CLaSS Computer Literacy Software – From Design to Implementation
A Three Year Student Evaluation

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Abstract

Both computer literacy and information retrieval techniques are required to undertake studies in higher education in the United Kingdom. This paper considers the research, development and the 3-year student evaluation of a piece of learning technology in computer and information literacy (CLaSS software).

Students completed a questionnaire to examine their own assessment of knowledge and competence in computer and information literacy and based on this assessment CLaSS software was created to assist nursing students with computer and information literacy.

This paper draws on existing literature and applies a specific learning model to the software while considering software engineering and user-centered design methodologies. The technical processes involved in designing and creating the software are briefly considered with software development data analysis discussed.

A 3-year student evaluation of the software after it's release was undertaken to consider the long-term validity and usefulness of this software with the results analysed and discussed.

Keywords:
Computer Software. Computer Literacy, Information Literacy, Student Evaluation, Software Design.

Introduction:
The Computer and Information Literacy skills of undergraduate students has presented Universities with significant challenges [1] and with the integration of nurse training into higher education in the early 1990's [2], the problems associated with computer literacy have been particularly hard to solve for nurse education.

The problems associated with the acquisition of communication and information technology (C&IT) skills have been well documented by Chambers & Coates, 1990 [3]: Gassert & McDowell, 1995 [4]: Graveley, Lust and Fullerton, 1999 [5]: Topp & Kinn, 1999 [6] and others in the International nursing community.

In the United Kingdom the issue of widening participation has been a major government issue for higher education [7] with accessibility, inclusion and key skills [1],[8] being issues that nurse education has continually tried to address.

Background of the research study:
A project started in 2000, attempted to address some of the computer and information literacy skills problems faced by nursing students at the University of York in England where research into the computer literacy needs of students was undertaken [9].

The research had the premise to discover what levels of computer and information literacy a group of nursing students had already gained and whether there was a need for a piece of learning technology to address this issue.

Quantitative research was carried out via a questionnaire that was designed to elicit the students' own assessment of their computer skills and knowledge. The questionnaire included a five-point Likert-type scale with scale descriptors: excellent, good, adequate, poor and very poor, throughout the analysis "Poor" and "Very Poor" were considered together as both less than "Adequate".

497 students were highlighted for the study; these participants were undergraduate post-registration nursing students (qualified employed nurses undertaking further educational courses), with only 12% of the students involved in the study being on full time courses. Questionnaires were distributed and collected by lecturers within teaching sessions, which gave a high response rate of 69% (n=342).

Questionnaire Results:
The results were analysed in the two main categories of computer literacy and information literacy. The computer literacy category is concerned with the knowledge and ability to use computers whereby the information literacy category is concerned with the knowledge and ability to perform searches and communicate electronically. A summary of the results are in figure 1.

The results from this survey indicate that these students had deficits in both computer and information literacy with a large number of these students perceive themselves as being unskilled in the use of computers. Based on these findings a piece of learning technology was created called the 'Computer Literacy and Skills System' (CLaSS) to assist nursing students with their computer and information literacy (C&IL) needs.

CLaSS Software:
CLaSS software is an interactive computer training package to assist nursing students improve areas of computer and information literacy (C&IL) that the students feel they need to concentrate on. It consists of five individual tutorials covering basic and

intermediate computer competencies [10]. The software was designed to run across a wide area network (WAN), the Internet and/or delivered via CD-ROM.

Summary of C&IL Results 2001

92% of students were female giving a ratio of 12 female to every male student
21% felt their ability to use a mouse or keyboard was below adequate
36% felt their ability to navigate through Microsoft Windows was below adequate.
26% felt their ability to use a word processor was below adequate.
25% did not know how to search for a book or journal article in a library.
48% were not able to use an electronic library catalogue.
40% felt their ability to request journal articles through a University library was below adequate.
34% didn't know how to access information on the Internet and 46% felt their knowledge of the Internet was below adequate.
50% of the students did not use electronic mail
46% felt their understanding of 'what a bibliographical database is' was below adequate.
57% felt their ability to access a bibliographical databases through their University was below adequate.
72% did not know what 'Boolean searching' was and only 16% felt their understanding was adequate or above.
When asked if a computer skills system was a good idea 94% felt it was and 87% said they would use the system occasionally or frequently.
58% felt their understanding of disk drives (floppy A and C drives) was below adequate.
46% felt their knowledge of 'what a CD-ROM is' was below adequate.
39% felt their knowledge of file management (i.e. how and where to save work) was below adequate.

Figure 1

CLaSS software covers the following criteria (see figure 2).

1: Understanding what the keys do on the keyboard.

2: Learning to use a mouse.

3: Navigating Windows 2000 and basic word processing.

4: How to use a bibliographic database.

5: How to search the Internet and use e-mail.

CLaSS Learning Model

The learning model that CLaSS adopted is based on David Ausubel's subsumption theory [11]. Ausubel's work was concerned with verbal/textual lessons in schools and in his subsumption theory, he contended that "the most important single factor influencing learning is what the learner already knows" [12].
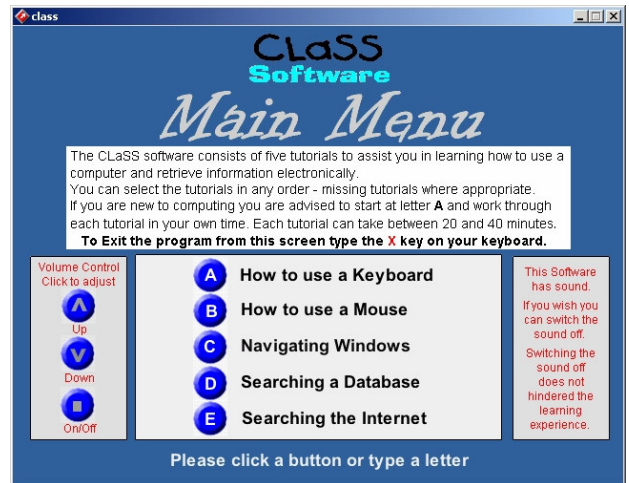

Figure 2

Ausuble argued that when learning, the student needs to link background knowledge (knowledge the student already has) to the foreground knowledge (what is being taught to the student) and to do this Ausuble advocated the use of 'organisers' to bridge the gap between what the learner knows and what s/he needs to know before s/he can successfully learn the task in hand" [13].

It was possible to apply Ausuble's theory to the implementation of the CLaSS software by considering the background knowledge as computer literacy and the foreground knowledge as information literacy. As is seen in the questionnaire results a large proportion of the nursing students in the study had limited or no background knowledge (computer literacy) and because of this factor the computer literacy tutorials (keyboard, mouse and Windows) can be views as Ausuble's organisers preparing the way for the foreground knowledge in the form of information literacy (Internet and database searching). Once the background knowledge has been attained or revisited, links to the information literacy or foreground knowledge is made and so completing the process.
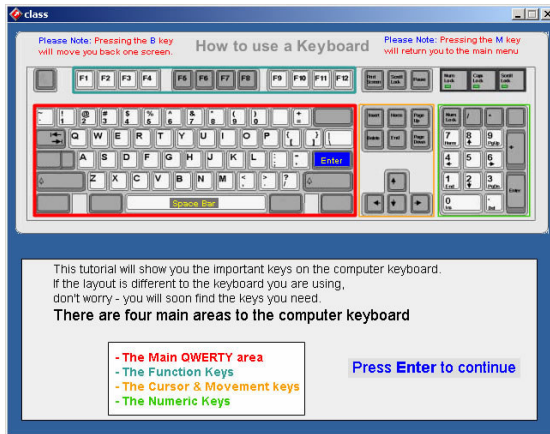
Figure 3

CLaSS Development Process:
CLaSS software utilised the development process of Analysis, Planning, Design, Implementation and Testing and was applied as a 'system development life cycle' [14]. Norman & Draper's [15] user-centred design approach was also utilised to incorporate Norman's 'Seven Principles of User-Centered Design' [16] see figure 4.

User-Centered Design Methodology

1	Use both knowledge in the world and knowledge in the head.
2	Simplify the structure of tasks.
3	Make things visible: bridge the gulfs of Execution & Evaluation.
4	Get the mappings right.
5	Exploit the power of constrains, both natural and artificial
6	Design for error.
7	When all else fails, standardize.

Figure 4: Seven Principles of User-Centered Design' (Norman 1988)

In applying the principles of user-centered design the following points were noted:

1. Recognising the difference between inexperienced and experienced users and the awareness of implicit knowledge (visual cues) and explicit knowledge (labels on interfaces and instructions).

2. Simplifying the structure of some of the tasks was necessary after feedback evaluations showed problems in the procedural content certain tasks (i.e. the copy and paste task in the 'Navigating Windows' tutorial required simplifying).

3. Visibility throughout the software was of great concern and the acquisition of high quality images was problematical. Some of the computer screen images were sliced and enlarged to keep the quality high.

4. Every effort was made to insure that the mapping models [21] (i.e. a model that a user retrieves from memory) of the software were accurate.

5. The 'power of constrain' was used to particular effect in the 'How to use a Keyboard' and 'How to Use a Mouse' tutorials by limiting the users use of the Keyboard and Mouse.

6. Back buttons were integrated into the software to help reverse the error of clicking on the wrong link or button and irreversible operations were eradicated as much as possible.

7. There has been much standardisation in the form of text, buttons, links and images throughout all five tutorials.

The synergy of the two methodologies, User-Centered Design and Software Engineering were used to considerable effect and it was Shneiderman who stated that '*any user-centered design methodology must also mesh with any software-engineering methodology used*' [17].

Shneiderman also outlined that the relationship between software engineering and user-centered design hasn't always been smooth but by 1998 the relationship was considered to have arrived at a 'second-generation business-oriented design approach' [17 p104].

Software Piloting:
Software piloting was undertaken using three methods, a usability evaluation team examination and questionnaire, a student evaluation questionnaire and a cognitive walkthrough [17] experiment. The student and usability team evaluations were completed by the use of self-assessment questionnaires while the cognitive walkthrough evaluation was videotaped and summarised. It was also decided at this point to continue a 3-year student evaluation of the software to test its long-term validity and usefulness.

Initial Student Evaluation:

The initial student evaluation of CLaSS software was undertaken in May 2001. This was prior to the full release of CLaSS software. Two groups of nursing students on a study skills course were considered the ideal candidates to 'user test' the software. The CLaSS software was integrated into a taught basic computer literacy session with the students being asked to complete a short quantitative questionnaire at the end of the session. The questionnaire was based on Brooke's [18] 'System Usability Scale (SUS) questionnaire that had been developed for the Digital Equipment Corporation.

The scale descriptors used were 'Strongly Disagree' through to 'Strongly Agree'. The questions were designed in such a way that 'Strongly Agree' is not always the positive answer to liking the software the rational for this was that the evaluators would have to read each question before answering. The two groups of students totalled 19 were all female; the questionnaires were anonymous and were only catalogued when the data was inputted into SPSS software for analysis. A modified version of this questionnaire was also used in subsequent student evaluations in post software implementation.

Summary of Initial Student Evaluation:

- 100% of students agreed or strongly agreed that they liked the introductory animation and that they found the software easy to navigate.

- 84% of students disagreed or strongly disagreed that the software was unnecessarily complex.

- 74% of students agreed or strongly agreed that they would like to use the software frequently.

- 95% of students agreed or strongly agreed that the various tasks in the software were well integrated, that the images used and the learning information was appropriate.

- 90% of students disagreed or strongly disagreed that there was too much inconsistency in the software.

- 89% of students thought the software was easy to use.

- 100% of students disagreed or strongly disagreed that the software is very cumbersome to use.

- 68% of students agreed or strongly agreed that they felt confident using the software.

- 79% of students disagreed or strongly disagreed that they thought they would need help to use the software.

- 90% of students disagreed or strongly disagreed that it was hard to read the text in a tutorial.

- 89% of students agreed or strongly agreed that it was easy to follow the on screen instructions in a tutorial.

- 84% of students agreed or strongly agreed that it was easy to see the colour coded boxes in a tutorial.

The overall results from this group of students were very positive with only 16% of students who didn't feel very confident using the software, which equates to three students.
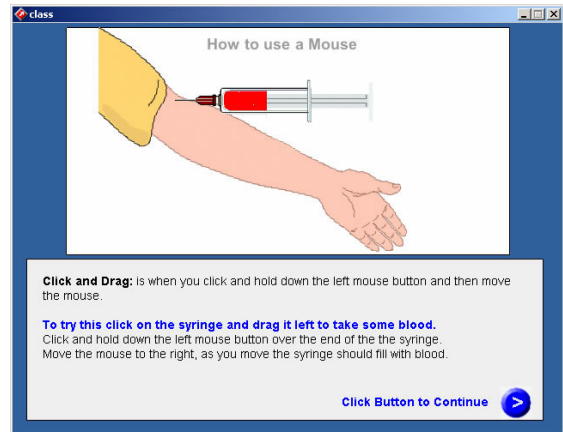

Figure 4

Usability Evaluation:

A usability evaluation team of educators completed a very detailed 85 question 'mixed method' [19] questionnaire that aimed to combine qualitative and quantitative methods, a full report on the usability and cognitive experiment are available in the OJNI paper. *'Computer Literacy and Skills System (CLaSS) A Software Development Project into Computer and Information Literacy for Nursing Students'* [20].

The comments from the questionnaires and the cognitive walkthrough session were collated into a list of recommendations. This list of recommendations led to modifications being made to the software prior release. CLaSS software was released onto the University of York computer network during the summer of 2001 and it was decided that a yearly student evaluation would continue for 3 years to monitor the usefulness and validity of the software.

Figure 5

Post Implementation Student Evaluation:

Year 1 Feb 2002: The first student evaluation took place approximately six months after the release of CLaSS software when a small group of 9 student nurses used CLaSS software on another taught study skills course. The questionnaire was changed to include more questions on the tutorials and less about the usability of the software.

The results were similar to the initial (pre-release) student evaluation with a few exceptions. 81% of students agreed or strongly agreed that the software was easy to navigate. 67% of students thought the software was easy to use compared to 89% in the initial evaluation. Tutorial questions found that 45% of students agreed that the Windows and Internet tutorials was hard but due to the small number of students evaluating the software this percentage equated to 3 students.

Year 2 Feb 2004: The evaluation of CLaSS software didn't continue until it was possible to have a significant number of students to evaluate the software. The use of CLaSS software was integrated into the University of York's Department of Health Sciences pre-registration nursing program with 73 students using CLaSS throughout the latter part of 2003. The concerns from the Year 1 (Feb 2003) group of students that the Windows and Internet tutorials were too hard was shown to be unfounded by this group with 87% disagreeing that the 2 tutorials were too hard. It was also interesting that 93% of the students thought that CLaSS was a useful resource.
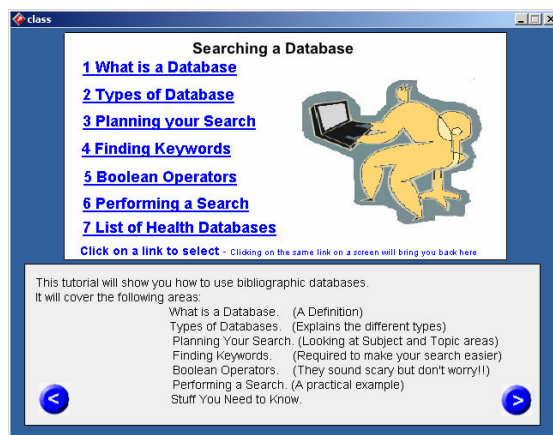

Figure 6

Year 3 March 2005: A final group of 100 students evaluated CLaSS in March 2005 finding that 86% agreed that the learning information in CLaSS was appropriate and 81% found the software easy to use.

Accumulative 3 Years Results
The accumulation of the 181 student evaluations and the 3 years have been collated with only the pre-release initial student evaluation being excluded because of the difference in questions and focus.

Summary of 3-Year Student Evaluation:

- 78% of students agreed or strongly agreed that they liked the introductory animation

- 83% found the software easy to navigate.

- 73% of students disagreed or strongly disagreed that the software was unnecessarily complex.

- 82% of students disagreed or strongly disagreed that it was hard to follow instructions in CLaSS.

- 82% of students agreed or strongly agreed that the various tasks in the software were well integrated.

- 68% of students disagreed or strongly disagreed that there was too much inconsistency in the software.

- 84% thought the use of images appropriate.

- 81% of students thought the software was easy to use.

- 67% of students disagreed or strongly disagreed that the software is very cumbersome to use.

- 71% of students agreed or strongly agreed that they felt confident using the software.

- 62% of students disagreed or strongly disagreed that they thought they would need help to use the software.

- 86% of students agreed or strongly agreed that they thought the learning information appropriate.

- 79% of students disagreed or strongly disagreed that it was hard to complete the MOUSE tutorial.

- 79% of students disagreed or strongly disagreed that it was hard to complete the KEYBOARD tutorial

- 80% of students disagreed or strongly disagreed that it was hard to complete the WINDOWS tutorial.

- 76% of students disagreed or strongly disagreed that it was hard to complete the INTERNET tutorial.

- 68% of students disagreed or strongly disagreed that it was hard to complete the DATABASE tutorial.

- 68% of students disagreed or strongly disagreed that it was hard to use the CLaSS database.

- 82% of students agreed or strongly agreed that CLaSS is a useful resource.

Post Study Integration:
Since completing the software development and evaluation, CLaSS software has been used by approximately 300 nursing students each year (2005 and 2006) and this is likely to continue into 2007. In early 2006 the Department of Health Sciences implemented a new pre-registration nursing curriculum and CLaSS was embedded into a first year module on Nursing Informatics & Evidence Based Practice. The rational for this was that much of

the module is dealing with computer and information literacy.

A revised and updated version of CLaSS software will be needed in the next few years as by the end of 2007 CLaSS software will be five years old. This is planned for when the University of York computer network changes from the Windows 2000 platform to a newer version of Windows.

Network platform tests using Windows XP were done by the University earlier this year (2006) on CLaSS with the software passing without problems. The University decided not to change from Windows 2000 in 2006 but it is likely to in the next couple of years. At that time CLaSS screen shots will need to be replaced and content updates will be made. At present there is no redundancy of content as the software was initially designed to be as future proof as possible.
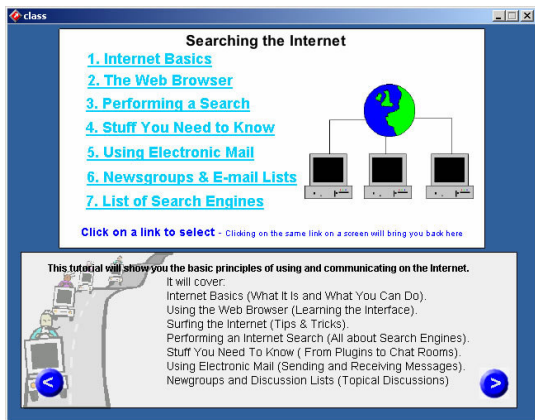

Figure 7

Conclusions:

The initial objectives of the evaluation of CLaSS software was to identify the level of computer skills that nursing students had and then continue to examine if CLaSS software was useful and viable as a tool to assist students with computer and information literacy. The evaluation results have clearly shown that students feel they benefit from access to this software and that has continued throughout 2006 and will continue in 2007.

In an attempt to balance the student learning experience CLaSS software was designed, developed and rigorously tested according to the strict development protocols outlined within this paper.

Educators, nurses and students have successfully evaluated the resulting software and the analysed data formed conclusive proof of the validity of the software It seems that even when the expectations of undergraduate students are that they are highly computer skilled and information literate, there is still the need to have access to some form of computer literacy software such as CLaSS and that students value such resources.

CLaSS software can be seen at www.classsoftware.co.uk

Full 3-year evaluation results are available at: http://www-users.york.ac.uk/~ijc4/

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