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The 'WCC Heuristic Evaluation Set' – Towards a Discount Methodology for
Evaluating the Usability of Web Communication and Collaboration (WCC)
Groupware in Teaching and Learning

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Abstract

A growing number of workplaces and educational environments are implementing virtual teams (VTs) or intend to in the future, and it is likely that most information workers will become part of a virtual team at some stage (McDonough et al., 2001). Groupware is the core mechanism for VT communication and collaboration. However groupware suffers from poor usability. This is due in part to: (1) a lack of usable groupware-specific discount evaluation methodologies, and (2) the limited number of groupware-specific design principles to support the development of usable groupware systems (Knutella et al., 2004).

In this paper we present the ‘WCC Heuristic Evaluation Set’ – a framework designed to identify and uncover causes of groupware usability problems, specifically in the genre of Web Communication and Collaboration (WCC) groupware. The heuristic set is the first step in the development of a new discount evaluation methodology that can be applied to the WCC genre. The framework adapts Jakob Nielsen’s (1993) single user heuristic method to the groupware multi-user domain and has been specifically developed to be used easily by non-expert usability practitioners. Additional empirical research is being conducted to establish the validity of the heuristic set as a discount evaluation methodology. The longer term aim of this research is to extend the ‘WCC Heuristic Evaluation Set’ towards the development of an informed set of design principles to improve the usability and effectiveness of WCC groupware in the workplace and in teaching and learning environments.

Introduction

Knutella et al (2004) argue that at present there are no basic groupware design principles and therefore no heuristics that can be used for collaborative software design and evaluation. Groupware developers do not have international standards to refer to, unlike their single-user counterpart industry standards (ISO 9241-11 (1988) *Guidance on Usability*, the ISO 13407 *Human-Centered Design Process*; and ISO 25062 (2005) *Common Industry Format for Usability Testing*). As a result evaluators and designers have difficulties in identifying best practice, and in working towards commonly accepted design principles and benchmarks.

Groupware is defined as ‘any computer-based system that support groups of people engaged in a common task (or goal) and that provide a shared environment’ (Ellis et al., 1991, p39). *Web Communication and Collaboration (WCC)* groupware provides a persistent collaborative virtual environment, which, in turn, provides a VT ‘place’ for communication and collaboration to occur. Communication is carried out using rich media webcasting delivery mechanisms, while collaboration is facilitated by providing shared workspace environments and artefacts, such as shared whiteboards and shared note spaces. Group activities for this groupware genre include: conducting webmeetings; providing online training sessions; delivering live or on-demand web presentations; and participating in ‘live’ online classrooms.

The need for genre-specific heuristics

Many traditional User-Centred Design (UCD) evaluation methodologies are not being employed in practice, as they are deemed too expensive or cumbersome to implement (Nielsen, 1993). *Discount engineering* approaches offer cheap user-friendly approaches to the evaluation and design of software. Jakob Nielsen’s heuristics evaluation methodology (1993) is widely used in industry, and has proven effective in uncovering usability problems in single-user interfaces. Heuristic evaluation defines an interface inspection process where several evaluators examine the user interface and judge its compliance with recognised usability principles called ‘heuristics’. This and other single user discount methodologies are starting to be adapted for groupware usability evaluation (Baker et al, 2001; Mankoff et al., 2003).

Increasingly, research points to the need to develop genre-specific groupware heuristics. Empirical research has demonstrated efficiency and effectiveness gains when evaluators utilise genre-specific heuristics to uncover usability problems specific to that genre (Baker et al, 2001). Findings from comparative heuristic tests between genre-specific heuristics sets

and Nielsen's original heuristic set reveal that modified set of heuristics can uncover a greater number of usability issues than Nielsen's set (Mankoff et al., 2003).

The WCC environment represents a unique genre of groupware. It is a multi-user domain, (as opposed to Nielsen's target single user environment) and emphasises the primary importance of rich media communication, with additional supports for collaboration. It is conceptually aligned to the 'Social Web Cockpit' environment (Gräther and Prinz, 2001); 'Common Information Spaces' (CIS), (Bannon, 1992), and the Locales framework (Fitzpatrick et al., 1996). As such, it is important and appropriate to generate a specific and customised heuristic set for this groupware genre.

Eight Heuristics for Web Conferencing and Collaboration (WCC) Groupware

The WCC heuristic set, presented below, was constructed using Somervell and McCrickland's five-step framework for generating meaningful heuristics (2004). This framework offers a constructive methodology for the generation of heuristics by focusing on the user goals associated with the target genre. By identifying the user goals, evaluators can consider the context of the application use, in tandem with the more focused interface component analysis of traditional heuristic evaluation methodologies.

The heuristic set is underpinned by Cockburn and Jones' groupware design principles (1995) that highlight the importance of both minimising individual user effort while maximising user benefit for the successful adoption of groupware systems. Three specific models ground the heuristic set in well established groupware research: (1) Fitzpatrick, Mansfield and Kaplan's '*Locales framework*' (1996); (2) Baecker's '*Design Principles for Rich Media Communication via the Internet*' (2003) and; (3) Baker et al's '*Groupware Heuristics for Shared Workspaces*' (2002).

The heuristic set comprises eight individual heuristic statements. This reflects Nielsen's view that the heuristic set should be small in number (Nielsen had ten original heuristics); and mirrors the Baker et al. (2000) eight-heuristic groupware model. Individual heuristic statement construction follows the Somervell and McCrickland (2004) five-stage model outlined above. Each heuristic is structured with a representative opening statement, followed by supporting statements that specify high level design issues to help the reader to understand its meaning. Examples of typical groupware supports are provided to guide the evaluation process.

Heuristic 1 Provide centres for communication and collaboration

Centres (locales) collect people, artefacts and resources in relation to the central purpose of the social work. Participant usage develops technical spaces into social places for communication and collaboration. A locale provides the site, the means, and the resources for a group to pursue task and team work. Locales should be dynamic so that they can evolve along with people, the artefacts, and the purposes that define them (Harrison and Dourish, 1996).

Typical groupware supports for this heuristic include: (1) *unique identification of the environment through banners or labels*; (2) *login authentication mechanisms reinforce user ownership of the environment*; (3) *persistent group member information such as individual areas of expertise, email contact lists etc. to foster a sense of a user community*; (4) *familiar tools which are available when group members access their environment*.

Heuristic 2 Provide synchronous communication mechanisms

Effective communication is essential for collaboration activities. Synchronous communication mechanisms facilitate real-time interaction. Rich media communication mechanisms are increasingly in high demand due to: (1) increased bandwidth availability; (2) the development of streaming media channels algorithms and codecs; and (3) through cheaper deliver mechanisms such as voice over the Internet protocol (VoIP). These technical advances can increasingly facilitate greater choice in communication channel availability and

selection. Group members can provide direct information using visual, verbal and written communication channels.

Rich media channels can provide the means for intentional gestural communication to support interaction, and to convey task information. Intentional gestural communication can take many forms. *Illustration* occurs when speech is acted out or emphasized, e.g., signifying distances with a gap between your hands. *Emblems* occur when actions replace words, such as a nod of the head indicating 'yes'. *Deictic reference* or *deixis* happens when people reference workspace objects with a combination of intentional gestures and voice communication, e.g., pointing to an object and saying 'this one'. Consequential, or unintentional communication of an individual's embodiment 'give off' awareness information about what's going on, who is in the workspace, where they are, and what they are doing. This visible activity of unintentional body language and actions is fundamental for creating and sustaining teamwork.

Typical groupware supports for this heuristic include: (1) *audio-video, audio only, and/or text chat channels*; (2) *telepointer cursors that offer a low-technical means for supporting embodiment in a virtual workspace*; (3) *simple cursor enhancements that can be facilitated by providing customised user colour selection, or by attaching the user identification information to the cursor*; (4) *emoticons (facial keystroke expressions) can convey user sentiment in text chat*; (5) *avatars reflect a user's embodiment in a virtual environment*.

Heuristic 3 Ensure synchronous communication quality of service delivery

The quality of rich media communication channels must be acceptable to the end user. Poor quality of service delivery will hinder direct communication, and will fail to communicate the unintentional information a person gives off in typical face-to-face communication. The failure to communicate effectively will undermine the collaborative process.

Designers must consider the trade-off between the reliability of uninterrupted transmission of streaming media, versus determining the amount of data to buffer prior to playback of the stream. For video-on demand services, designers of today's commercial media streaming products find, for example, that buffering delays ranging from 5 to 15 seconds strikes an acceptable balance between delay and playback reliability.

For real-time live communication typical acceptable response times are in the order of a few seconds. The IEEE suggests that one-way video channel delays of less than 150 mili-seconds is acceptable as for audio-visual channels, while delays of less than 450 mili-seconds are acceptable for one-way audio data delivery. The type of network access will often determine the quality of service levels for rich media communication. The evaluator should use their own experiences and judgment to ascertain appropriate quality versus time levels that are acceptable, given the network access available.

Typical groupware supports for this heuristic include: (1) *allowing user selection of the highest available communication channel*; (2) *providing alternative media channel selection for users*; (3) *providing audio-video, audio only, and text chat alternatives*; (4) *offering video on/off toggle selections, audio on/off toggle selections*; (5) *providing bandwidth connection selection options that facilitate alternative channel selection mechanisms*.

Heuristic 4 Provide asynchronous communication mechanisms

Social spaces that are constructed using a room metaphor contain familiar properties of that metaphor. A room is that bounded space that affords the features of partitioning, containment and permeability. This infers that participants can separate or bring people and artefacts together (Kuhn and Blumental, 1996). Users can deposit or remove artefacts from the environment. User can expect that any artefact deposited will be in the same place, and in the same state unless another participant has moved or manipulated it in the intervening period of time. The environment should be customisable to reinforce ownership and privacy (Covi et al., 1998).

Typical groupware supports for this heuristic include: (1) *the facility for users to generate, edit and delete or store persistent messages*; (2) *the opportunity for users to generate meeting agenda and minute spaces within the environment*; (3) *the facility for users to generate useful information about the group, such as areas of interest or contact details*.

Heuristic 5 Provide awareness mechanisms

Awareness is central to the grounding of communication and collaboration. Awareness within the centre or locale helps participants maintain a sense of shared place, and keeps them informed about shared activity. This includes an awareness of: other participants; the artefacts comprising the environment; where resources are located; and how events or artefacts are changing (Gutwin and Greenberg, 1999). *Intentional awareness* is defined as ‘an understanding of the activities of others, which provides a context for your own activity’ (Dourish and Bellotti, 1992, p5). *Tacit or background awareness* considers peripheral as well as focussed attention. This occurs when team members are engaged in parallel but independent ongoing activities. *Non-related awareness* provides an understanding of the activities outside the current task context; where one is interested in a collaborator who is not currently present, and who may not be working on a shared task. *Access awareness* involves being able to access resources on demand; for example when using an email address book to quickly contact a participant.

Typical groupware supports for this heuristic include: (1) *audio-video, audio-only and text communication channel provision*; (2) *‘WYSIWIS (What You See Is What I See)’ is a term used for groupware interfaces that guarantee that all users view the same interface perspective at all times*; (3) *‘Relaxed WYSIWIS’ design that allows for various user views, such as radar, overview, and user detailed view*; (4) *customised cursors enhancements can be facilitated by providing customised user colour selection, or by attaching the user identification information to the cursor*; (5) *participant lists*; (6) *group contact information*; (7) *asynchronous messaging facilities, such as notes, agenda and minutes spaces within the environment*.

Heuristic 6 Provide communication through shared artefacts

Consequential communication also involves information unintentionally given off by physical artifacts as they are manipulated. This information is called *feedback* when it informs the person manipulating the artifact, and *feedthrough* when it informs others who are watching. Seeing and hearing an artifact as it is being handled helps to determine what others are doing to it. Identifying the person manipulating the artifact helps to make sense of the action, and to mediate interactions.

Typical groupware supports for this heuristic include: (1) *‘WYSIWIS (What You See Is What I See)’*; (2) *telepointer cursors*; (3) *simple cursor enhancements through customised user colour selection, or by attaching the user identification information to the cursor*; (4) *archiving the status of shared workspace artefacts to provide a useful means for users to track the state of the object at different date/time intervals, thus allowing a visual continuum in terms of the manipulation of the object*.

Heuristic 7 Allow easy access to relevant information

A knowledge base is important for facilitating group processes and interactions. Allowing easy access to shared common knowledge improves group coordination. Knowledge of all topics relevant to the group should be made available to any participant at any time.

Typical groupware supports for this heuristic include: (1) *the facility for users to generate, edit and delete or store persistent messages*; (2) *the opportunity for users to generate meeting agenda and minute spaces within the environment*; (3) *the opportunity for users to generate useful information about the group, such as areas of interest or contact details*; (4) *simplified access to information through easily accessible drop-down menus, or clearly identifiable tab areas in the workspace*.

Heuristic 8 Allow the archival and retrieval of events

Virtual teams should have control over: (1) past, present and future aspects of routine and non-routine work; (2) how people coordinate and negotiate plans and activities over time; (3) how people leverage past experiences; (4) how breakdowns are noticed and repaired; and (5) how processes are supported. Providing archiving facilities allows the accurate tracking of group processes and outcomes. It allows participants to manage and stay aware of their evolving interactions over time. The provision of archiving facilities also facilitates protection mechanisms. This is important, as concurrent activity is common in shared workspaces, where people can act in parallel, and simultaneously manipulate shared objects. Concurrent access of this nature is beneficial. However, it also introduces the potential for conflict. Protection mechanisms should be in place in the event that participants inadvertently interfere with work that others are doing; or alter or delete work that others have done. Archiving provides version control whereby participants can retrieve previously saved version of their work.

Typical groupware supports for this heuristic include: *(1) provide an 'Archive' button to capture a date/time stamped version of the artefact. This should be made available to users through an archive list; (2) provide a 'Record Meeting' option to capture the audio-video communication feed. This should be made available to users through an archive list.*

Summary and Future Work

In this paper we presented the 'WCC Heuristics Evaluation Set' – a framework designed to identify and uncover causes of groupware usability problems, specifically in the genre of Web Communication and Collaboration (WCC) groupware. The heuristic set is the first step in the development of a new discount evaluation methodology that can be applied to the WCC genre.

The next phase of our research is being conducted to establish the validity of the heuristic set as a discount evaluation methodology. We are specifically looking to establish the effectiveness and usability of the framework, as well as investigating the number of inspectors needed to uncover a critical mass of known usability issues in the WCC genre (Nielsen's 1990 study reported that 3-5 experienced inspectors could identify 75-80% usability problems in the single user domain, while the Baker et al. 2002 study reported a 40-60% success rate for the same number of inspectors in the shared workspace groupware genre). Our initial findings from studies using small samples of non-expert usability evaluation practitioners are encouraging. Quantitative analysis using the Hartson et al (2001) comparative heuristic evaluation analysis methodology reveals that the WCC heuristic set demonstrates high utility in uncovering genre-specific usability against thoroughness, validity, effectiveness and reliability metrics. Qualitative experimental analysis conducted with non-expert usability practitioners reports high WCC heuristic usability against learnability, memorability, and satisfaction measurements.

Additional studies are planned using larger sample sizes to validate the statistical significance of our initial findings. Further studies that compare expert and non-expert usability practitioners' performance are also needed to test the rigour of the methodology.

The longer term aim of this research is to extend the 'WCC Heuristic Evaluation Set' towards the development of an informed set of design principles to improve the usability and effectiveness of WCC groupware in the workplace and in teaching and learning environments.

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