Usability Evaluation of a Medium-sized ERP System in Higher Education

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Abstract: The critical importance of Enterprise Resource Planning (ERP) systems in modern business has created a demand for ERP consultants with the appropriate competencies to implement, maintain and support these systems. Education and training programmes have been implemented in order to provide ERP specialists and graduates with the required industry relevant ERP competencies. The majority of these education and training programmes utilise large ERP systems for instructional purposes, however users of these systems encounter usability issues whilst learning to use the systems. The use of medium-sized ERP systems has been proposed for educational purposes as they are less complex and easier to learn than large ERP systems. Empirical studies on the usability of ERP systems, particularly for medium-sized ERP systems are limited. This paper reports on empirical research on the usability evaluation of a medium-sized ERP system. The study identified three categories of criteria and 10 criteria which can be used for usability evaluations of medium-sized ERP systems. The criteria were used in a case study to evaluate the usability of a medium-sized ERP system and to obtain qualitative feedback on the usability of the system. The most frequently reported positive usability features of the ERP system were the tree-structure of the menus and the grouping of logically related items. Negative features which were reported included the clutter of the user interface and difficulties with finding information and controls. These results can provide valuable insight into the ERP learning process for university educators and researchers. The usability evaluation results can assist ERP designers with improving ERP usability, which can improve the quality of ERP training and education programmes and ultimately ERP project success. The usability evaluation results provide considerable insight into the usability problems encountered by students when learning to use ERP systems in their university courses and provide a valuable contribution to usability theory and in particular frustration theory.

Keywords: ERP usability, learning ERP; navigation of ERP systems; ERP education; ERP system evaluation

1. Introduction

An Enterprise Resource Planning (ERP) system is defined as 'a highly unified, consolidated and reliable network of business systems, built on a single integrated platform' (Vaman, 2007). The removal of barriers to sharing information between functional divisions and the holistic management of processes have enabled ERP systems to increase the operational processes, profitability and productivity of organisations (Magal and Word, 2012; McGauhey and Gunasekaran, 2007). In spite of the economic recession over recent years, ERP systems are dominant in the marketplace and this trend is expected to continue (Forrester, 2011). Small to medium enterprises (SME) have implemented ERP systems and vendors have introduced less complex, medium-sized ERP systems such as Sage, SYSPRO and Softline Accpac, to suit the requirements of these organisations. Large ERP systems are often too sophisticated and complex for smaller organisations, although vendors such as SAP and Microsoft have introduced new or scaled down versions aimed specifically at the SME market (Winkelmann and Matzner, 2010).

ERP implementation success can be affected by the level of appropriate specialised competencies within the ERP project team (Ifinedo and Nahar, 2009; Rothenberger et al., 2010). Organisations that recruit ERP specialists require graduates who have industry-relevant ERP competencies. The ERP competencies related to the various ERP systems must be acquired by ERP specialists and graduates of undergraduate Information Systems (IS) degrees, in order to implement and support business applications (Boyle and Peslak, 2010; Scholtz et al., 2011). An increased demand for ERP specialists with the appropriate competencies exists internationally (Beer, 2010; Law et al., 2010; Ngai et al., 2008) and in South Africa (Scholtz et al., 2011; Seymour et al., 2006).

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In response to the demand for ERP specialists, several ERP training and education programmes have been developed which incorporate ERP systems for instructional purposes (Hustad and Olsen, 2011; Seethamraju, 2007; Surendran and Somarajan, 2006). However, the practical use of the ERP systems in these educational programmes is often accompanied with students experiencing learning difficulties when learning to use these complex ERP systems (Seethamraju, 2007; Theling and Loos, 2005) which are not designed to support teaching (Shtub, 2001). Surendran and Somarajan (2006) reported that the adoption of an ERP system in the curricula in higher education improved student competencies but the ease of use of the ERP system was rated poorly by the students. Another study by Seethamraju (2007) showed that students had an improvement in transactional competencies but struggled to understand the underlying business process flow of the ERP system tasks due to the complexity of the user interface. Studies into the usability of ERP systems used by students in higher education can improve the usability of these tools.

Several studies in industry have revealed that the complexity of ERP systems has resulted in user interfaces (UIs) which suffer from poor usability (Singh and Wesson, 2009; Yeh, 2006) and user frustration (Matthews, 2008; Topi et al., 2005). The poor usability makes it difficult for users to interact with the ERP system and to complete required tasks, which further impacts the time taken to learn the system (Topi et al., 2005). Usability problems with ERP systems, similar to those reported in industry, have also been encountered by training and education institutions (Surendran and Somarajan, 2006). The learning curve for students is usually steep as students have to master the many menu paths within a single ERP system (Theling and Loos, 2005). Studies of ERP system adoptions in higher education programmes have reported that medium-sized ERP systems are less complex and easier to use than large ERP systems (Hustad and Olsen, 2011; Winkelman and Matzner, 2010). However these studies have been largely qualitative.

The potential benefits of ERP systems for organisations can be increased by improving the usability of ERP systems which can, in turn, reduce the length of the training time and increase employee user satisfaction (Topi et al., 2005). Continued research into the improvement of ERP system's usability is required in order to provide user interfaces for ERP systems which are easy to use, easy to learn and support the user's tasks. In particular field studies which focus on users' perceptions of ERP systems are required which can improve the understanding of the factors that affect usability. Research into improving the usability of ERP systems in education is required in order to address the complexity and learning curve problems of ERP systems.

Usability evaluation is any analysis or empirical study of the usability of a prototype or system (Foltz et al., 2008). Several studies (Costa, 2010; Singh and Wesson, 2008; Van Norren, 2009) have proposed usability criteria which can be used for usability evaluations of ERP systems. However all of these studies have taken place in industry and not in a higher education environment. The level of experience of an undergraduate student is not the same as a person in industry, therefore their perceptions of usability may differ. Existing studies of ERP adoption in the IS curricula are focused primarily on the pedagogical aspects and have not explored the usability or ease of use of the ERP system. Empirical research relating to the ease of use or usability of ERP systems is required (Topi et al., 2005), particularly with regards to the evaluation of the ease of use of medium-sized ERP systems in educational environments (Hustad and Olsen, 2011).

This paper investigates how IS students experience the usability of a medium-sized ERP system which forms part of an IS educational program. The investigation aims to propose a set of usability criteria for evaluating the usability of ERP systems used for instructional purposes and to report on the usability evaluation of a medium-sized ERP system using these criteria. The usability criteria are intended to support the identification and classification of usability issues that occur while learning to use ERP systems in higher education. This paper will contribute to the improvement of the usability of ERP systems for students who need to use these systems as part of their undergraduate IS courses. The investigation aims to address the following research questions:

1. *What usability criteria and heuristics can be used to evaluate the usability of a medium-sized ERP system during the learning process?*
2. *How do students rate the usability of a medium-sized ERP system whilst learning to use it?*
3. *What features of the user interface of a medium-sized ERP system do students like the least and which features do they like the most?*

This paper is structured as follows: Section 2 will discuss ERP systems and ERP usability criteria and heuristics used in usability evaluations. Section 3 will explain the research methodology adopted and the participants involved in the study. The results of the study are presented in Section 4 while Section 5 analyses and discusses the findings. Conclusions and recommendations are made in Section 6.

2. Usability criteria for ERP systems used in the learning process

In the late 1990s, many organisations that had not previously adopted ERP systems became motivated to do so because of the Y2k problem and the introduction of the Surbanes-Oxley Act in 2002 (Vaman, 2007). The Surbanes-Oxley Act legislates that top management are now liable for certifying the accuracy of financial information (Monk and Wagner, 2009). Several reports have cited the growing dominance of ERP systems in the business, academic and medical community (McGauhey and Gunasekaran, 2007; Mohamed and McLaren, 2009). Even small to medium-sized organisations have implemented ERP systems (Esteves, 2009; Koh et al., 2009). Despite the current economic and business climate, there is still a positive forecast for the ERP market and according to a report from Forrester, the global ERP system market will increase to $50.3bn by 2015 (Forrester, 2011).

Shaul (2005) proposes that an ERP system can be classified according to the size of the organisation that it is designed to support. There are four tiers in this classification with Tier 1, the Enterprise level, addressing the needs of the largest organisations with incomes of over $200 million (Figure 1). Tier 1 ERP systems include SAP, Oracle, Microsoft and SageERP (SYSPRO, 2010). Vendors have also introduced medium-sized ERP systems which are specifically designed for organisations in Tier 2 (upper mid-market) and Tier 3 (lower mid-market). Organisations in Tier 2 are usually in the $20 million to $200 million income bracket and ERP systems in this tier include those in Tier 1 as well as SYSPRO, Softline ACCPAC, SAP Business All-In-One and others. Tier 3 software is designed for single site organisations of under $40 million income and with five to 30 users. ERP systems for small to medium organisations are classified as Tier 4 software which are comprised of basic accounting systems such as Pastel, Accpac and Quickbooks.

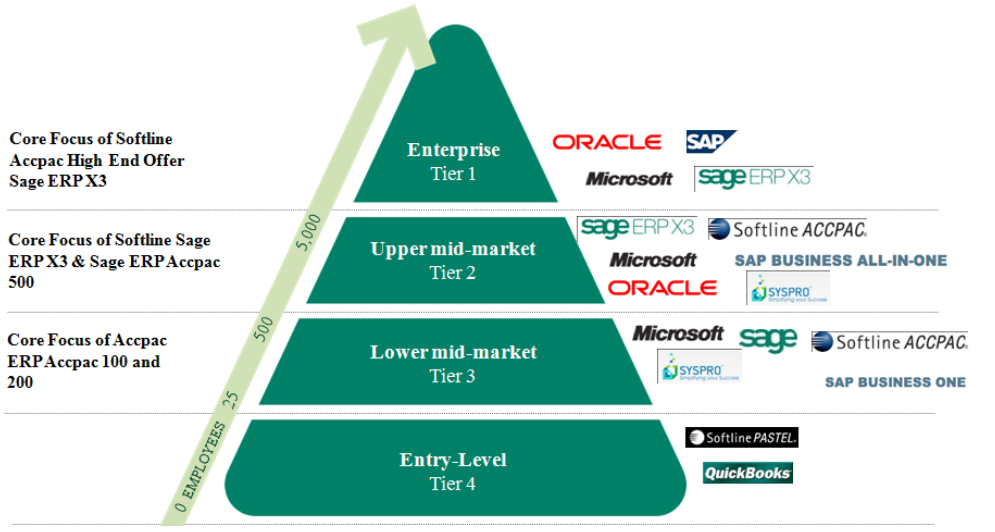

Figure 1: ERP Systems by Tier (SYSPRO, 2010) {Figure not referred to in the text?}

The global demand for ERP systems has increased the demand for ERP competencies and several IS education programmes have adopted the hands-on use of ERP systems for instructional purposes with successful results (Hustad and Olsen, 2011; Wang et al., 2009). Surendran and Somarajan (2006) report that the market value of students increases when exposed to an ERP system that has a high market share. A large percentage of studies exposing students to the hands-on use of an ERP system, reported an improvement in knowledge by the students and positive learning outcomes (Surendran and Somarajan, 2006; Wang et al., 2009; Winkelmann and Leyh, 2010). However, the adoption of ERP systems in education programmes is often hindered by the poor usability of complex ERP systems (Surendran and Somarajan, 2006).

Several studies on the use of ERP systems in industry, report on their poor usability (Singh and Wesson, 2009; Yeh, 2006) and difficulties with learning to use these systems (Topi et al., 2005). Similar findings are reported in higher education, where students find that ERP systems are a challenge to learn and the complexities of the UI often force them to focus on the completion of the tasks without understanding how the tasks contribute to the underlying business concepts (Wang et al., 2009; Winkelmann and Leyh, 2010).

Working with medium-sized ERP systems that are less complex than large scale systems such as SAP can still provide students with an understanding of the basic capability of an ERP system (Ask et al., 2008; Hustad and Olsen, 2011; Winkelmann and Leyh, 2010). This alleviates the problem of student frustration encountered while learning the ERP system (Scott and Walczak 2009). The Hustad and Olsen (2011) study reported that students were more satisfied with the lower learning curve of the Microsoft Navision ERP laboratory assignments compared to the assignments on the large, complex SAP system. Microsoft Navision is a Tier 2 ERP system and therefore classified as a medium-sized ERP system.

The usability of a system has been defined by the International Organisation for Standardisation (ISO) 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, 1997). This standard identifies the three criteria of usability as the *effectiveness, efficiency* and *satisfaction* with which users within the organisation are able to accomplish their task before selecting a final solution. Nielsen (1993) describes usability as: "*the quality attribute that assesses how easy user interfaces are to use"*. According to Nielsen (1993) the components (or criteria) of usability are learnability, efficiency, memorability, errors and satisfaction.

Studies of ERP system usability evaluations propose several usability criteria which can be used in the evaluation process (Costa, 2010; Van Norren, 2009). Usability criteria can be used to analyse the user experience and can help reveal patterns that may be hard or even impossible to see (Tullis and Albert, 2008). A usability criterion can be converted into several related heuristics which are guidelines or general principles that can guide a UI design decision or that can be used to evaluate a decision that has already been made (Nielsen, 1993). A literature review of studies of usability evaluations was undertaken with particular reference to ERP system usability evaluations and the criteria and heuristics used for these evaluations. Three criteria for testing the usability of open-source ERP systems in industry were proposed by Costa (2010) are the three proposed by ISO (1997) namely: effectiveness, efficiency and satisfaction. In another study of ERP systems usability in industry, Van Norren (2009) used the criteria of learnability, efficiency, memorability, errors and satisfaction; however the focus of this study was on cultural differences with regards to usability.

A study by Singh and Wesson (2009) identified existing usability issues with a medium-sized ERP system, SAP Business One, by means of a heuristic evaluation using five categories of criteria, namely: navigation, presentation, task support, learnability and customisation. The Singh and Wesson (2009) study was the only study found which proposed and validated usability criteria for medium-sized ERP systems, and each of the five criteria recommended in this study is supported by several other studies. *Navigation* has been reported as a primary design issue in several other ERP usability studies (Calisir and Calisir, 2004; Mathews, 2008; Surendran and Somarajan, 2006; Topi et al., 2005), besides the Singh and Wesson (2009) study and can therefore confidently be used as a criterion for evaluating the usability of ERP systems. Navigation problems have been identified as one of the main barriers that prevent ERP systems from delivering their potential benefits to organisations (Matthews, 2008). The criterion of *Navigation and Access to Information* and its related heuristics aim to determine the ability to identify and access appropriate information, menus, reports, options and elements accurately and effectively. *Presentation of Screen and Output,* and its related heuristics aim to determine the appropriateness of the layout of the ERP system menus, dialogue boxes, controls and information on the screen for data entry and output generation (Singh and Wesson, 2009). Issues identified in usability studies of ERP systems relating to presentation include problems with the complexity of the screen display and problems in understanding and interpreting output from the ERP system (Costa, 2010; Singh and Wesson, 2009; Topi et al., 2005; Wang et al., 2009; Winkelmann and Leyh, 2010). The presentation criterion for ERP systems include consideration of how well the visual layout is designed.

Learnability is the criterion used to determine the degree of effort required to learn how to use the system efficiently and effectively (Nielsen, 1993; Preece et al., 2006) and can be used as one criterion to evaluate ERP system usability (Singh and Wesson, 2009; Wang et al., 2009; Winkelmann and Leyh, 2010). Learnability is one of the most important criteria of usability and refers to the capability of the system to enable the user to learn to use the application (Nielsen,1993). *Customisation* relates to the ability of the ERP system to be customised according to the specific needs of an organisation (Singh and Wesson, 2009). Customisability is a measure of the extent which the system can be adapted, either by the user or by the system. *Appropriateness of Task Support* aims to establish if there is an accurate alignment between the system and the real world, in order to ensure effective task support and efficient task completion (Singh and Wesson 2009).

The results of the literature review as well as an analysis of the five criteria proposed by Singh and Wesson (2009) revealed that three of these criteria are most suited for evaluating the usability of ERP systems used for instructional purposes in introductory ERP courses, namely navigation, presentation and learnability (Table 1). These three criteria were validated in the highest number of related studies in similar environments. A further motivation for eliminating the criterion of task support was due to the fact that the tasks performed by the students are prescribed by the instructor and are therefore mandatory. In addition students are novices in terms of business task knowledge so are not qualified to rate the system in terms of task support. Since customisation tasks are generally not included in introductory ERP education programmes, the criterion of customisation is also not required for evaluating ERP systems in education

Table 1: ERP Usability Criteria (Adapted from Singh and Wesson, 2009)

NAVIGATION
Navigation and Access to Information
Information can be easily accessed Functionality can be found quickly and easily The user interface supports efficient and accurate navigation of the system There is a correlation between the searched item and the required item.
PRESENTATION
Presentation of Screen and Output
The visual layout is well designed The information provided by the system is timely, accurate, complete and understandable The layout of menus, dialog boxes and controls are easy to understand and interpret and are well structured
LEARNABILITY
Degree of ease to learn how to use the system effectively
A user can learn how to use the system without a long introduction The various functions of the system can be identified by exploration There is sufficient on-line help to support the learning process

3. Research context and methodology

The use of a combined case study and survey strategy was used to address the research questions listed in Section 1. The survey strategy was used by administering usability questionnaires to the students in order to gain empirical feedback. The case study strategy can penetrate situations in ways that are not always susceptible to numerical analysis and provide analytic rather than statistical generalisation (Benbasat et al., 1987). A case study strategy is particularly well-suited to IS research (Benbasat et al., 1987; Lee, 1989) and can be a useful tool for gathering requirements, evaluating interfaces and understanding how users complete tasks (Benbasat et al., 1987). Case studies often rely on multiple data sources and collection techniques to act as sources of corroborating evidence which can increase confidence in the data (Yin, 2003). Qualitative data and data analysis are usually emphasised in case studies and the focus is primarily on questions that help describe or explain behaviour and have considerable ability to generate answers to the 'Why?', as well as the 'What?' and the 'How?' questions. This makes it suitable for this study where the research questions relate to "What features of the user interface do students like/dislike? (RQ3)", "Why do students have problems with the usability of ERP systems?" and "How do students rate the usability of an ERP system? (RQ2)". The answers to the research questions are not purely quantitative values. The case

study strategy is therefore a suitable strategy to use for this study where the objective is to evaluate the usability of a medium-sized ERP system and in particular to identify the features (positive and negative) of the UI of a medium-sized ERP system.

A single case study approach was used for this research and the case study selected is the Nelson Mandela Metropolitan University (NMMU) in South Africa, where a Management Information Systems (MIS) course aims to establish a sound theoretical knowledge of management information systems and ERP systems, as well as the attainment of transactional competency of ERP systems. The three core competencies addressed in the ERP section of the MIS course are *Business Process Management (BPM); ERP Theory and Concepts* and *ERP Transactions.* The ERP system which was adopted into the course for instructional purposes was the medium-sized ERP system, SYSPRO, which has been identified as one of the best ERP solutions in the Tier 3 category (Kristine, 2011).

Students in the MIS course are required to attend three lectures and four practical sessions where they perform hands on tasks on the SYSPRO ERP system (Table 2). The practical sessions were one hour long and took place once a week for three weeks. Four usability questionnaires (P1 – P4) were administered to participants, one at the end of each practical session in order to obtain quantitative and qualitative feedback regarding the usability of the SYSPRO ERP system. All four usability questionnaires comprised of the same set of questions and consisted of two sections. The first section of the questionnaire required the participant to rate 10 usability criteria on a 5-point Likert scale. These criteria are grouped into the three usability criteria categories proposed (Table 1), namely: navigation, presentation and learnability. The second section of the questionnaire included several open-ended questions, which enabled the users to give feedback on their perceived positive and negative features of the SYSPRO system.

Table 2: Lectures and Practical Sessions in ERP

Week	Lecture	Competency	Practical Session	Research Instrument (Usability Questionnaire)
Week 1	Lecture 1	ERP Theory and Concepts	Prac 1	P1
Week 2	Lecture 2	Business Process	Prac 2	P2
Week 3	Lecture 3	ERP Transactions	Prac 3	P3
			Prac 4	P4

Face validity of the questionnaire was established since the questions were derived from and agreed on by literature, whilst content validity was confirmed by means of a pilot test where the research instruments were refined. Cronbach's alpha coefficients for the summated scores derived from the four usability questionnaires (P1 – P4) were calculated (Appendix A). Nine of the 10 criteria were within the acceptable range for Cronbach's alpha which means the internal consistency is high (Nunnally, 1978). Learnability in the usability questionnaires P1 (α = 0.55) and P2 (α = 0.6) obtained values in the range 0.50 to 0.69, the interval deemed acceptable in the early stages of basic research.

The only item which had a low Cronbach's alpha was presentation in P1 (α = 0.45). The related results should therefore be treated with caution. One sample *t* tests were performed (Rosenthal and Rosnow, 2008) on the usability ratings in order to calculate the significance of positive or negative scores, where the following interval ranges apply: Negative = [1 to 2.6); Neutral = [2.6 – 3.4]; and Positive = (3.4 – 5].

The research study, abided with the procedures of the Research Ethics Committee (Human) of the NMMU and ethical approval for this study was awarded by the NMMU Ethics Committee. In line with this, the researchers made explicit to the student participants that their interests would be safeguarded and that they would remain anonymous. The cohort of MIS students that consented to participate (*n* = 36) was a convenience sample and are representative of students that typically enrol in the course every year. The MIS course is a core module in a 3 year undergraduate IS degree. All the students are full time students with no industry experience. The data for 8% of participants (*n* = 3) was eliminated due to missing values, resulting in a sample size of 33 which could be used for analysis. The majority of participants (79%) fall in the age group 21 to 25 years and are female (Table 3). The fact that the majority of students in the sample were female could be considered as a possible limitation due to potential gender bias.

Table 3: Participant Profile

		n	%
Gender	Male	7	21
	Female	26	79
	TOTAL	**33**	**100**
Age	<21	3	9
	21-25	26	79
	>25	4	12
	TOTAL	**33**	**100**

4. Results

The analysis of the quantitative data (Section 4.1) revealed that participants viewed the usability of SYSPRO positively. A qualitative data analysis provided more in depth, rich content regarding the types of features which participants liked and disliked (Section 4.2).

5. Quantitative results

Six of the 10 usability criteria were rated in the neutral range, four were in the positive range and none were in the negative range (Appendix B), where the following interval ranges apply: Negative = [1 to 2.6); Neutral = [2.6 – 3.4] and Positive = (3.4 – 5]. A one-sample *t* test was performed on the four positive usability criteria to determine if they were significantly positive (Table 4). The highest rated criteria was *'There is a correlation between the searched item and the required item'* (μ = 3.83), and the second highest was *'Information provided by the system is timely, accurate, complete and understandable'* (μ = 3.75). These were the only two significantly positive rated criteria (where p <= 0.01) and are indicated in red in Table 4.

Considering the overall usability ratings for all four practical sessions (Figure 2), presentation had the highest score (μ = 3.51), with navigation second (μ = 3.44) and learnability lowest (μ = 3.33). Presentation and navigation both had scores in the positive range, whilst the learnability score was in the neutral range.

Table 4: Positive Usability Criteria for SYSPRO

Usability Criteria	Mean	t	d.f.	p-value
NAVIGATION				
There is a correlation between the searched item and the required item.	3.83	3.37	25	.002
PRESENTATION				
Information provided by the system is timely, accurate, complete and understandable.	3.75	3.24	25	.003
The layout of menus, dialog boxes, controls are easy to understand, interpret and are well structured.	3.50	0.93	25	.363
LEARNABILITY				
The various functions of the system can be identified by exploration.	3.42	0.13	26	.898

6. Qualitative results

Qualitative data analysis of the open-ended responses from the usability questionnaires, was performed using content analysis whereby the text is categorised or coded into themes or categories (Kolbe and Burnett, 1991). The text responses were analysed and coded according to themes where the three usability criteria were used as pre-existing (apriori) themes. Within these existing themes, content was analysed again and in more detail, coded and then similar codes were grouped into sub-themes. The number of responses per theme was then calculated in order to determine the highest and lowest frequencies within a theme. The responses related to the question regarding the features most liked were coded as "positive" responses (Section 4.2.1), whereas the responses to the question regarding the features least liked were classified as "negative" responses (Section 4.2.2). .

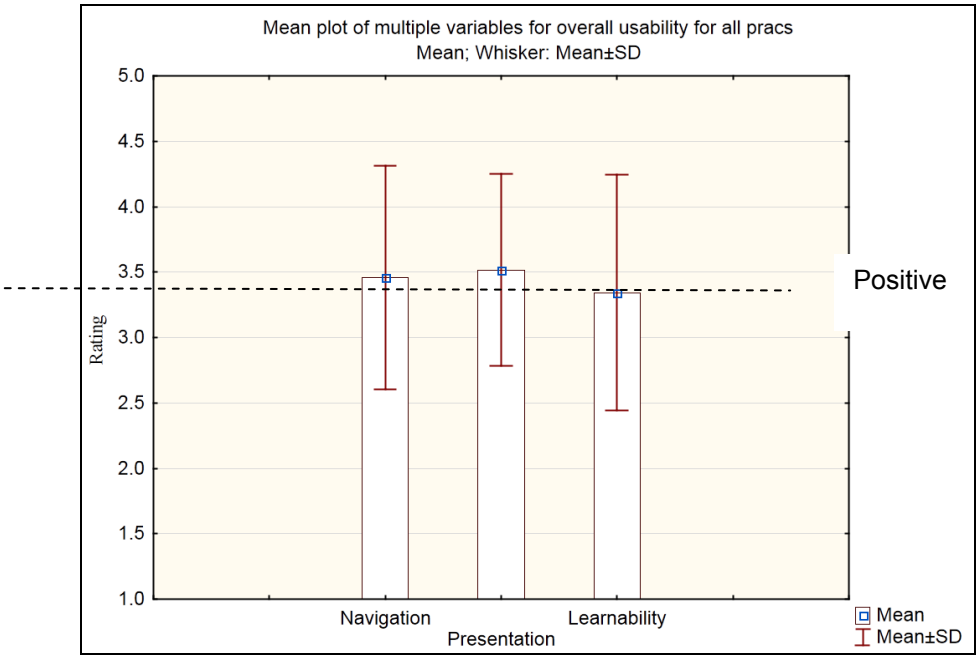

Figure 2: Mean Plot of Overall Usability for all Practical Sessions

7. Positive qualitative responses

The usability criterion which had the highest frequency of related positive responses was navigation. The most frequently rated features identified by the participants related to SYSPRO's main menu design and structure. The tree structure was cited by several participants as a positive feature which enabled easy navigation and drill down. One participant stated that '*The tree view menu let's you drill down to specific information very quickly',* whilst another participant liked *'The tree view on the left. It shows the programs that are used often (because of recently used items)'.*

Users also liked the general structure of the menu which enabled easy navigation and some examples of responses which related to this theme are:

- The menu structure is logically laid out and easy to navigate;
- All options (Accounts Payable, Accounts Receivable) are grouped into folders and tree structures, making navigation of the companies accounting records easy to obtain.

The usability criterion with the second highest count of responses for positive features was presentation. One aspect of presentation which the users liked was the layout of the SYSPRO interface. Several participants liked the logical layout and grouping of information and how structured various parts of the user interface are. One user reported that *'All information is grouped according to orders, suppliers and customer information, instead of having it all together.'*

The ability to hide information that is not being used was also reported as a positive feature in the presentation theme. Another user expressed this as follows, '*Information can be hidden or visible and as such if I don't want to see it but don't want to close it I can just hide it'.* Another aspect of the presentation criterion cited by participants is the attractiveness of the interface. The concept of attractiveness is similar to the concept of aesthetic and minimalist design identified by Nielsen (1994), a key criterion for UI design.

In the learnability theme, several users reported that they found SYSPRO's user interface familiar and similar to the Microsoft interface and that this assisted them with learning SYSPRO. One user stated that '*Menu bars and menu items are easy to understand. They are similar to other familiar applications' menus'.* Familiarity is a factor of learnability and is the extent to which a user's knowledge and experience in other real-world or computer-based domains can be applied when interacting with a new system (Compeau and Higgins, 1995).

8. Negative qualitative responses

Participants were asked to identify and describe one feature of SYSPRO that they liked the least. These are referred to as negative responses. The highest frequency of negative responses was related to the presentation criterion. Some participants expressed their difficulties with the cluttered UI and too many open windows, and some example comments in this theme are:

- Too many windows, every action performed seems to open another window;
- The way the windows seem to overlap. Creates a cluttering sense of being lost;
- Every time I had to cancel what I had opened I found that irritating as I could have many pages open.

One participant stated that '*For a first time user, the amount of menu/windows can be overwhelming. Creating an introductory interface for first time users would assist the learning curve.'* Some participants struggled to focus on more than one activity (screen, function, option), and reported confusion as a result of too many open windows, features and open tabs. As stated by one participant, '*The main window gets cluttered with all the open tabs. That will make a novice user of this program very confused'.*The second most frequent negative feature was related to navigation and in particular consisted of problems with the hidden controls in SYSPRO such as the tabs and scrollbar, which sometimes caused confusion of the users. Several participants struggled to find the relevant data, functions and controls, for example scrollbars, in screens such as the purchase order screen (Figure 3). Comments included:

- Hard to find something right in front of you;
- Can't always see the scrollbars;
- Having certain functions of the system hidden from the user, upon clicking they will appear, i.e. the automatic hide tabs;
- The tabs although useful for navigation sometimes, cause confusion when looking for specific information;
- The toolbar on the right side which is hidden when not used, I preferred it pinned.

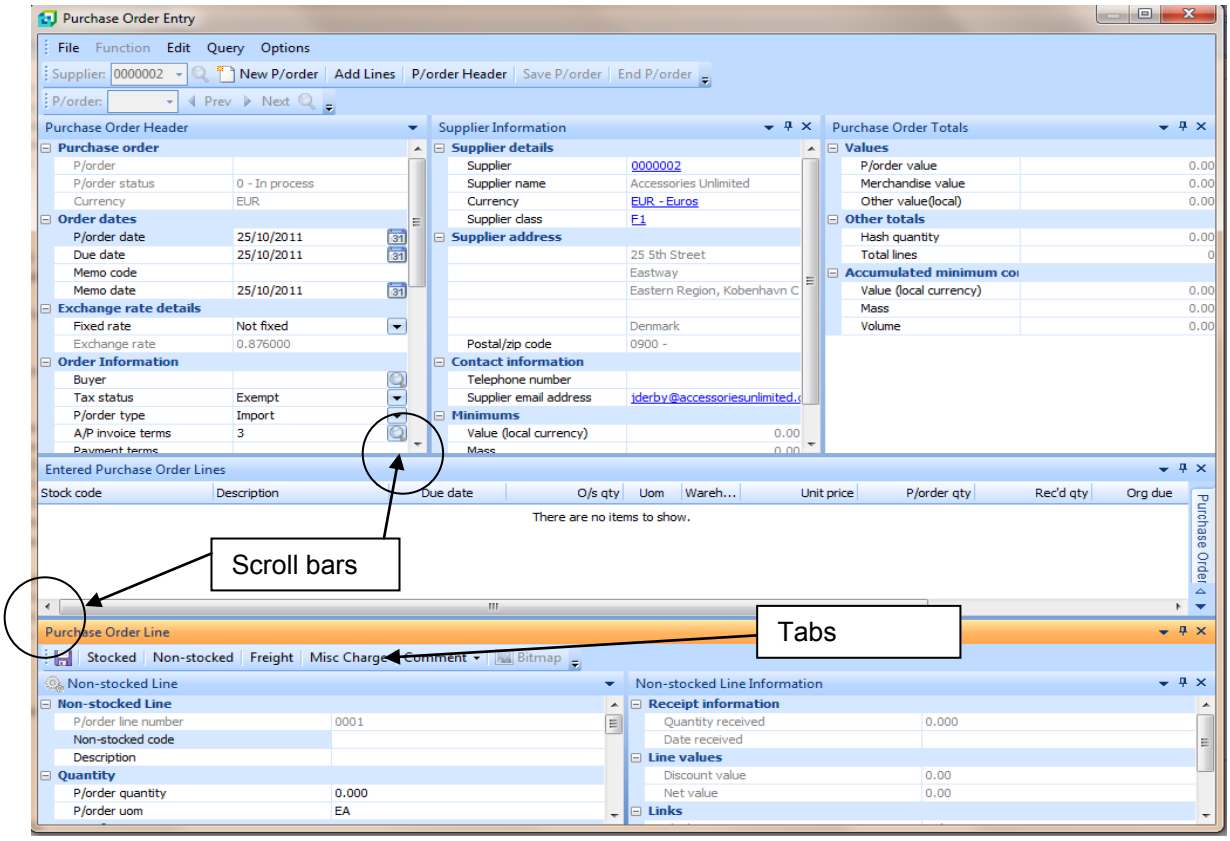

Figure 3: SYSPRO Purchase Order Entry Screenshot

Several problems related to the learnability criterion were reported, specifically to the lack of guidance provided by the system. One participant stated, *'Difficult to determine where to go and what to do the first time I used the system'.*

9. ERP design guidelines

The results of the usability evaluation of the medium-sized ERP system, Syspro, revealed that overall the aggregated quantitative usability criteria of presentation and navigation were rated positively. Learnability was the lowest criteria, but was still not rated negatively as the mean ratings were in the neutral range. However this could be improved so system developers and designers need to consider improving the learnability of ERP systems when designing them for instructional purposes. The highest rated issue related to the finding of required items which suggests that it is critical to consider this criteria and related heuristics when designing the UI of an ERP system.

Several qualitative negative responses related to the lack of guidance provided by SYSPRO were received which confirmed findings of a related study reporting that an introductory interface should be provided by an ERP system to cater for novice users learning to use the system (Topi et al., 2005), and that an ERP system should provide guidance for novice users in order to improve navigation (Surendran and Somarajan, 2006).

The most popular features of SYSPRO related to navigation and the main menu design and structure. The tree structure of SYSPRO's menu and its drill down feature was cited by several participants as a positive feature which enabled easy navigation. This confirms the principle that user interfaces should provide a tree view menu that enables drilling down to specific information very quickly (Shneiderman and Plaisant, 2005). A tree structure is recommended when a collection of menu items grows and becomes difficult to maintain under intellectual control. Designers of ERP systems should take into account the principle that broad and shallow menu structures should be provided, rather than narrow and deep ones (Norman and Chin, 1988).

The additional frequently cited positive features related to the presentation and layout of the SYSPRO interface, specifically the menu and the grouping of information. The familiarity of the SYSPRO interface was also identified as a feature that the participants viewed positively. This supports findings of related studies (Galitz, 2007; Hustad and Olsen, 2011; Koh et al., 2009) stating that ERP systems that employ familiar concepts and use a language that is familiar to the user can improve the ease of learning. It can be deduced that these principles should be incorporated into the design of ERP systems used for instructional purposes.

The most frequently cited negative features of SYSPRO related to the presentation criterion and was connected to the cluttered UI as a result of too many menus and windows which caused confusion. This confirms Shneiderman and Plaisant's (2005) theory that the incorrect use of tree structures in menus can occasionally lead to confusion or disagreement. The reported experience of confusion by users of ERP systems has not been identified by any previously related studies of ERP use in education, but could however be related to the concept of frustration experienced by ERP users as reported by Topi et al. (2005). These findings also support other research reporting the problems with the complexity of the UI and the need to cater for novice users (Topi et al., 2005). This problem could be avoided by adhering to the user interface design principle of simplicity which states that a dialog should consist of the minimum and should be natural and logical for the user to use (Nielsen, 1993).

Hidden controls such as scroll bars in several windows in the SYSPRO user interface, was another frequently reported negative feature. This supports the principle that functionality can be placed in context-sensitive controls or hidden user interfaces, but that this should not be the only way in which the function can be invoked (Johnson, 2000). Less visible or hidden methods can be provided, but these should always be secondary methods, with more visible methods being primary. SYSPRO designers could therefore investigate other methods of offering the functionality provided by the hidden controls.

10. Conclusions

The research questions of this paper have been successfully addressed. The results indicate that the three categories of criteria of navigation, presentation and learnability, together with their related heuristics, can be used to evaluate medium-sized ERP systems in higher education (RQ1). The usability of the medium-sized ERP system, SYSPRO was generally rated positively by the students;

therefore the second research question has therefore been answered. Several qualitative feedback was provided by students in terms of the features they liked they most and those they liked the least, which provided an in depth analysis of students' experience of learning to use a medium-sized ERP system. The third research question relating to the positive and negative features of SYSPRO encountered by users while using a medium-sized ERP system have thus been successfully addressed.

The results show that medium-sized ERP systems can be successfully used in education; however their usability can still be improved further The findings confirm other related studies reporting the importance of navigation in ERP systems used in industry and in education. Whilst several navigation problems were encountered, there were also several aspects of the user interface which the students liked, such as the tree view and menu structure. Several students cited 'confusion' due to the complexity of windows. The importance of using a system that is familiar was also reported. Therefore several practical, key contributions have been made in this paper for designers of ERP systems. ERP designers should take into account the results of the analysis of the usability related responses in order to assist them when designing an ERP system which is intended for instructional use. The reviewing case study results reported in this paper has provided issues relating to the usability of ERP systems that might be of interest to a wide range of users and technology experts. Several design guidelines for ERP systems for instructional purposes were provided (Section 5). The most important guideline relates to providing guidance for novice students and the need for an introductory interface. Other guidelines proposed relate to the use of familiar interfaces, languages and concepts; the use of broad and shallow menu structures; the use of hidden controls as secondary methods and the avoidance of clutter and complexity in ERP UIs. The contributions can therefore facilitate the improvement of the usability of ERP systems. ERP educators can also benefit from the results presented in this paper by taking into account the proposed criteria and guidelines when planning which ERP system to use and when evaluating potential systems. In addition they should consider the benefits of implementing a medium-sized ERP system which may be less complex than a large ERP system.

The insights provided by this case study provide important contributions to Human Computer Interaction (HCI) researchers, ERP researchers and other researchers and can assist with a deeper understanding of other similar cases or situations. The use of mixed methods data analysis using both quantitative and qualitative data analysis in a case study strategy provided insight into understanding how users complete tasks while learning to use an ERP system that would not have been possible with only a positivistic approach using purely quantitative data analysis.

This study formed part of a larger study which investigated the competencies required for ERP graduates as well as the different learning approaches. Future research could explore various ERP system alternatives for ERP educational purposes and do a comparison of the usability of large ERP systems, medium-sized ERP systems and simulated ERP systems. The results of this study have highlighted the need for an ERP system used for instructional purposes, which is not as complex as existing industry ERP systems but can still provide the required competencies. Additional research on the usability of medium-sized ERP systems is recommended which can explore the design of an ERP system that can support teaching and provide improved user guidance, especially for novice users.

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Appendix A: Cronbach's Alpha for the Usability Questionnaires

Criteria	Practical Session	Instrument	Cronbach's Alpha
Navigation	Prac 1	P1	0.76
	Prac 2	P2	0.80
	Prac 3	P3	0.89
	Prac 4	P4	0.87
Presentation	Prac 1	P1	0.45
	Prac 2	P2	0.67
	Prac 3	P3	0.70
	Prac 4	P4	0.86
Learnability	Prac 1	P1	0.55
	Prac 2	P2	0.6
	Prac 3	P3	0.81
	Prac 4	P4	0.91

Appendix B: Descriptive Statistics for the Usability Criteria for all Practical Sessions

	n	Mean	SD	Min	Median	Max
NAVIGATION						
Information can be easily accessed	26	3.28	0.80	0.75	3.50	4.50
Functionality can be found quickly and easily	26	3.23	0.73	1.50	3.38	4.50
The user interface supports efficient and accurate navigation of the system	26	3.35	0.66	1.75	3.38	4.50
There is a correlation between the searched item and the required item	26	3.83[+]	0.65	2.50	3.75	5.00
PRESENTATION						
The visual layout is well designed	26	3.25	0.70	1.50	3.25	4.50
Information provided by the system is timely, accurate, complete and understandable	26	3.75[+]	0.55	2.50	3.75	4.50
The layout of menus, dialog boxes, controls are easy to understand, interpret, and are well structured.	26	3.50[+]	0.55	2.50	3.50	4.50
LEARNABILITY						
A user can learn how to use the system without a long introduction	27	3.22	0.88	1.75	3.25	4.50
The various functions of the system can be identified by exploration	27	3.42[+]	0.80	1.25	3.50	4.50
There is sufficient on-line help to support the learning process	27	3.31	0.63	1.75	3.25	4.50

[+] Positive range