Claims Analysis Meets Structuration Theory: Analysing Qualitative Students' Interactions with NTU's edveNTUre

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Abstract
In contrast with quantitative usability evaluations, qualitative evaluations are often criticized for not producing statistically significant findings because of the small sample population used in the studies. Using a case study of a good e-learning system, edveNTUre, at Nanyang Technological University in Singapore, this paper demonstrates that even with six subjects, we can obtain rich analyses of user interactions with edveNTUre. Well-established theories such as Interaction Framework, Claims Analysis and Structuration Theory were synthesized to analyse user interactions, adding meaning and "depth" to the observational data collected.

Introduction

Designers need robust, quantifiable metrics to help designers compare and evaluate the effectiveness of interactive systems, but to understand the reasons why problems occur, insights from qualitative usability evaluations are beneficial. However, qualitative evaluations are often criticized for getting small number of subjects to give feedback. Generally, most people feel that in order to get statistically significant results, a number of people (around 20-25) should be asked to carry out the experimental task, in order to pick up a wider range of problems and to get some sense of the frequency and the consequences of each. However, Nielsen and Landauer (1993) conclude from analysing usability problems described in eleven published projects that the maximum cost/benefit ratio for a medium-large software project could be derived from using three test users.

In observational studies of users interacting with systems, the intention is to learn which detailed aspects of the interface are good and bad in helping users complete the tasks, and how design could be improved, Dix et al (1997) argue that small numbers of users are more cost-effective as common/frequent problems but not infrequent or minor ones are encountered first. (The problem is — and remains for any methodology — how to find the infrequent disasters!). With 3-6 people, qualitative usability user studies hope to get qualitative results and impressions. Hence, video analysis, think-aloud protocol, questionnaire and interview are often used in this kind of studies. Sessions are

video-taped, and the tapes are then analysed to identify potential areas of difficulty or usability problems experienced by the users.

Using a case study of an e-learning environment at a local university in Singapore, this paper describes a usability study conducted with six subjects to understand the interaction issues and problems experienced by the subjects. To analyse the interactions, we turn to well-established theories in computer science and social science to add meaning and "depth" to the data collected, and demonstrate that even with a small number of subjects, we obtained rich data.

The paper is structured as follows: We begin with a review of selected, established theories to describe and explain user interaction issues. Next, we discuss the user study conducted, and explain the findings and analyses. The paper suggests recommendations to improve interaction design of the e-learning system, and concludes with a discussion of using theoretically-based qualitative analyses for usability evaluations.

Review of Selected, Established Theories for Analysing User Interactions

In this section, we briefly survey three well-established theories such as Interaction Framework, Claims Analysis and Structuration Theory so that their methods and findings can provide a background for the body of this paper and the issues explored within it. We will be synthesizing these theories to analyse qualitative observational data to explain user interactions, adding meaning and "depth" to the observational data collected.

a. Interaction Framework

Interaction involves at least two participants: the user and the system. Both are complex and are very different from each other in the way they communicate and view the domain and the task. For interaction to be successful, the interface must therefore effectively translate between them. This translation can fail at a number of points and for a number of reasons. Models of interaction can help us to understand exactly what is going on in the interaction and identify the likely root of difficulties (Dix et al., 1997). The two models used in our analyses are:

- *Norman's model of interaction* is perhaps the most influential because of its closeness to our intuitive understanding of the interaction between the human user and computer. The user formulates a plan of action and this is then executed at the computer interface. When the plan, or part of the plan, has been executed, the user observes the computer interface to evaluate the result of the executed plan, and to determine further actions.

- *Interaction Framework* developed by Abowd and Beale addresses the limitation in Norman's model of interaction to include the system explicitly. According to the Interaction Framework, there are four major components in an interactive system: the System; the User; the Input and the Output. The interaction framework is a means to judge the overall usability of an entire interactive system. All of the analysis suggested by the framework is dependent on the current task (or set of tasks) in which the User is engaged. This is not surprising since it is only in attempting to perform a particular task within some domain that we are able to determine if the tools we use are adequate.

b. Claims Analysis

Our study was inspired by Carroll's work on the task-artifact cycle, user-centred strategies such as scenario-based design and claims analysis (Carroll, 2000). The task-artifact cycle explains why design is never completely "done". At the start of any software development, tasks help articulate requirements to build artifacts, but designed artifacts create possibilities (and limitations) that redefine tasks. Hence, managing the task-artifact cycle is not a linear endeavour with starting and ending points [1]. There will always be a further development, a subsequent version, a redesign, a new technology development context. The design scenarios at one point in time are the requirements scenarios at the next point in time. Carroll [1] stresses the importance of maintaining a continuous focus on situations of and consequences for human work and activity to promote learning about the structure and dynamics of problem domains, thus seeing usage situations from different perspectives, and managing tradeoffs to reach usable and effective design outcomes. Claims analysis was later developed by Carroll [1] to enlarge the scope and ambition of scenario-based design approach to provide for more detailed and focused reasoning. Norman's influential model of interaction [7] is used as a framework in claims analysis for questioning the user's stages of action when interacting with a system in terms of goals, planning, execution, interpretation and evaluation.
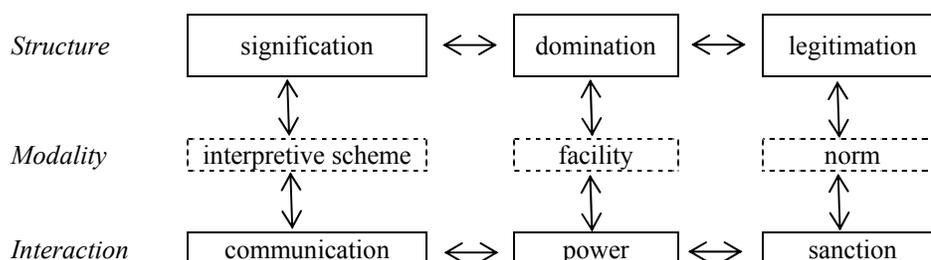
c. Structuration Theory

While claims analysis seeks to hypothesise the effects of system features on users and their actions, structuration theory was considered in light of the study. The double hermeneutic is conceived by structuration theory as the 'mutual interpretive interplay between social science and those whose activities compose its subject matter'

(Giddens, 1986, p xxxii). As Giddens (1986) argued, 'all social actors, it can properly be said, are social theorists, who alter their theories in the light of experience' (Giddens, 1986, p 335).

This experience is reflected in the everyday living and working of actors in communities – implying that they have the potential to, whether consciously or unconsciously, reflect on theories of the domains they interact with, and include them in their practical consciousness (referred to by Giddens (1979) as mutual knowledge), leading to changes in actions; which at the same time, recursively shapes practical consciousness. Such recursive effects imply that the structure of social realities are transformed, and render theories unsustainable over time.

Perhaps one of the most important applications of this theory lies in the recognition of structure and agency as 'duality' – making clear the distinctions between structure and agency yet recognising them as dependent upon each other iteratively. The application of this theory recognises that the structural properties of social systems impose themselves as influencing mediums and at the same time, outcomes of the social practices they 'recursively organise' (Giddens, 1986, pp 25). These dimensions are illustrated in the well-known diagram (see Figure 1):

Structure   signification ⟷ domination ⟷ legitimation

Modality   interpretive scheme   facility   norm

Interaction   communication ⟷ power ⟷ sanction

Figure 1. Dimensions of the Duality of Structure (Giddens, 1986)

As illustrated in Figure 1, social structure and human interaction are broken down into three columns. Each structure and interaction is then associated with each other recursively via the linking modalities (interpretive scheme, facilitative, and normative). Three forms of structure are given here, representing various embedded social realities: signification, domination, and legitimation. For example, as humans communicate, they use interpretive schemes to help them make sense of their interaction; at the same time these interactions change or reproduce the same interpretive schemes that are embedded in structures as signification. The facility used to allocate resources is manifested in the wielding of power, which in turn produces and reproduces facilities influencing social structures of domination. Norms on the other hand, referred to also as moral codes; provide both understandings and sanctions for human interactions, ultimately also producing legitimation within structures.

Orlikowski (1992) and others (Rose and Scheepers, 2001) have done much work applying structuration theory to the field of technology. Orlikowski and Robey (1991, p 151) say that 'in its constituted nature – information technology is the social product of subjective human action within specific structural and cultural contexts – and [in] its constitutive role – information technology is simultaneously an objective set of rules and resources involved in mediating (facilitating and constraining) human action and hence contributing to the creation, recreation and transformation of these contexts'.

Given the rich contexts and changing nature of use of information technology, it continually requires a constant renewal of definition. In the study of learning portals such as edveNTUre, there are highly dynamic interactions between people, technology, and the institution. This is both a techno and social reality, which is charged by human actions as it is energised by objective technological inventions – which effectively are shaped by one another.
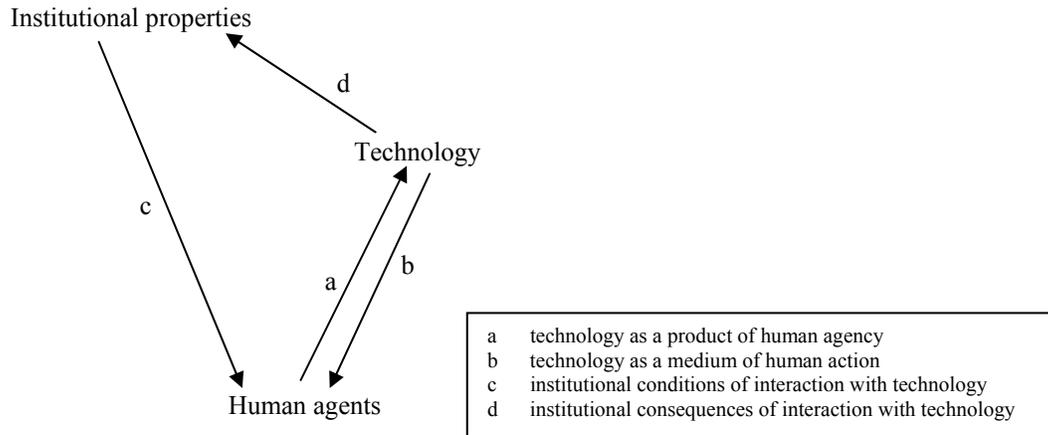
This is reinforced by Orlikowski and Robey (1991), who argue that the study of technology typically involves two broad traditions of assumptions: social reality as subjective or objective. Research assuming the subjectivity of social systems focuses on subjective human experiences, interpretation of them, and elements of human behaviour modifying the world. The contrasting view of objectivism focuses on the properties of institutional elements shaping social systems, providing explanations for their influences on human actions and relationships.

Structuration theory was developed to resolve this tension between subjective and objective realities. Giddens (1979), who asserted that the grounds of mutual exclusiveness between subjectivism and objectivism is flawed, developed the theory of structuration to accommodate the two traditions. Structuration theory views the subjectivity and objectivity of social realities as equally important. According to structuration theory, cultural context is generated and regenerated through the interplay of action and structure.

In the study, edveNTUre is therefore studied using a recursive model of information technology developed by Orlikowski (1992) who based the work on the asserted duality of structure in structuration theory. The recursive nature of technology based on structuration theory is manifested in the properties of technologies as being created

and changed by human actions; but also supporting and constraining these actions. Using the structurational model of technology (Figure 2), the interactions between people and technologies are studied for their recursive effects on human actions and some detection of the effects on institutions are also discussed at the same time.

Claims analysis, in seeking to enhance reflective design by identifying the positive outcomes and negative consequences or risks that may adversely affect usability, has similar aims in achieving reflexive practice. Structuration theory is therefore adopted in the study to make inferences on how users allocate significance to functions, resources and information on the interface, and together with norms and facilities how their goals, plans, actions, interpretations and evaluations are shaped. Such evidence is sourced using grounded theory.

Institutional properties

d

Technology

c

a   b

Human agents

a	technology as a product of human agency
b	technology as a medium of human action
c	institutional conditions of interaction with technology
d	institutional consequences of interaction with technology

Figure 2. Structurational Model of Technology (Orlikowski, 1992)

The Study
a.   Aim
This paper describes a qualitative study to conduct a usability evaluation of a good e-learning system to detect potential usability problems through innovative use and synthesis of well-established theories in computer science and social science, leading to user-focused recommendations to address these problems.

b.   EdveNTUre: Case Example of a Good E-Learning System
The Nanyang Technological University's e-learning platform, called edveNTUre (http://www.edventure.edu.sg/; retrieved 8 April 2008) was selected because it is regarded as a good e-learning system having won several international awards. Previous user studies on edveNTUre have been conducted from teachers' and students' perspectives (e.g Eng, 2003; etc.). From the teachers' perspectives, the utilization of the features in edveNTUre had a negative outlook but overall satisfaction was high for the features that had been used. From the students' perspectives, utilization of the features was mostly in the content area (uploading of course materials, online lectures and online quizzes) compared to communication features (email, virtual chat, group pages and discussion boards).

c.   Data Collection
The qualitative component of the study was carried out in two parts, held in laboratory sessions between a researcher and a participant. In the first part, participants were asked to complete a questionnaire enquiring about their background knowledge, demographics, and the nature of use of the portal. This questionnaire provides some user background survey about the participants. In the second part of the study, they were given a simple task at the portal and time alone to complete the task. Participants were observed through a remote video recorder in another room. After the task was determined as completed by participants, they were then interviewed using questions from the claims analysis technique for around 45 minutes to an hour. All participants are regular users of the portal, and are postgraduate students enrolled in the School of Communication and Information.

Other than using questions from the claims analysis technique to analyse and predict positive and negative consequences, the interview process was also treated as a semi structured interview to encourage open-ended discussions. The method is also useful to present rich pictures of individual realities of the participants in the case study, and thrive on the interactions and interdependencies of the researcher and subjects (Pickard and Dixon, 2004).

One of the main advantages of this method is also its ability to gather new ideas and information from interviewees. These emerging perspectives can then be used as evidence to support new findings.

In an attempt to test the integrity and process of the research design, a pilot study with three participants was carried out. Participants were also asked for feedback after each session, which helped to refine the questionnaire and the set up of the qualitative study. It should be noted that the findings discussed here does not include findings from participants of the pilot study.

The fieldwork with six participants took approximately three months to complete, between September 2007 and November 2007 – including the research design, laboratory sessions, transcriptions and data analysis. The questionnaires helped to shed light on the responses coming from the participants, and also provided background knowledge on each participant. For the tasks that users carried out, they were analysed using the interaction framework (see table 1 for example). With the permission of the participants, all interviews were recorded and transcribed for analysis.

Findings and Analyses

a. Using Interaction Framework and Claims Analysis

Using Subject C2, we illustrate how a subject's interactions with edveNTUre were analysed using the Interaction Framework. The intention of the analysis is to elicit problems, give hints on the form and extent of information therapy provided in the DLs in helping subjects to complete their tasks. Figure 3 shows coding of the translations between components proposed in the Interaction Framework (Dix et al, 1997). User's browsing interactions can be analysed according to four categories based on the Interaction Framework: (i) user action (UA); (ii) user evaluation (UE); (iii) system display (SD); and (iv) system response (SR).
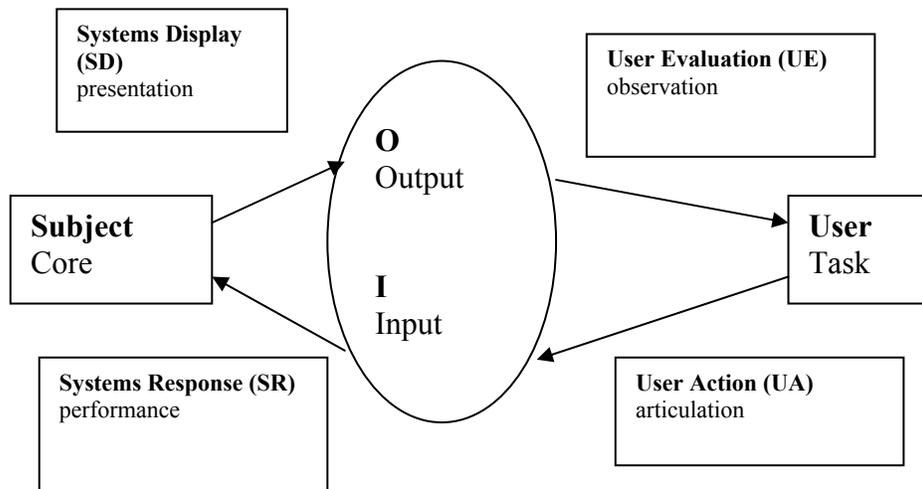

Figure 3. Coding based on Interaction Framework (adapted from Dix et. al., 1997)

Table 1 tabulates analysis of Subject C2's browsing interactions with edveNTUre. Column 1 shows a record of user's browsing interactions, and classifies user's browsing interactions according to the four components of the Interaction Framework: (i) UA; UE; SD and (iv) SR.

Column 2 draws conclusions on observations made from SR, SD and UE. Conclusions drawn based on SD give us clues on which design features/aspects of the interface help subjects to achieve their goals (see Table 1). From UE, we get indications of problems that might have prevented subjects from achieving their goals. These problems could either be due to: (1) systems; (2) user; or (3) design faults. System problems are machine or server-related problems. For instance, "too many results returned" and "could not filter results" are some examples of systems problems. User problems refer to errors made by users. This could be due to subjects keying in wrong data or subjects misreading information on the screen. If the problem is a user problem, then it is psychological and may be due to users' inability to exploit computer screens, and complex information structures. Thus, as a psychological problem, it can be alleviated but not solved by better design.

Table 1. Analysis of Subject C2's Interactions with edveNTUre

User Action (C2)	Remarks		
	From SD (before UA)	From SR (after UA)	From UE (after UA)
Subject started by clicking (UA) onto "CI6112/H6611 – Human Computer Interaction – Users, Tasks, Designs' (SD), followed by 'Discussion Board' (SD).	Links were available organised under different boxed sections for browsing.	Results were returned.	Results returned contained all posts for the course, and he could not find a way to filter the results. Too many results returned.
He then clicked on 'Understanding Users' (UA) and results were returned (SR). He clicked on 'Group 3 – Agree on Personas Article' (SD) and scrolled down the page to read the post (UA).	Screen refreshed details to allow selection.	Detailed contents of selected post were displayed.	Post was relevant after detailed scrolling and reading.
He clicked on the 'Back' button (SD) of the browser (UA).	Browser provided the option to return to the previous screen.	Screen refreshed to give the previous screen of results' listing.	Back to previous screen in order to select desired post.
He used his mouse to click (UA) on the checkbox of the same link (SD). He then clicked (UA) on the 'collect' button (SD) and the page refreshed, displaying contents of the post he has collected (SR).	Collect function button was displayed as an option for the user.	Detailed contents of the post were displayed once more, this time with print option.	Post has been collected, although there was some hesitation. The task of collecting a post was successful (UE).

b.   Using Structuration Theory

The data collected were analysed in various ways. In the first part of the study, the questionnaire helped to characterise the background of participants. The results from this questionnaire were used to inform the insights from the second part of the study, and at the same time helped to provide a benchmark for comparing results of the qualitative component with the quantitative component of the project.

Using the claims analysis technique, interview transcripts were analysed for positive and negative consequences. At the same time, because the questions were also used as a guide to a semi-structured interview, there were other insights emerging from the transcripts. The analysis of the transcripts was therefore carried out using a two-pronged approach; firstly with claims analysis highlighting positive and negative consequences, secondly with using the grounded theory approach.

Analysis of data by identifying broader themes and specific categories is a typical method of analysing qualitative data (Huberman & Miles 2002). It is the approach used by grounded theorists (Glaser & Strauss 1967; Charmaz 2003). Five steps to the data analysis were used, namely:

- The transcribed data were produced in printed form.
- Two researchers read through the data, making notes about the tentative themes (with definitions) which appeared to be emerging.
- Passages of data were labelled with categories and linked to one of the themes so that identically labelled or categorised data could be retrieved as needed. Further themes (broader than categories) were identified and defined as necessary. As with themes, categories were given a short title and a definition if needed. Categories that were initially broad were sometimes sub-divided to be more precise as the analysis progressed.
- Categories were conceptually organised, meaning that thought was given to the similarities, differences and relationships among the categories.
- Final themes were developed in preparation for documenting the research findings. The themes and categories that emerged from the study are presented in Table 2.

The discussion in this section will focus on understanding how participants in the study allocate significance to functions, resources, and information on interfaces. At the same time, understand how their norms and interactions

with available facilities influence their actions. These inferences can then be used to shed light on the claims analysis.

Table 2. Investigated Themes, Categories and Quotations

Themes	Categories	Quotations
Actions driven by modalities	(1) Norms	(1) *I won't know that there is a discussion board within the courses if I have not used this before so it's because of past experience in using edveNTUre, I know where is the discussion board, that's why I am able to go to the right place.* (2) *Everyday we use this interface so it is very friendly and familiar to me. I already know which area is the most correct part to browse.* (3) *I think it's because I usually just find information in the discussion, so after the interface refreshes, I will only look at this one part – the section with all the posts.* (4) *Usually I will come in to view the discussions and then I will leave. Only if I have to participate then only I will explore other buttons and functions.* (5) *To go back I will usually use the back button of the browser... it's just a natural tendency.* (6) *The interface didn't explain much but I was thinking I click to find out what the task means.* (7) *People who are not familiar with discussions, they will not know that it is actually inside the course page...but I know because I've used this many times.* (8) *Based on Google, this is not consistent or standard.*
	(2) Facility	(1) *The different icons appearing beside the results also tell me that the search has retrieved a good variety of resources so I conclude that the search is comprehensive.* (2) *The links tell me somewhat that some are more important than others, so they prompt me to click on them.* (3) *The homepage displayed so many separation boxes and there are terms I didn't understand so I was a little confused.* (4) *I prefer to use notepad rather than the portal because it gives me more control over the file.* (5) *I usually customise my home page so all the links I normally use are there on the first page.* (6) *My attention is focused on this area so I ignore the box up there. I even looked at the display search but somehow I missed the collect button. Maybe it's because I have never used it.*
	(3) Interpretive scheme	(1) *The relevance scores and the score bars caught my attention the most but I missed the information on 'type', 'location' and 'last modified' because I don't think they are very important.* (2) *Yes, I trust the ranking first then only I click on the links.* (3) *Even if there is a link to the discussions board I think I still might waste time in getting to it...because I don't understand what the term means and we haven't been asked to use this function much.*
Online Behaviour	(1) Learning-related	(1) *I don't think a visual tutor or online tutor is appealing to me.* (2) *Learning is very purpose driven for me. I always go into the portal just to get to the subject links, course documents, maybe what's new and then log out after that.* (3) *Not really attractive, but I don't use much of edveNTUre other than for courses. My use of the portal is quite purposeful so I don't stay very long in there.* (4) *These are all academic stuff so I don't want to stay here anymore.* (5) *It's all academic and they are not interesting to me unless there's a forum or something...* (6) *I'm usually only interested in the courses area.* (7) *I look at discussions but seldom post...unless I have intelligent answers, because the answers posted are usually quite intelligent.* (8) *[The portal] is easy to access and I can find my school documents easily and can discuss with my course mates if I have any questions.*
	(2) Non-learning related	(1) *If animation is used in the web interface it adds to the loading time so the portal won't be very efficient. I find it irritating.* (2) *Ya, because some of my friends use this portal and links from here and go another...I do not know initially what are they doing; but eventually I learn how to use this portal from them.*

As the interviews were focused on task-related actions, two main themes emerged – one relating to actions driven by modalities (norms, facility, and interpretive schemes) and the other relating to online behaviour. Within each theme different categories are recognised. It should be reminded that these categories do not imply dichotomies but should be viewed as recursive and interdependent factors. However, for the purpose of discussion they are examined differently.

In the first theme, there were three identified types of actions; based on: norms, facility and interpretive schemes. In norms, participants acknowledged how their actions were based on what they accept or perceive as normative interfaces and standards. For example, a participant commented: '*Usually I will come in to view the*

discussions and then I will leave. Only if I have to participate then only I will explore other buttons and functions'. This explained the norm for this participant in a discussion board, and implies that the participant will not explore other functions in the page unless there is impetus for participation. In terms of design, this also meant that functionalities or tasks allowing participation in a discussion board should perhaps be grouped together on the interface instead of being dispersed. Another participant explained how using the 'back' button of the browser has become a norm for her in stating that '*to go back I will usually use the back button of the browser… it's just a natural tendency*'. Again, this explained the norm for this participant in using browser-based interfaces in a certain manner. In terms of design, this has significant implications when a 'back' button is being included on the interface.

Other actions were driven by the facility itself allocating resources (such as information) on the interface. For instance, a participant said '*the links tell me somewhat that some are more important than others, so they prompt me to click on them*'. This indicated that the way the interface organised the links on the page has significant implications in perceiving the relative importance of these links. Another participant, who collected posts in a discussion board by using a separate application (notepad) instead of the function provided at the portal, explained '*I prefer to use notepad rather than the portal because it gives me more control over the file*'. This implied that between the application and the portal, the application was perceived as more powerful in its ability to allocate and control information resources for the participant.

The last category in the first theme relates to the way participants used interpretive schemes to allocate significance to resources and therefore explained their actions. For example, one participant explained how some information displayed in a search result are more significant than others: '*the relevance scores and the score bars caught my attention the most but I missed the information on 'type', 'location' and 'last modified' because I don't think they are very important*'. In terms of design, this could mean that the display was perceived as overloaded with information for the participant. In another expression, a participant also demonstrated how different functions holds relative significance based on her own understanding and communicated interactions. She contended that: '*even if there is a link to the discussions board I think I still might waste time in getting to it…because I don't understand what the term means and we haven't been asked to use this function much*'.

Again, it should be reminded that these categories are recursive; for instance the way the facilities are designed and perceived can be significantly influenced by norms and interpretive schemes as well. Similarly, interpretive schemes can also be shaped by the facility – in the previous discussion where a participant explained how some information are more significant than others in a search result, it may be that the organisation of such information in the facility had led to the differentiated signification, or that the facility had led the participant to relate the interpretation to the norms he perceive in the results of search engines.

The second theme that emerged from the interviews was related to online behaviour, where it was further differentiated as learning and non-learning related. As the interviews evolved around edveNTUre, most of the discussions in this theme were based on learning-related behaviour – but there were instances where non-learning related behaviour were also found to be significant in shaping the actions of participants.

In learning-related behaviour, a participant explained the lack of participation in discussion boards. Here she commented '*I look at discussions but seldom post…unless I have intelligent answers, because the answers posted are usually quite intelligent*'. This has several implications: the perception of quality in course-related discussions, the fear of being perceived as unintelligent therefore explaining the lack of public participation, and the value of discussions in enhancing the learning of participants even though they do not publicly participate. A few participants also commented on their purpose-driven, somewhat non-exploratory learning behaviour. One participant commented '*learning is very purpose driven for me. I always go into the portal just to get to the subject links, course documents, maybe what's new and then log out after that*'. Another commented more negatively, explaining how he is resistant to linger on in the portal after he is done with his tasks in the portal: '*These are all academic stuff so I don't want to stay here anymore*'.

Other non-learning related discussions explained the actions of participants. These statements add to the larger background context of participants, which also help to shed light on their learning-related behaviour. One participant noted how he is irritated by the loading time for animation in a portal – which led to his dislike of the idea of having animated online tutors to guide him in a portal. He expressed this point clearly: '*If animation is used in the web interface it adds to the loading time so the portal won't be very efficient. I find it irritating*'. Another related to the influence of her peers in shaping how she used the portal. She stated: '*Because some of my friends use this portal and links from here and go another…I do not know initially what are they doing; but eventually I learn how to use this portal from them*'. This has larger implications towards peer-learning in online environments.

Using the structurational model of technology as discussed earlier in Figure 2, the discussion now turns to how interactions between users and the portal shape user actins and at the same time imply institutional consequences as a result of such interactions. In the directional arrow depicted as *a*, the portal is pictured as a product of human

actions. In the context of the study, this is conceived as the portal being shaped by the way users use it. For example, the course links placed up front on the home page reflected significant importance allocated to these links – and this was reinforced by participants expressing how they used these course links the most. In *b*, where technology is pictured as a medium of human actions, the portal is conceived as constraining or empowering actions. This is evident in how participants were constrained by the available functionalities at the discussion board. In another example, the availability of advanced search empowered participants to conduct integrated search at the portal using advanced options.

In *c*, institutions interact with technology contingent on the conditions placed on humans. In the study, this is simply conceived as the institution making it compulsory for students to use the portal as part of their course requirements. The last factor, *d*, considered institutional consequences as a result of human interactions with technology. Unlike the other factors, such consequences are not immediate and can only be observed over time. Examples are the shaping of budget allocation and other resources by the institution, influences on the institution's approach to learning and teaching, or even the way the institution interacts with users.

The study has resulted in some contributions. The use of questions from claims analysis as a semi-structure interview has proved to be effective, as participants were able to project subjective experiences and realities while relating to objective actions and interfaces. At the same time, the method had also allowed researchers to gather new perspectives and deeper insights in order to understand and provide wider contexts for the actions of participants. The study, intended to be participative, had also resulted in a form of participative action research. This is conceived as a technique for researchers to make interjections and become agents of change – in the study for example, after participants had completed the appointed tasks on their own, the researcher was pointing out differences between links in times of confusion, explaining claims analysis as a design technique and how certain functions work for participants who have never used them. Whether participants use such interactions to shape their actions in the portal after the study it is not known – but it is argued here that in light of these interactions the cumulative knowledge of participants are enhanced.

The use of structuration theory had also been useful, to provide greater contexts for explaining human actions, and take into account conditions and consequences from institutions and technology. This helped to illuminate the interacting influences from the technology and institution, and at the same time help to consider the implications of human actions. For claims analysis which identifies positive and negative effects, the findings using structuration theory are complementary, as they provide deeper insights on how these positive and negative consequences come about and their implications. In addition to these contributions, significant insights have also been drawn on online behaviour and actions, which help to illuminate current and future trends, perceived norms, facilitative allocation of resources, and the interpretation of resources.

Discussion and Conclusion

In contrast with quantitative usability evaluations, qualitative evaluations are often criticized for not producing statistically significant findings because of the small sample population used in the studies. Using a case study of a good e-learning system, edveNTUre, at Nanyang Technological University in Singapore, rich analyses of user interactions with edveNTUre can be obtained with only six subjects using and synthesizing well-established theories such as Interaction Framework, Claims Analysis and Structuration Theory to analyse user interactions, adding meaning and "depth" to the data collected.

This is on-going work for us. The initial work has created useful findings to understand user interactions and hence interaction design of edveNTUre. We are repeating this study with more user groups across the university and between two other local universities in Singapore. Control for factors such as Web skills, gender and study habits/preferences would also be considered in subsequent studies.

Acknowledgments

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