

Usability, Engagement & Development of a Digital Usability Laboratory in a Higher Education Environment.

David Cox
Faculty of Technology
Southampton Solent University
East Park Terrace, Southampton
SO14 0YN. UK
(+44) (0)23 80 319942
david.cox@solent.ac.uk

ABSTRACT

The paper provides an illustration of the complexities of developing a usability laboratory for mainly undergraduate and some external sources within a university environment. It also examines how undergraduate computing students engage with the concept of usability evaluation and with digital usability recording/analysis equipment; this is done in the context of a typical HCI module and when working on a final year independent project. General engagement, lab configurations, equipment and recording/analysis tools are discussed. Student engagement with the lab facilities is considered to be good and the lab is seen as an additional means of improving student engagement with usability evaluation and its practicalities. Brief reference is also made to the use of the lab for outside consultancy.

Categories and Subject Descriptors

K.3.0 [Computers and Education]: General

H.5.0 [Information Interfaces and Presentation (e.g., HCI)]: General

General Terms

Performance, Human Factors, Verification

Keywords

Human, computer, interaction, HCI, usability, evaluation, lab, laboratory, engagement, participant, analysis, recording, user

1. INTRODUCTION

The growing importance of usability evaluation for product and interface design in industry has seen an increase in environments where products can be tested and evaluated. One of the main areas for such evaluation has been the usability laboratory, usually consisting of an area where participants represent

potential users in the evaluation process, and an observation area which allows viewing and possible recording of a participant or participants engaged in such evaluation. There has been a proliferation of usability laboratories over the last two decades mainly within industry and private consultancy. However, the original expansion mainly used analogue recording equipment which made the analysis process quite time consuming and the cost benefit questionable. Within academic institutions other means of evaluating the usability of digital products continued to be used though the adoption of some kind of digital lab has steadily increased in recent years. The reasons for this adoption are elaborated below. It is also worth remembering the academic context in which HCI and usability are represented.

2. BACKGROUND & USABILITY

The area of usability in university computing departments within the British higher educational system is usually presented to undergraduates as part of a human-computer interaction (HCI) module. This may be a module which is taken for a whole academic year or possibly for one semester only and, within such a constrained period, human factors and design often compete for curriculum time with usability analysis, evaluation and testing. Of course usability in itself cannot be divorced from cognitive issues and could easily fill a complete semester based module. However, for learners (who are often new to this domain) this is not possible so any laboratory used by such students for evaluation work must broadly (a) provide rapid digital evaluation techniques and (b) use equipment with a shallow learning curve.

2.1 Justification & Background

With the above two general objectives in mind, Southampton Solent University, Faculty of Technology, School of Computing & Communication proposed that a usability laboratory should be constructed and bid for money for this within the Science Research Investment Fund (SRIF) scheme [6].

Initial focus was on justifying why this type of lab was required within a university context. Two main reasons emerged both based on usability: i) primarily, the necessity to provide our students with a facility which would allow quantitative (and diagnostic) usability evaluation of digital products either built by students themselves or by others; ii) a secondary factor - the possibility of the School acting as consultants and evaluating software products for private companies in order to generate income for the University. Learners on Southampton Solent University's BSc Business Information Technology (BIT) and Computing programmes are required to look at evaluation

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techniques as part of a range of topic areas of study in one of the programme's Level (Year) Two modules, Human-Digital Interaction Design (HDID). This is consolidated in the students' final year with an option module: Human Computer Interaction (HCI) which is also offered to students on our Computer Network Programme. Additionally, all final year students are required to do an independent Project dissertation which would normally either be product-based requiring a software 'build' or possibly research based requiring the defence of a number of objectives. Some students - particularly those taking the HCI option - include a usability evaluation in their dissertation.

The HDID and HCI modules are primarily concerned with usability, cognitive and human analysis factors, evaluation and design and emphasize practical interface design work as well as a practical focus on evaluation and human factors. All of these elements are included because they are integral cogs in the process which leads to the production of usable products and an understanding of these elements, and in particular an understanding of usability, helps emphasize the importance of user-centred design [2]. One of the primary goals of HCI in industry is to inform the design of technical artefacts which support the goals of an organisation [4] and one of the key aspects that can inform design and promote usability is robust evaluation of a product. Usability laboratories offer an additional means of providing (particularly quantitative) usability evaluation, discrete observation of participants and, with the relevant software, rapid statistical analysis and reporting of the evaluation.

In addition to this primary academic objective, usability laboratories are seen as a way of bringing external money to universities in the form of consultancy evaluation for outside clients wishing to test their devices or systems. Such evaluation could be done by academic staff or possibly by final year undergraduates or research graduates. This and the academic primary objective provided the main reasons for justification of a Usability lab in the context of the School of Computing and Communication within the University.

2.2 Further lab justification & consideration

Concurrent with the proliferation of usability laboratories over the last ten to fifteen years has been a rapid enhancement in digital computer technology superseding the expansion of mainly analogue recording and viewing equipment. The latter technologies have benefited usability lab processes but have also, at times, made the analysis of recorded evaluation a very slow process. The investment by industry in state-of-the-art labs (whether audio or digital) has made organisations' commitment to usability clear to their customers and users [9]. However, the investment benefit becomes more unclear if the evaluation is muddled by a laborious and possibly time-consuming recording processes.

In recent years, digital audio and visual recording equipment has made the analysis process less time consuming and has also reduced both the complexities of configuring and using systems. This in turn has reduced the costs of building a lab. Laboratories have become more common in places where one did not exist before and this is particularly true in the academic world. Andre et al. [1] point out that universities have invested in the process of developing usability laboratories and these often mirror the look and feel of labs in industry albeit on a smaller scale. The

reduced complexities of using digital equipment and costs of installing relevant software provided further reasons for building a usability laboratory. The SRIF bid was based on the above justifications and was successfully accepted in August 2005. The university was awarded £47,806 for the laboratory and this fund could be spent from April 2006 until 31 March 2008. Staff within the Computing & Communication school were given the responsibility of sourcing a suitable room and equipment, a task which was new to both academic staff and technicians involved in the project.

3. LABORATORY CONFIGURATION

The traditional configuration for a usability laboratory consists of two adjacent rooms divided by a one-way mirror, i.e. a glass partition that acts as an opaque screen or mirror from room B but which acts as transparent glass from room A. The glass partition, therefore, allows those in the Observation area (room A) to observe participant subjects in the Participant area (room B) without disturbing them. We spent some time deciding whether this configuration would be feasible, suitable or indeed necessary. Evaluation of the usability of a digital product can be conducted in a variety of ways. Techniques such as heuristic evaluation, focus groups and paper-based reporting of usability metric outcomes are all effective and can all engage the student learner [3]. The traditional configuration, therefore, was not a foregone conclusion. Main obstacles consisted of lack of viable

Table 1. Basic lab equipment requirement

Participant Room	Observer room
6 Remote Control IP Cameras with video only	1 Hard drive Recorder
3 Remote control IP Cameras with Sound	1 Rack Unit
6 Microphones	2 Video Monitors
6 Desktop computers	1 Network Switch
1 Recording in progress light	3 Audio mic. Mixers
6 Audio mic. mixers	3 Microphones
	3 Desktop computers
	1 Recording in progress light
	3 Audio mic. mixers

rooming space and the difficulties in illustrating our requirements to those responsible for building the two rooms and installing the partition. Other questions focused on the complexities of suitable recording and analysis equipment at a reasonable price within the given budget; consideration was also given to suitable soundproofing of the two rooms to further enhance the privacy of the participant. It was thought that because of the nature of the bid and the School's commitment to a permanent area devoted to usability evaluation, a traditional viewing and participant area would be adopted, along with digital analysis equipment and software. It was thought that this would also enhance the students' experience of evaluation techniques. Building work did not begin until late 2006 and the space was not completely ready for installation of equipment until 2007-08 academic year.

3.1 Equipment configuration requirements

Because of the size of the available rooms, there had to be a balance between participant/observer comfort and providing the facilities for a reasonable number of participant/observer students at any one time. The average tutorial group size of students involved with the two modules described above is 20. However, the room size dictates that this number could never all be accommodated. Any consultancy work or work done by Project students would normally involve small groups anyway so we felt that a good compromise for our requirements would be the equipment described in Table 1 with six participant and three observer workstations.

Table 1 represents the basic equipment requirement without any consideration given to suitable usability software. In addition to the equipment outlined, audio and network cable and various connectors were also required. We decided that this equipment required a configuration dictated by the criteria described above. This configuration is illustrated in Figure 1.

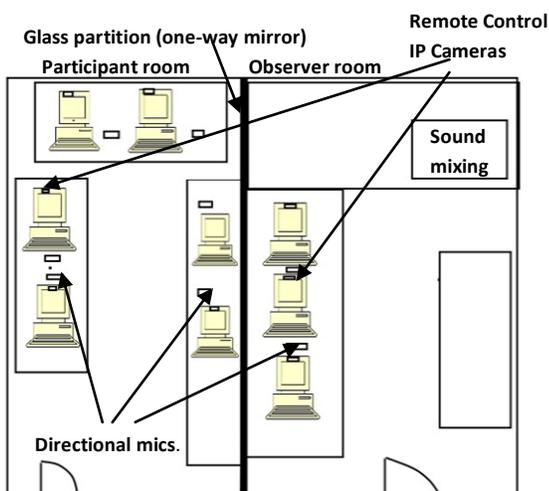


Figure 1. Usability Lab configuration

3.2 Software considerations & engagement

Well over half of the original fund earmarked for the laboratory was used in the construction of the partitioned rooms and glass screen separating these rooms. The installation of much of the hardware described in 3.1 also consumed substantial amounts from this fund. We were required to consider very carefully which software we would purchase for the lab. Moreno Rocha and Martinez [8] and others point out that HCI and usability is a hard sell both academically and in a commercial context. The area of evaluation, in particular, is a topic which is sometimes difficult for learners to engage with. However, usability and evaluation are inexorably linked and in emphasizing usability, learners should be motivated to consider the importance of more than one method of product evaluation.

This is also true in the commercial world. Providing local industry with more than one clear cut tool which makes the cost outlay of evaluating usability appealing is very important. The choice of software was, therefore, also very important. The main focus of our students would be on evaluation of web and windows based products. Our evaluation tools had to be able to cope with

mainly static screens (in the sense that they are not generally movie images) with users focusing largely on a variety of dynamic and interactive web pages or stand alone applications. To a lesser extent, some consideration was also given to animation or moving image but this was not our main focus though we welcomed tools that would cope with this.

During the development process we were fortunate to attend a series of HCI conferences in a period between 2005 – 2008 which were not only attended by academics but also by commercial representatives who highlighted various digital recording products. In particular, a tutorial on interviewing skills for usability testing [7], was attended by a range of usability consultants and employees responsible for usability within their company. Many of the tutorial attendees used Morae, [10] a software based usability evaluation and recording tool which measures and collects data during usability testing. These conferences also highlighted the importance of recording the users' area of interest and exactly which part of the screen an end-user would actually look at. Products which do this are generally known as eye-trackers. They use technology such as infra-red to record the movement of the users' eyes and provide a gaze track or plot which illustrates which areas of the screen the user has looked at. They tend to be at the more expensive end of the range of analytical usability tools whereas Morae is at the cheaper end of this range. One of the main products in this area is the Tobii Technology eye tracker. Tobii "specializes in eye tracking and eye control [with] technology [that] makes it possible for computers to know exactly where users are looking" [11].

4. RECORDING TOOLS

Further investigations were made into comparable software in both of the above areas (cf. 3.2) with cost, quality and requirement matching being major considerations. This was a fairly long and time consuming process which took 1.5 years in total until August 2008. For example, we discussed and viewed demonstrations of comparable eye tracking products over this period both at conference fairs and on site within the University. Careful consideration was given to a range of software during this period and purchases were made along with other equipment for the lab (cf. 3.1). We felt that our students and lab required an easy to operate tool which did analytical measurement of computer usage and a more sophisticated tool which recorded exactly where the participant looked on the screen. We therefore opted for both the Morae analytical tool and the Tobii eye tracker. There was little remaining of the allocated budget following original construction work, purchase and installation of equipment. The Morae tool was, therefore, purchased earlier in this period and the more expensive eye tracker much later with additional funds.

4.1 Morae Recorder, Observer and Manager

Morae [10] consists of three separate components that can be used for testing, analysis and recording. They are the Morae Manager, Morae Recorder and Morae Remote Viewer. Together they give reasonable flexibility in terms of recording and managing a group of participant subjects. We have tested software with up to six participants at a time without any serious issues and the provision for statistical analysis is comprehensive.

The recorder captures video, audio, on-screen activity, and keyboard/mouse input such as keystrokes, mouse clicks and web

page changes during a research session. It produces a video of both the screen and the participant user through internet protocol (IP) cameras which were supplied with the Morae Remote viewer (see below). This matches well with our requirement for quantitative analysis of participant user performance in terms of tasks, errors made, mouse clicks, etc. It also removed the need to invest in a hard drive recorder. Six were installed in the participant area (see Fig. 1). The Morae Observer (also named the Remote Viewer) enables observers to view the user's experience remotely make notes, and flag tasks in real time via a network. The Manager is a good example of how the recent generation of digital recording equipment have reduced the analysis time of usability evaluation (cf. 2.2). It enables viewing and analysis of Morae recordings, automatic calculation of metrics, graph generation, etc. Rather than travelling through a video in a complete linear fashion, the software indexes the screen video and audio as well as the in-screen video of the participant. This allows analyst students to move directly to an area quickly and display meta data information such as a list of all mouse clicks that occurred and when they occurred.

4.2 Tobii Technology eye tracking

The Tobii eye tracking system [11] consists of an infra red panel attached/integrated to a 17" TFT monitor. The monitor is very portable and is 'plug and play' in nature allowing fairly intuitive set up and use. It also allows quick calibration of a participants eye movements. This hardware is the most expensive component of the complete system probably due to its state of the art eye tracking which has good tolerance levels. In addition to this component, Tobii Studio™ software provides analysis and recording facilities and is very sophisticated in its provision of in-depth qualitative and particularly quantitative analysis. It will also provide indexed recordings and meta data in a similar fashion to Morae. Our eye-tracking requirements were very detailed and specific but the key requirements were that the system should: allow normal unencumbered head movement by participants, have a high tolerance for glasses and contact lenses and have reasonable intuitiveness in terms of use. The data capture/analysis software should be able to record & provide video playback of a gaze track of a subject's view of different stimuli; provide statistical analyses of dynamic and static stimuli; and provide heat maps of visual stimuli of a number of users overlaid. Original tests on this system prior to purchase revealed that the system satisfied the above criteria and particularly showed a very high tolerance for glasses and contact lenses, a situation that can present problems with some participants wearing these items. The software is intuitive which is good for our students.

5. USE AND STUDENT ENGAGEMENT

The lab has been used seriously since August 2008. Students on final year Projects and on modules described in 2.1 have been encouraged to use the facilities. It was always felt that the eye-tracking facility would prove to be the attraction in terms of usage and usability evaluation and this has proved to be the case. However, the Morae evaluation tool has a lower learning curve and is intuitively easier to utilise for a rapid test of six participants at a time.

5.1 Engagement, activities, issues

Motivation and engagement within the learning process is difficult to separate from the attempt to encourage students to recognise the importance of usability and evaluation. Without engaging students, it is unlikely that they will internalise different evaluation techniques and recognise their importance in relation to usability. It is often the case that, when concentrating on these areas, it is difficult to move learners to an area where



Figure 2. View of Participant area from Observer room

they are intrinsically interested in the subject and able to internalise and output creatively. Intrinsic motivation is possibly the most valuable of the different types of motivation [5]. The desire to learn and its inherent values of curiosity and enlightenment is a strong motivator. Students who become engaged in this manner will work around the subject and explore it more fully than those who simply see it as a way of gaining more marks in an assignment. Initial indicators are that this is the case with the Usability Laboratory. The desire to use the facilities amongst final year Project students is high. The curiosity value of the eye tracker appeared to 'nudge' a significant number of students in this direction. Students welcomed the chance to investigate and 'work around' a problem. Many, of course, recognise the value of being able to provide evidence that software products they have built, or are investigating, are usable. They are particularly attracted to: the facility to plot a gaze track of a series of interfaces which a user has viewed; the facility to overlay several users' gaze plots; and the facility to produce a heat map as an overlay of several users and prove that certain areas of the screen design do their job well (or badly) in attracting users' attention. The Morae analytical and recording tool is also popular possibly because students can see the value of being able to evaluate software with six different participants reasonably easily and with little training.

Both recording/analysis tools produce a wealth of statistical data and, if anything, students underestimate the time required to analyse the results of their recordings. They also underestimate the human factor, i.e. the time and organisational requirements required to get six willing, happy and relaxed participants in one room. This is emphasized in the HDID unit but it is difficult to illustrate the 'reality' without students actually doing the organising themselves.

5.2 Engagement. Benefits of lab.

Final year project students are fairly intrinsically motivated because they are working independently on a self-selected topic which interests them. However, when they reach the stage where they are working in the lab on their project they become

particularly enthused; in academic year 2008-9, of four students who focused their final year projects specifically on research into usability or extensively used the lab to evaluate the usability of products they had built, one received first class honours equivalent for his Project dissertation and the other three achieved good second class honours equivalent. It is too early to analyse results for the present year 09-10 but initial trends show that with increased exposure, there has been an approximate 40% increase in final year students volunteering to focus their projects around or specifically on usability issues involving the lab. Those students at Level 2 who have been exposed to the lab within the HDID module also remain enthused and display a similar level of engagement. These were given a range of tasks to test on each other in relation to a specific piece of software using different equipment. This allowed comparison with other evaluation techniques [3], generated lab booking requests from students and will be extended in future. The laboratory has also been used for research and consultancy work for companies outside the University. This is at an initial development stage only but finance, insurance and web/software development companies are interested. Most wish to improve the quality and usability of their web sites and this has involved some intensive testing using the equipment described above.

6. CONCLUSIONS

The development of our usability lab has been a long and sometimes complex process involving not only planning the layout of the space but also the installation and selection of lab hardware and usability software. It has been an interesting learning curve for those concerned and we have been lucky in having the support of good technical staff. The lab and its equipment have only reached a more than acceptable 'working stage' in the last year but already final year students have engaged well with the facilities and have seen the value of rigorous usability evaluation. It is evident that to increase engagement with Level 2 students, more time needs to be allocated to lab use. In addition to this, different task based evaluation activities should not only be given to different groups of Level 2 students, but they should be also be asked to devise their own evaluation tasks for use within the lab. As well as familiarising students with the equipment, time and consideration should be given to 'participant organisation techniques' though this is difficult given the time allocation within the module. In terms of consultation we are, at present, considering different ways of publicising and marketing the lab. In terms of student engagement, the lab can be considered a success and we hope to increase student awareness even further in this area using the suggestions described above.

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