

EVALUATION OF WAW

The construction of the WAW demonstrates that it is possible to base a walkthrough method on activity theory. To verify that it is possible for others than the authors to use WAW in practice we have tested the method. Our greatest concern has been whether or not the method is usable. In other words: is WAW usable for usability inspectors (or others) to inspect web sites, and does WAW identify usability problems on and in connection with web sites? Furthermore it is interesting to examine the effectiveness and efficiency of WAW, but since reliable measurements of the effectiveness and efficiency of the method

would require an extensive amount of data and probably still be inexact, we will only sum up the tendencies based on our current experiences.

To evaluate WAW we performed two different studies with inspectors who have never used the WAW method before. In both studies only parts of the web sites were analyzed.

The first study was an inspection of a web site under development by two of the developers of the web site. The developers of the web site are also computer science students with a comprehensive knowledge about web sites, some knowledge about HCI (both completed a course on HCI) and a little knowledge about activity theory. The purposes of this study were to evaluate the usability of WAW by inspectors with a fair knowledge of web sites, usability and some activity theory; WAW's ability to identify relevant usability problems; and to some extend to examine the effectiveness and efficiency of the method. By letting two developers of the web site cooperatively inspect while thinking aloud, it was possible to observe complications and difficulties in using WAW and the time consumption alongside the identified problems. This study was carried out twice with different developers of the same web site.

The second study was carried out by letting different inspectors inspect web sites they were either developing or redesigning with WAW. The inspectors were academics with intermediate knowledge about web sites and HCI and only very little knowledge about activity theory. The purpose of this test was primarily to examine whether or not WAW was usable for usability inspection of web sites, and secondarily if the method was usable for inspectors with only limited knowledge about activity theory.

Is WAW usable, and does it identify usability problems?
Our tests clearly show that WAW is usable to inspect web sites, and that WAW identifies problems on and in connection with web sites. The tests show that the computer science students (in the first study) as well as the academics (in the second study) are able to inspect web sites using the method, but unfortunately not without some problems. In accordance with the time used on performing the WAW, the academics in the second study had more difficulties the applying the method than the students had in the first study, who had just a little knowledge about activity theory. However, the students had difficulties in understanding minor details as well. In general, the problems in using WAW were related to difficulties in understanding activity theory – especially the contextualization, and problems in understanding the procedure of performing the WAW.

Nevertheless the identified problems were indeed relevant. By comparing the problems that were identified using WAW in the first study, with the later error reports and questions send to the webmaster of the web site, it is evident that the identified problems (that were not solved after they had been identified) had invoked problems for the users. Some of the identified problems contain aspects of usability that standard approaches might not identify – e.g. the need for a real-life introduction workshop with hands on exercises, online conversion of Word-documents into RTF-documents to support cooperation across software platforms, or a FAQ about printing problems when the user has not transferred money into his/hers printing account. None of the described solutions were implemented, and the later experiences with the web site clearly show that users had problems understanding how collaboration was supported by the web site.

In the first study (with the students) the contextualization was utilized as a thinking tool supporting a general discussion and clarification of the use of the web site. We see it as a strength of the method that it "invites" to such an open ended application.

Effectiveness and efficiency of WAW
Comparison and validation of usability measurement methods is complicated and most often the validity of such studies is questionable. However, to provide a rough assessment of the effectiveness and efficiency of the WAW, we outline the time used to perform a WAW in the studies and in our own use.

Identifying uses (step 1.1) did not involve any problems and naturally depends on the number of uses the web site must support. If a reasonable requirement specification is present, identifying the uses may last up to 2 hours.

Contextualization (step 1.2) done by inexperienced users of WAW usually takes about 1.5-2.5 hours depending on the complexity of the web site, and on how precise the requirement specification etc. is. A contextualization is usually done only once or maybe a few times for each inspection, so it would be reasonable to calculate 2 hours for experienced inspectors to contextualize the identified uses.

Identifying the activity system containing the use situation, the problems and the solutions for each identified use (step 2 and 3) typically lasts about 35 minutes. An experienced inspector might do this quicker.

In other words; a reasonable time schedule for the experienced WAW-inspector to inspect a web site would include 1 hour to identify uses, 2 hours to contextualize the uses and 20-30 minutes for each use to identify problems and solutions. This means that it should be possible to inspect an "average" web site in one day – of course depending of the number of different uses and users/target groups and the complexity of the web site.

CONCLUSIONS

The WAW illustrates that it is indeed possible to build practical tools for early usability inspection based on activity theory. Our studies of WAW in use suggest that it is possible to spot problems beyond the level targeted by traditional methods like the cognitive walkthrough. Moreover, the evaluation of the method indicates that it is both cheap and fast, making it possible for one or two inspector to analyze a web site in a few hours. Compared to established analytical methods like the Cognitive Walkthrough [13], WAW gives the inspector stronger means for predicting whether or not the user, or rather the different users can make sense of the web site in the context of their specific situations. The strength of WAW compared to e.g. the cognitive walkthrough is that WAW has explicit support for considering the entire context of use based on the human activity framework. It is obviously a question open for debate whether it would be possible to remove the theoretical stuff from the method as it has been done with the cognitive walkthrough. Our conclusion so far, however, is that the theoretical basis is important and manageable for the different users of the method. The evaluations of WAW showed that the method is most likely to be successful if inspectors have some knowledge of the basic concepts of activity theory. In the second round of tests the group who had read an early draft of the present introduction in addition to the step by step description of the method were able perform the walkthrough by themselves. Our initial worry was that the complexity of the WAW and its dependence of the inspector's understanding of activity theory could be a limiting factor. However, our evaluations indicate that this might not be an insuperable problem.

It might be argued that the WAW is too loosely based on activity theory, and that a more careful use of the theoretical basis would have yielded a stronger method. However, our initial motivation has been that activity theory has to commit itself to provide practical instruments for IT-design, rather than merely providing great analyses of IT use and design. With respect to web site usability in general, our experiments with WAW indicate that web site usability methods would benefit from a stronger theoretical grounding

Future work with WAW will include the construction of a formalized inspector guide and the application of the method in a large-scale web site development project. Another step further could be to develop assessment methods more rigidly derived from activity theory.

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BIOGRAPHICAL NOTES

Olav W. Bertelsen is an associate professor of human-computer interaction and systems development at the Department of Computer Science, University of Aarhus. Olav has been teaching human-computer interaction at the interdisciplinary multimedia education since 1998. His PhD thesis, Elements of a Theory of Design Artefacts, was an attempt to give a systematic account, based on activity theory, on the tools, methods, techniques etc. mediating the design of computer artefacts. Actual research interests include common information spaces; activity theory based methods and techniques in human-computer interaction; and a reformation of human-computer interaction as an aesthetic discipline based in dialectical materialism.

Mikkel Godsk is a web-editor and a student of information technology and multimedia science at the IT University West, University of Aarhus, and is currently writing his master's thesis in the field of human-computer interaction on an activity theory based method for web site analysis. Mikkel is trained as New Media Manager and has since 1998 worked with different aspects of human-computer interaction. Furthermore Mikkel has worked as web-designer, web-editor, webmaster and usability inspector, and developed knowledge about practical development and test of web sites. Recently, he has been teaching web usability at retraining courses.

FIGURES

1. DESCRIBING AND SITUATING THE WEB SITE AND ITS USES

1.1 IDENTIFYING THE USES

- What *necessary* uses must the web site support?
- What *frequent* uses must the web site support?
- What *inexpedient* uses must the web site support?
- What *other* uses must the web site support?

1.2 CONTEXTUALIZATION

1.2.1 The web site and its future use:
- What is the purpose of the web site?
- What characterizes the users/target groups?
- What characterizes the originators?
- What characterizes the design?

1.2.2 Situating the web site and its uses:
- Is it a versioning or a further development, redesign or new web site?
- Experiences with the existing web site (if any)?
- Reason for redesign or further development?
- Influence on existing use/work procedures?
- Are there corresponding web sites? What are their characteristics? Experiences with these web sites.

1.2.3 Mediation:
- What kinds of mediation will the web site support? System, tool and/or medium?
  - What consequences does it have?
- Are there any ”web rare” mediations?
  - What consequences does it have?

1.2.4 Internalization and Externalization:
- What kinds of internalization and externalization must the web site support?
- Must the users learn or express something with the web site?
- Do users cooperate/communicate via the web site?

1.2.5 Network of activities:
- In what other activities is the web site included (look for motives)?
- How do these activities relate to the considered activities?

1.2.6 Distribution:

For each user/target group ask:
- Will this target group mainly use the web site with the web site as context?
  - If yes, describe the rules, community and division of labor of the web site context.
- Will this target group mainly use the web site with the internet in general as context?
  - If yes, describe the rules, community and division of labor of the internet context.
- Will this target group mainly use the web site within a local context?
  - If yes, describe the rules, community and division of labor of the local context. (This may require special tools from other sciences).

1.3 IDENTIFYING POSSIBLE USE SITUATIONS

For each specified use ask:

What possible use situations may the specified use be a part of:
- Why does <the user/target group> use the web site for/to <use> ? (What is the motive?)

Engeström’s components for the specific activity (defining the use situations):
- Which actions is the use situation realized through?
- What is the object, subject, outcome, instrument, rules, community and division of labor?

2. IDENTIFYING PROBLEMS

The specified use situations are inspected one by one, action by action

For each use situation:

Immediate contradictions:
- Does the use situation have any immediate contradictions?
- Is there an immediate solution (to eliminate the contradiction)?
  - If yes, make a note of the solution.
  - If no, make a note of the contradiction, the use, kind of use (e.g. “necessary") and the current action.

For each action in the use situation:
- Have any components changed?
  - If no, go to the next action.
  - If yes, have there arisen any conflicts?
    - If no, go to the next action.
    - If yes, note the current action and identify contradictions and solutions as shown above.

3. FOLLOW-UP

For each identified, and not yet solved (in step 2), problem consider:
- Is it possible to *ignore* the problem?
- Is it possible to *solve* the problem by changing the design of the web site?
- Is it possible to *prevent* the problem by modifying the “requirement specifications” and how?
- Is it an *actual* problem (this requires empirical investigation)?

Figure 1. The Web site Activity Walkthrough (WAW).

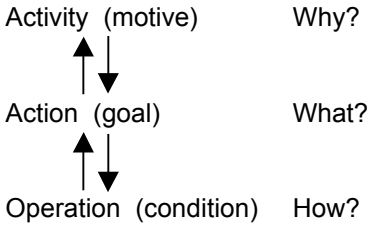

Figure 2: The hierarchical structure of activity.

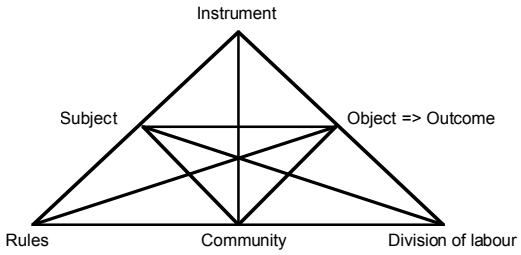

Figure 3: The systemic structure of human activity. Adopted from Engeström [7 p.78].

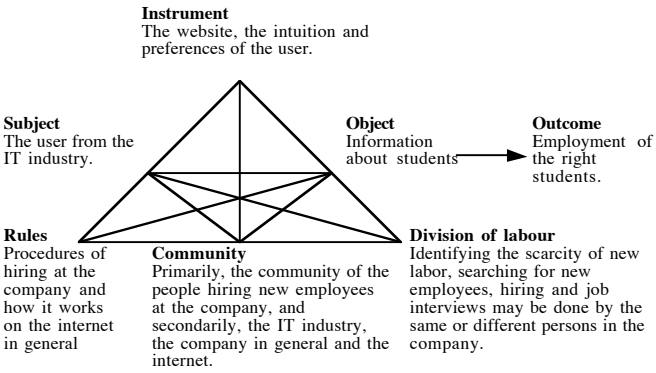

Figure 4: The activity system containing use situation #1 involving the use of the web site.

Use situation (importance of use)	**Action**	**Problem**	**Solution**	**Follow-up solution**
# 1 (necessary)	Immediate contradiction of the use situation	Contradiction between the procedures of hiring (rules) and the web site; since the company usually employ labor through announcements – no headhunting!	To change the appeal of the web site or letting the companies announce job openings.	No follow-up solution.
	Immediate contradiction of the use situation	A contradiction between representing the students in text and graphics and craving for means for meeting the whole person face to face.	No immediate solution.	A simple *solution* is to provide contact information of the students.
	# 4: Searching the web site	How the information is structured on the web site in relation to how information about personal qualifications is structured in the industry. (possible problem, needs verification)	(To structure the information about the personal qualifications of the students as in the industry.)	(It might be possible to *ignore* this problem since the industry should know that the web site is not a recruitment site, or *preventing* the problem by modifying the requirement specification.)
	# 5: Acquiring information about students	A contradiction between the data about the students on the web site (object) and the usual design of a job proposal or what the user wants to know (subject).	To either add more information about the students (but this may cause other contradictions to other specifications of the web site) or add an email address, so the user may contact the student and obtain the needed information.	No follow-up solution.
	# 6: Selecting the students	A contradiction between how different people usually are involved in hiring new employees (division of labor) and what instruments the web site offers (instrument).	The presentation of information of the web site may be changed according to the preferences of the different people at the company. May not solve the problem.	*Solving* the problem by changing the design of the web site, or *verifying* the genuineness of the problem by an empirical investigation.

Figure 5: Summary of actions, problems and solutions of use situation #1.