Course Management Systems from a Usability Perspective

Indira Padayachee
Paula Kotzé
Alta van der Merwe

Abstract

The advent of the Internet and the World Wide Web has revolutionised practices in business, government, health, and education amongst others. In education, the Internet and World Wide Web opened new doors for teaching and learning, thereby affording educators an opportunity to deploy new teaching, learning and administration strategies and affording learners a rich learning experience. In South African higher education institutions, course management systems (CMSs) have been adopted, and are becoming increasingly popular among academics. However, much attention has been focused on the technology, namely the functionalities and tools offered by CMSs. Very little effort has been directed at understanding the usability properties of this class of software and the impact it may have on adoption of this type of software. This paper focuses on the evaluation of selected CMSs used in higher education by using specific usability criteria and principles as the basis for the evaluation. This usability inspection method is termed heuristic evaluation, which is performed 'as a systematic inspection of a user interface design for usability' (Nielsen 2005). Results pertaining to the heuristic evaluation of the selected CMSs will be discussed. This paper is part of a larger study that aims at generating knowledge about the interactive properties of CMSs.

Keywords: Heuristic evaluation, testing, evaluation methods, e-learning, course management systems

Introduction

Higher education institutions have witnessed an upward trend in the acceptance and adoption of course management systems (CMSs) by academic staff and students. While much attention has been focused on the technology and adoption rates of CMSs, little effort has been directed at understanding the usability properties of this class of software. The usability properties of CMSs should allow both teachers and learners to efficiently operate this interactive software, and should make provision for the performance of the intended learning activities (Ardito *et al.* 2006). According to Kruse (2000), the user interface of an e-learning system can become a barrier if it is not well designed, where users can become bewildered, lost or frustrated with 'confusing menus, unclear buttons or illogical links' (Costabile *et al.* 2007).

The purpose of this paper is to describe a heuristic evaluation (HE) of selected CMSs used in the context of higher education, based on specific usability criteria and principles developed by Nielsen (2005). The CMSs selected are all open-source e-learning applications reviewed by the University of KwaZulu-Natal as possible replacements for the existing online learning system OLS (in-house system) (Learning Management Systems Review, 2007). While propriety systems like Blackboard (formerly known as WebCT) (Blackboard 2009) are widely used, well-established, and support a large user-base, they are very costly. This has led to some universities, such as the University of KwaZulu-Natal, to migrate from propriety to open-source solutions (University of KwaZulu-Natal Learning Management System (LMS) Review 2008)**.**

Due to the absence of specific heuristics aimed at the evaluation of CMSs, a heuristic evaluation method based on the general heuristics proposed by Nielsen (2005) was chosen to evaluate the selected set of CMSs. This method is not only a quick and cost-effective technique, but it can also serve to supplement user testing in that heuristic evaluations can identify many usability problems that are not discovered by user testing (Nielsen 2007c). The usability problems identified as a result of this evaluation technique may be beneficial to designers of such systems, since these problems could be attended to in future versions of the software. The ultimate benefactors of heuristic and other usability evaluations of e-learning applications would be the primary stakeholders namely lecturers and students as they can work with ‘easy to learn’ and ‘easy to use’ systems.

In presenting the results of this research, we first provide the context of the research with the problem statement and research objectives in the next section, followed by the literature review, research methodology, findings and analysis, and answers to the research questions. The final section concludes the study by discussing the significance and limitations of this study, and makes recommendations for future research.

Problem Statement and Research Objectives

Minimal attention has been given to understanding the usability of course management systems, therefore the problem addressed in this research is the usability properties displayed by a selection of open-source course management systems designed for use in higher education institutions. The goal is to conduct a usability study by establishing compliance of selected open-source course management systems to usability principles using the heuristic evaluation method. The research objectives addressed in this research are the following:

- *Identify usability problems encountered when mapping Nielsen’s heuristics to selected open-source course management systems.*
- *Evaluate the effectiveness of heuristic evaluation for uncovering usability problems in interactive systems.*
- *Describe the characteristics of usability problems found by heuristic evaluation.*

Literature Survey

The introduction of the Internet and the World Wide Web has revolutionised business, government, health, and educational practices, amongst others. These technologies have impacted education by affording educators an opportunity to deploy new models and tools for teaching, learning and managing courses. Learners, on the other hand are given the opportunity to participate in active, independent, self–reflective and collaborative modes of learning (Kakasevski *et al*. 2008).

The South African government has acknowledged the role of information and communication technologies (ICTs) in transforming teaching and learning environments into 'an inclusive and integrated practice where learners learn collaboratively, engage in meaningful contexts and develop creative thinking and problem solving skills' (Government Gazette 2004).

E-learning is characterised as 'any time', 'any place' education using ICTs as delivery platform, and can address challenges such as congested education facilities, lengthy commuting time for teachers and students that live far from universities, and life-long education (Ardito *et al.* 2006).

E-learning systems/applications primarily used in higher education maybe categorised as course management systems (CMSs), learning content management systems (LCMSs), and learning management systems (LMSs):

- According to Horton & Horton (2003) a LCMS simplifies the task of 'creating, managing and reusing learning content, namely media, pages, tests, lessons and other components of courses'. This class of software does not provide testing capabilities, but may deliver tests created and administered by a test creation tool.

- A LMS is characterized as systemic in that it is 'the infrastructure that delivers and manages instructional content, identifies and assesses individual and organizational learning or training goals, tracks the progress towards meeting those goals, and collects and presents data for supervising the learning process of an organization as a whole' (Szabo & Flesher 2002 cited in Watson & Watson 2007).

- CMSs are used primarily for online or blended learning in higher education, allowing lecturers to place course materials online, add registered students to courses, track student performance, allow for online submission of student assignments and projects and facilitate communication and collaboration with students as well as their lecturers (Watson & Watson 2007).

While each of these categories of e-learning software has a distinctive purpose and character, they share certain functionalities. CMSs are, however, the primary focus of this paper. Typical **c**ourse management systems include Blackboard (http://www.blackboard.com/), Moodle (http://moodle.org/) Atutor (http://atutor.ca/), Dokeos (http://www.dokeos.com/), Sakai (http://sakaiproject.org/) and several more (http://www.edutools.info).

Evaluating Usability of e-Learning Systems

Usability is defined as 'the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use' (ISO 9241 1997). According to Nielsen (1993), usability principles 'are generic guidelines that are applicable to all user interfaces' with the intention of making an interface user-friendly.

Usability evaluation studies assist in the acceptance and adoption of educational technologies and ultimately improve software users' productivity. There are several usability evaluation methods (UEMs) namely cognitive walkthroughs, heuristic evaluation, usability testing, surveys, interviews, and observational methods (Dix *et al.* 2004; Nielsen 1994). As mentioned previously, a heuristic evaluation method based on the general heuristics proposed by Nielsen (2005) was chosen to evaluate the selected set of CMS due to its cost-effectiveness and generic applicability to a wide range of applications. The next section discusses heuristic evaluation in more detail.

Heuristic Evaluation

'Heuristic evaluation (HE) is a discount usability engineering method for quick, cheap, and easy evaluation of a user interface design' (Nielsen 2005). According to Nielsen (2005) HE is a popular usability inspection method that is a systematic inspection of a user interface design against pre-specified usability criteria. The goal of this usability inspection method is to locate usability problems in the design to be addressed as part of an iterative design process. HE involves a small set of expert evaluators (with knowledge of usability engineering and system domain knowledge) who inspect the interface and determine its compliance with recognized usability principles (the 'heuristics') (Nielsen 2005). An advantage of HE is that it does not require evaluators to undergo training in the use of the target software. The evaluators are given sufficient time to familiarise themselves with the software and in addition evaluators are permitted to request information about the domain if they are non-domain experts (Nielsen 2007a).

Nielsen (2005) cautions that this technique does not provide a systematic method to solve usability problems nor does it suggest a way to assess the quality of any redesigns.

HE is mostly employed during development, but can be an effective technique with fully implemented systems. The research described in this paper used HE to uncover basic usability problems in selected CMSs, i.e. fully implemented systems. According to Nielsen (2007a) the responsibility for analyzing the user interface is placed with the evaluator in a heuristic evaluation session. During the evaluation session, the evaluator examines the interface numerous times, by closely inspecting the different dialogue elements and comparing them with a list of recognized usability principles (the heuristics) (Nielsen 2007a).

The ten general principles for user interface design are described in Table 1 (Nielsen 2005). They are called 'heuristics' because they are more in the nature of rules of thumb than specific usability guidelines. These heuristics served as the usability evaluation criteria for the CMSs.

Table 1: General User Interface Design Criteria (Nielsen 2005)

Heuristic	**Description**
1. Visibility of system status	Users should be kept duly informed on what the systems is doing, how is it reacting to user input and what is going on by means of system generated feedback.
2. Match between system and the real world	The system should speak the user's language that is terminology should be based on users' language for tasks; Meaningful icons, mnemonics and abbreviations should be used. In addition information needs to be presented in an intelligible manner.

3.User control and freedom	Users often make mistakes. They need to be able to confidently explore the system without the fear of irreversible damage. Systems should provide cancel, undo, quit, and redo functions.
4.Consistency and standards	Applications should have the same visual appearance throughout the system. Words, commands, actions have same effect in equivalent situations. The same controls should be used and should occupy the same location in all windows. The design should conform to interface standards.
5.Error prevention	Systems should be designed to eliminate or prevent the occurrence of errors by error checking mechanisms for example confirmation options.
6.Recognition rather than recall	Objects, information and actions should be visible or easily retrievable so as to minimise the user's memory load. For example the use of menus, icons, and choice dialog boxes promotes recognition over recall.
7.Flexibility and efficiency of use	Experienced users should be able to perform frequent actions quickly by the use of accelerators such as function keys, abbreviations, context menus, double clicking, navigation jumps to required window etc.
8.Aesthetic and minimalist design	There should be no irrelevant information in dialogues.
9.Help users recognize, diagnose, and recover from errors	There should be no codes in error messages, i.e. they need to be expressed in simple terms, clearly indicate the nature and location of the problem and indicate how it can be resolved.
10. Help and documentation	It should be easy to search for information, help should be focused on the user's task, concrete steps should be provided and documentation should not be too large.

Research Methodology

For this research a case study methodology was followed at the University of KwaZulu-Natal. The unit of analysis was selected open-source course management systems. Data was collected from three groups of evaluators using Nielsen's general 'heuristics' to evaluate the usability properties of selected CMSs. The participants constituting the groups were drawn from Information Systems & Technology honours students that were registered for the Human Computer Interaction module. Students organized themselves into groups for conducting the heuristic evaluation of a CMS. Each group was made up of 3 to 4 honours students. Nielsen (2007a) recommends the use of about five evaluators, with a minimum of three. The postgraduate students chosen to be evaluators in this study have studied and applied human computer interaction (HCI) at the undergraduate and post-graduate levels, and have experience with CMSs. This is consistent with Nielsen's (2005) recommendation that evaluators have experience with both applying HCI principles and with the domain.

The target CMSs selected for the purposes of this study was Moodle (http://moodle.org/), ATutor (http://www.atutor.ca/) and Dokeos (http://www.dokeos.com/). These are all open-source CMSs also known as e-learning platforms that were easily accessible for evaluation and were reviewed by the University of KwaZulu-Natal ICT department with a view to replace the current online learning system (OLS). The ICT administrator provided login access rights and user privileges to participants so that they could accomplish given tasks commensurate with a tutor or lecturer.

Each group of evaluators was required to perform a heuristic evaluation of a given CMS using Nielsen's ten heuristics as described in Table 1. Each member of the group was required to conduct and record the results of the heuristic evaluation separately. Once the individual evaluations were completed, the results were aggregated and documented in a report. This was in keeping with Nielsen (2007a) guidelines for conducting a heuristic evaluation, where individual evaluators examine the interface independently, and only after all individual evaluations have been concluded, are evaluators allowed to communicate and aggregate their findings. Based on the evaluation, groups were required to write a report on the usability of the given CMS, highlighting the usability problems uncovered together with respective severity ratings.

The heuristic evaluation was conducted using a task based approach. The lecturers and tutors have tasks to accomplish and the interface with which users directly interact should be oriented to these tasks (Dix *et al.* 2004). The real world tasks provided the basis for interaction with the respective systems with the aim of identifying usability problems. It is important to note that evaluators were mandated with identifying usability problems against a set of heuristics and not necessarily problems with respect to tasks performed. Consequently evaluators were given an opportunity to get clarification with respect to the tasks to be performed. In addition, the evaluators were given a month to familiarize themselves with the target systems before compiling a report.

Evaluators were given the following tasks to perform with the respective CMSs: register a course/module; publish simple text course outline; add and manage course participants; upload files; make announcements; conduct an online chat with course participants; create a group; conduct a group discussion; add an assignment online; create and share a blog; send an e-mail to course participants; and create a self assessment quiz. The evaluators cum students have prior experience of communicating via the threaded discussion forum, creating blogs, conducting online chats, uploading files, etc. with CMSs and other virtual learning software, and therefore had an understanding of the tasks performed.

An additional step in the heuristic evaluation process requires evaluat-ors to rate all of the usability problems identified. According to Nielsen (2007b) the rating can be done quantitatively using the following 5-point scale as depicted in Table 2. The evaluators were required to record the seve-rity of each usability problem using the 5 point scale listed in Table 2 in their reports. Table 5 presents a summary of the results of the severity rating.

Table 2: Severity Rating Scale for Usability Problems (Nielsen 2007b)

0	I don’t agree that this is a usability problem at all
1	Cosmetic problem only: need not be fixed unless there is extra time
2	Minor usability problem: fixing this should be given low priority
3	Major usability problem: important to fix, so should be given high priority
4	Usability catastrophe: imperative to fix this before product can be released

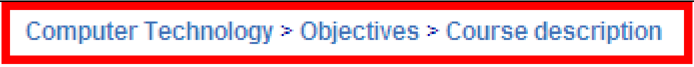
Findings

The heuristic evaluation results are organized and summarized in Table 3 according to heuristics used as the basis for the evaluation. A selected list of usability problems are presented here based on typical heuristic violations.

Table 3: Selected Usability Problems in Target CMSs

CMS	Usability Problem(s)
Visibility of System Status	
ATutor	When uploading a file the user is not aware of the progress of the upload.
Moodle	• No confirmation message when the 'save changes' button is pressed. • No status or progress bar to show the user the amount of time remaining until the file upload is complete.
Dokeos	After correcting error(s), the error box is still visible leading the user to believe that the system is processing an error.
Match between System and the Real World	
ATutor	The word 'Filter' is used to initiate the search function which is not consistent with real world conventions.
Moodle	• The keyboard icon preceded by a question mark is used to invoke the help documentation. A keyboard would not be usually associated with a help function. • The edit icon ('hand with a pen') is used to add a course participant, which is more suitable for editing or writing something.
Dokeos	The icons are confusing for example: • The build icon ('wand') is used for editing of questions for quizzes instead of the 'modify' (pencil) icon. • The spanner and screwdriver icons are used for 'course settings' are more suited to maintenance.
User Control and Freedom	
ATutor	Errors for e-mail messages appear on a new screen and do not support 'redo' (resend) once the error appears.
Moodle	• There are no exit points or undo/redo options available when uploading the file. There is no way of stopping the upload of

	an incorrect file without closing the browser. • The delete function also does not provide undo/redo.
Consistency and Standards	
ATutor	• There is no consistency when uploading a file. ‘File storage’ and ‘File manager’ are two ways in which a user can upload files. • The chat system looks totally different from the ATutor interface design and left the user feeling that an external chat was being used.
Moodle	• ‘File uploaded successfully’ feedback message is in red which is normally user to alert users to errors. • The word ‘beep’ is in blue indicating a hyperlink but it acts like a button, not consistent in terms of standards and has no affordance since the shape and attributes of an object should suggest what can be done with it. • No consistency in button layout throughout the application.
Dokeos	• A title to be filled for reply thread in a group discussion, instead of automatically filling it in with the original message topic title. • Creating a blog is not intuitive and does not match past experience with other blog displays on web. • The confirmation dialog for initial tasks used a green tick for actions successfully completed. However, when confirming addition of groups, a blue info icon and box is used.
Error Prevention	
ATutor	The create course form has no introductory instructions, which should state that fields marked with an asterix (*) are compulsory fields.
Moodle	• There is no error prevention for flooding the chat-room with messages which is a commonly banned practice in chat-rooms. • There is no error prevention for abuse of the alert function, ‘beep’.
Dokeos	Field length for course code is not displayed when inputting data.

Recognition rather than Recall	
ATutor	The system does not make certain actions visible.
Moodle	No ‘enter/send’ button to submit your message in chat rooms. One had to recall this from past experience with chat rooms.
Dokeos	 Computer Technology > Objectives > Course description Breadcrumb in the wrong order.
Flexibility and Efficiency of Use	
ATutor	• No provision for importing class list. • The system lacks accelerators such as shortcut keys or icons that allow for quicker interaction for more experienced users. Uses sub tabs for tasks instead of icons.
Moodle	• There are no accelerators available for the user to be able to find the option to create a group discussion quickly, or to add and manage participants. • The only way to edit or make the course outline in Moodle is via a ‘summary’.
Dokeos	• After creating a group the system does not allow you to select the participants for groups, rather it adds all registered course participants to the group. • The functionality for course editing or maintenance are spread over 3 different sections in the system.
Aesthetic and Minimalist Design	
ATutor	The announcements page is complicated with the display of a task bar that has no relation to making an announcement (user has to know how to disable task bar).
Moodle	Creating a question for the quiz has too many options.
Help Users Recognize, Diagnose, and Recover from Errors	
ATutor	Although the error message for sending e-mail allows the user to recognize that an error has occurred, it does not diagnose the error, nor does it suggest how to solve the problem.
Moodle	Clicking on ‘path’ in the summary section produces an error message, which does not help to diagnose or correct the problem.
Dokeos	Error messages are simple and forgiving, but they are generic and do not point out error or suggest ways in which to correct them.

Help and Documentation	
ATutor	Help provided to send an email is not goal oriented and does not provide sufficient information for a user to complete this task.
Moodle	• There is no task specific help for many of the options on the quiz questions for example terms such as ‘Grade’ and Type are not appropriately defined. The ‘Go’ button does not provide a tooltip to inform the user where they will be taken and what will happen. • A user must understand how hyperlinks work because once you find the e-mail address you have to click on it to mail.
Dokeos	There is very little help provided with respect to a specific task. There are no step-by-step instructions. Even when help is provided the terms are not consistent with the actual system.

Analysis

The usability problems presented in Table 3 were encountered by the evaluators performing the designated tasks that are commonly performed by tutors or teachers. Hence they represent typical problems or difficulties that would be experienced by users of target CMSs. According to Nielsen (2007a), ‘heuristic evaluation aims at explaining each observed usability problem with reference to established usability principles’. Based on the results of the usability evaluation, designers can make the necessary revisions to the system in accordance with the guidelines provided by violated principles for good interactive systems. In addition, there may be many instances where the fixes to usability problems are obvious and easily implemented as soon as they have been identified (Nielsen 2007a). Melton (2004) conducted a heuristic evaluation of Moodle and reported the following violations of Nielsen’s (2005) heuristics: Visibility of system status (‘dependent on the browser’s signals for status’); consistency and standards (‘there may be some variation in consistency across modules’; ‘problem with links’; ‘Navigation is a problem in forums’); error prevention (‘only one prevention mechanism located’); help and documentation (‘no help available from the main page, users need to go into a section’).

Analysis took the form of document analysis which in this instance was evaluators’ reports on the usability of systems. Each group of evaluators recorded the aggregated findings of heuristic violations for a course management system in a report based on the performance of the same set of designated tasks.

Table 4 presents a count of the distinct usability problem types found with reference to heuristics for each of the target CMSs, together with total heuristic violations.

Table 4: Number of Distinct Usability Problem Types for each CMS

Heuristics	**ATutor**	**Moodle**	**Dokeos**
1. Visibility of system status	1	3	1
2. Match between system and the real world	1	2	1
3. User control and freedom	1	1	-
4. Consistency and standards	3	3	3
5. Error prevention	1	2	1
6. Recognition rather than recall	2	1	1
7. Flexibility and efficiency of use	1	2	6
8. Aesthetic and minimalist design	2	2	-
9. Help users recognize, diagnose, and recover from errors	1	2	1
10. Help and documentation	1	3	1
Total	14	21	15

It should be noted that the number of distinct usability problem types for each CMS cited in Table 4 is a reflection of the evaluators' experiences with specific functionality in the system. Furthermore the count of distinct usability problems in Table 4 did not incorporate repeated occurrences of the same error due to the fact that this was not consistently recorded for each of the ten heuristics in all three reports. Hence the number of distinctive usability problems listed in Table 4 was based on illustrations and discussion of violations cited in the reports, and which were accompanied by a severity rating. It should also be emphasized that the heuristic violations only relate to the functionality of the system involving the pre-defined tasks and not to the systems as a whole. This would explain the low figures of usability problems presented in this research.

The summary data provided in Table 4 provides insight into the scope and degree of usability problems across established usability principles for the target CMSs. For example, evaluators of Dokeos reported a higher incidence of violations of the heuristic ‘flexibility and efficiency of use’ than any other heuristic. This summary helps designers when prioritising and taking corrective action for usability problems.

According to Nielsen (2007b), compilation of severity ratings of usability problems will indicate the order in which usability problems need to be addressed. Accordingly, evaluators’ severity rating scores of 1-2 (cosmetic to minor) were categorized as minor problems, and scores of 3-4 (major to usability catastrophe) were categorized as major problems. Table 5 presents the counts, as well as associated percentages pertaining to major and minor problems for each CMS.

Table 5: Severity of Usability Problems for CMSs

Severity Level	**ATutor**	**Moodle**	**Dokeos**
Minor Problems (1-2)	8	7	5
Minor Problem %	57%	33%	33%
Major Problems (3-4)	6	14	10
Major Problem %	43%	67%	67%

An analysis of the findings of the severity rating evaluations for each CMS follows:

- **ATutor:** ATutor has a few major usability issues when applying the heuristics to the system. In the main, a few cosmetic and minor changes are required for addressing usability problems with severity ratings of either 1 or 2. The major usability problems were associated with the following heuristics: ‘user control and freedom’, ‘consistency and standards’, ‘help users recognize, diagnose, and recover from errors’ and ‘recognition rather than recall’.

- **Moodle:** Evaluators reported a few minor and cosmetic problems that needed improvement, particularly with reference to the heuristic ‘consistency and standards’. Several major problems were identified as important to fix, and as such should be given high priority. These major usability problems were noted with reference to the following heuristics 'user control and freedom', 'flexibility and efficiency of use', 'help users recognize, diagnose and recover from errors', 'help and documentation'.

- **Dokeos:** The evaluators reported that the system displayed high conformance for heuristics 'error prevention' and 'aesthetic and minimalist design'. In addition the heuristic 'recognize rather than recall' enjoyed support via the use of visual tools and the breadcrumb technique. While the choice of icons did not comply with the heuristic 'match between system and real world' the system offered in some instances labels, and tooltips that provided clarity to the icons. The major problems were related to the heuristics 'flexibility and efficiency of use', 'consistency and standards' and 'help and documentation'.

Answers to Research Questions

This research has been motivated by a desire to understand the usability properties of CMSs. To this end, the usability properties of three selected CMSs (ATutor, Moodle and Dokeos) were investigated using the heuristic evaluation method.

This section discusses how the findings contribute to answering research questions corresponding with the research objectives outlined for the study.

- *What usability problems were encountered when mapping Nielsen's heuristics to selected open-source course management systems?*

The output of the HE is a list of the usability problems associated with each of the ten heuristics used as the basis for the evaluation of the target systems (refer to Table 3). This is consistent with the logical outcome of conducting heuristic evaluations whereby 'usability problems in the interface' are identified 'with reference to usability principles that are violated by the design' (Nielsen 2007a).

- *How effective is heuristic evaluation for uncovering usability problems in interactive systems?*

Heuristic evaluation, based on the basic heuristics defined by Nielsen (2005), has proved effective as a technique in uncovering several usability problems in interactive systems, in this instance CMSs. Evidence of the effectiveness of this technique is borne by the number and range of usability problem types discovered. According to Nielsen (1992), a heuristic evaluation is likely to be more successful when conducted by individuals who have knowledge of usability engineering and the system domain. A summary of the number of distinct usability problem types for each heuristic in each of the target CMSs was tabulated in Table 4.

Martin *et al.* (2008) performed a comparative usability study, using Nielsen's heuristics, of dotLRN, Moodle, and Sakai e-Learning platforms using Nielsen's heuristics, and reported the following percentage compliance to usability checkpoints: dotLRN 78%; Sakai 77%, and Moodle 68%. Since heuristic evaluation is a subjective technique, it is likely that different evaluators acting independently may discover both similar and dissimilar usability problems. This is consistent with the goal of heuristic evaluation, which is to uncover as many usability problems as possible. The findings of Martin's *et al.* (2008) study and results of this research illustrate the need for designers to pay more attention to the usability properties of course management systems.

A study that compared two evaluation methods namely heuristic evaluation and survey evaluation in evaluating *Info3Net*, which is the course website for *Information Systems 3* students, was conducted at Walter Sisulu University (WSU) in East London. The study involved both experts and students as evaluators. The study included a category on general interface design criteria based on Nielsen's heuristics. For this category, 4 usability experts using the HE method identified 38 problems, compared to 37 usability problems identified by 61 learners (survey method) (Ssemugabi & De Villiers 2007). This evidence from this empirical study relating to general interface design supports the effectiveness of the heuristic technique in that a similar number of usability problems can be identified with fewer resources expended.

- *What are the characteristics of usability problems found by heuristic evaluation?*

Table 5 provided detail on the percentage of minor and major problems encountered in each CMS. The findings as reported by evaluators' performing pre-defined tasks indicate a higher proportion of major problems for Moodle and Dokeos than for ATutor. Major problems for each of the target systems were associated with specific heuristics described in Table 1. There were several instances of the same usability problem as expert evaluators undertook different tasks, for example, lack of accelerators or shortcuts, inconsistent choice of colours for displaying positive versus negative feedback, poor choice of icons to match real world actions and so on. On the other hand, some heuristics were generally well-supported, but surfaced as a major usability problem in a single location. There was evidence of poor structure or organization of functionality, as was an absence of visual tools such as icons. This is in accordance with Nielsen (2007c) that 'usability problems can be located in a dialogue in four different ways: at a single location in the interface, at two or more locations that have to be compared to find the problem, as a problem with the overall structure of the interface, and finally as something that ought to be included in the interface but is currently missing'.

Conclusion

Some of the limitations pertaining to this research are the use of only one usability evaluation technique namely heuristic evaluation, the use of only generic heuristics (as opposed to domain specific heuristics), and the use of a small group of evaluators (3-4) for each target system. In order to overcome these limitations, recommendations for future evaluations include an increased number of evaluators for heuristics evaluations; the use of surveys to include a wider testing audience including undergraduate students; and the use of usability testing to provide more comprehensive testing of CMS software aimed at uncovering and reporting a wider spectrum of usability problems. Another limitation is the lack of literature with regards to heuristic evaluation of course management systems as noted in the introduction. This meant that an analysis or comparison of heuristic evaluation results across course management systems, both propriety and open source, was not tenable. The need for domain specific heuristics to evaluate CMSs is of utmost importance and the establishment of such heuristics is acknowledged.

The significance of usability studies is that it highlights usability problems which system designers can use for improvement or correction in future revisions of the product. Hence usability evaluations play a critical role in the human-centred design process. Furthermore usability studies provide information on the usability properties of interactive software, which helps organizations to make more informed decisions when selecting CMSs for adoption. The ultimate goal is to provide an improved user experience and user satisfaction for this class of software.

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Indira Padayachee
School of Information Systems & Technology (UKZN)
and School of Computing (Unisa)
padayacheei@ukzn.ac.za

Paula Kotzé
CSIR Meraka Institute
and School of ICT, Nelson Mandela Metropolitan University
Pretoria, South Africa
paula.kotze@meraka.org.za

Alta van Der Merwe
CSIR Meraka Institute
and University of South Africa
Pretoria, South Africa
alta@meraka.org.za