Holistic Personas and the Five-Dimensional Framework to Assist Practitioners in Designing Context-Aware Accounting Information System e-Learning Applications

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Abstract. Despite a growing demand for e-learning applications, there is a lack of research on eliciting requirements for design of context-aware Accounting Information Systems (AIS) e-learning applications (CAAISeLA) that incorporate the multiple-perspectives of adult learning theories in a workplace environment. This paper describes how Holistic Persona, an archetypical learner and user of an AIS application, can assist practitioners to elicit requirements for design of context-aware AIS e-learning applications for employees. It presents empirical results of twenty employees at a research-intensive Australian university who participated in evaluating the effectiveness of various e-learning resources. The results demonstrate that Holistic Personas and the Five-Dimensional Requirements Elicitation Framework (5DREF) can assist practitioners in designing context-aware AIS e-learning applications.

Keywords: Context-aware e-learning application · Adult learning theory Knowledge · Accounting information system · Holistic personas

1 Introduction

Consideration of diverse perspectives of users' activities balanced with multiple theories of learning in a workplace environment leads to more successful e-learning applications. In order to gather information about users' requirements at the business process level, each group of users should participate to contribute their components of the requirements. The main usability goal of e-learning applications is ease of its operation so that the learners can concentrate on learning new materials. User-Centered Design (UCD) methodology considers the goals of the users as a primary requirement of software applications and this can be better achieved if educators take into account each learner's characteristics and expertise [7]. However, it is often not possible for practitioners to meet with all users of diverse groups. Persona, an archetypical user of an application, is widely used by software engineers to design applications that are focused on the needs of users. For example, Madsen et al. [15] used personas, which they created, to assist with designing a personalized professional development website. Anvari and Tran [4]

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have proposed Holistic Persona, persona that incorporate demographics, personalities, intelligence, knowledge and cognitive processes, designed to more closely resemble the end users. Holistic Persona have been used in the design of teaching material in computing [3].

Context-aware applications have been deployed extensively [24]. The goal of context-aware applications is to make interaction with computers easier [11]. However, most applications address learners' context such as location, time, surrounding resources, learners' learning styles etc. Our extensive literature search was unable to identify any study that reports how users of AIS select e-learning resources to learn in the context of workplace environments and how practitioners consider the multiple perspectives and multiple characteristics of users towards learning AIS. This paper describes how Holistic Personas can assist practitioners to elicit requirements for designing e-learning resources of contest-aware AIS e-learning applications for employees. The findings of our empirical study will be valuable for academics and professionals who are interested in designing context-aware e-learning applications for employees. The rest of the paper is organized as follows: (2) background and related work; (3) methodology: the 5DREF and the design of e-learning resources using Holistic Personas; (4) results; (5) discussion; (6) contributions and limitations; (7) conclusion.

2 Background and Related Work

There are many context-awareness definitions. For example Li et al. [14] defined five context dimensions as who (user), what (object), how (activities), where (location), and when (time). Verbert et al. [24] presented the components of various context definitions: location, time, physical conditions, computing, resource, user, activity, and social. Abowd and Mynatt [1] identified the five W's (Who, When, What, Why, Where) as the minimum necessary information to understand context. Dey, Abowd and Salber [11, p. 106] stated that context-aware applications consider "*any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves*". Synthesizing context-awareness definitions from the literature [1, 11, 14, 24] and reflecting on experience in designing AIS teaching materials, we have identified that in addition to *why, who, when, what and how, evaluation* is needed to characterize the interaction between a user and a CAAISeLA. **Why:** The 'Why' addresses context-aware features such as learning style, teaching methods and strategies. Different learning theories require different sets of tools to support practitioners to develop learning resources. For example in a direct instructional approach, practitioners break a new body of knowledge into small steps with clear objectives to provide learners with the opportunity to practice with feedback on each step learnt [16]. According to Constructivist Learning theory [20] learning is an active process of creating meaning from experiences based on the learner's current or past knowledge [10] and constructivist learning occurs when the '*learner actively builds a mental model of the system she is to learn*' [6, p. 74]. 'e-*Learning, or better computer supported learning, focuses on the individual's acquisition (or rather construction) of new knowledge and*

the technological means to support this construction process' [21, p. 204]. Socio-constructivist theory states that interaction between learners and their peers is a necessary part of the learning process [25]. Hence practitioners of Socio-constructivist theory provide forums to promote social interaction and learning. Practitioners of scaffolding instruction teach students concepts that are just above their knowledge level by encouraging them to do an activity to improve beyond their current skills level [12, p. 138]. Hence some practitioners include quizzes to provide scaffolding instructions or provide e-learning materials that are less guided such as scenario writings to encourage learners '*to produce some outputs that are not contained in or presented in the learning materials*' [6, p. 79]. **Who:** In the context of AIS e-learning, the 'Who' is diverse and each group of users has their specified learning objectives [22]. When users are not available for eliciting requirements, personas can be used in designing e-learning applications [15, 17, 19]. For example, Maier and Thalmann [17] created three personas, that represented three distinctive informal learner types that resulted in three service areas: '*individuation, interaction and information*' [17 p. 59]. Panke et al. [19] incorporated personas that offer information on how to integrate digital media into teaching. Anvari and Tran [4] and Anvari et al. [3] used Holistic Personas for design of learning applications. **When:** Users of AIS are adults. Adults are motivated to learn by internal factors [32]. Therefore to design AIS context-aware applications, practitioners should consider when learners are motivated to learn. Deci and Ryan's [8] Self-determination theory states that a person's motivation depends on the fulfilment of the needs for competence, relatedness and autonomy. **What:** In a work environment, learning materials need to promote learners' new knowledge that '*can be transferred back to job and utilization of new skills to enhance organizational performance*' [26, p. 194]. Bloom's Revised Taxonomy incorporates the Knowledge Dimension and the Cognitive Process Dimension. The Knowledge Dimension considers what learners need to learn. The 'What' to learn for a CAAISeLA contains *Factual, Conceptual, Procedural* and *Meta-cognitive knowledge* [2] of AIS. **How:** The 'How' considers learners' view of the Cognitive Process. According to Bloom's taxonomy there are six levels: *Remember, Understand, Apply, Analyze, Evaluate* and *Create* [2]. **Evaluation:** An e-learning application should have tools to provide timely feedback to learners so that they can self-evaluate their performances and for educators to monitor learners' activities and progresses [23].

3 Methodology

This section discusses the application of the 5DREF and Holistic Personas for the design of context-aware AIS e-learning resources and the procedure for the study.

3.1 The Five-Dimensional Requirements Elicitation Framework

To guide the design process we used the 5DREF that consists of five dimensions [23]. In a context of AIS e-learning applications, the 5DREF provides a framework for practitioners to focus on (1) why (need) educators teach in certain ways, (2) who (users) are involved in the learning process, (3) what (resources) and (4) how (activity, social)

learners learn, and (5) evaluate the teaching and learning process. Each dimension is discussed below.

(1) **Curriculum Development Dimension:** To address 'Why' certain learning resources are used by practitioners while they teach, we examine the *Curriculum Development* factor of the *Change Management* dimension [23]. E-learning resource requirements are elicited mainly from educators. For example, applying Piaget's [20] Constructivist Learning Theory and Deci and Ryan's [8] Self-Determination Theory, forums are used in teaching to allow learners to interact and construct ideas with peers and quizzes are used to scaffold learners.

(2) **User (or Learner) Characteristics Dimension:** The context-awareness dimension, referred as the *learner* dimension, addresses the 'who', the *User Characteristics*. To assist the practitioner who lacked participation of learners during the design process, we authored two Holistic Personas, Megan and Kim, to represent AIS users. The Holistic Personas, Megan and Kim, can be obtained from the authors.

(3) **Knowledge Dimension:** The Knowledge dimension addresses 'what' to teach. To be context-aware Online AIS needs to take into account learners' existing knowledge and experiences and allow learners to choose their own target levels of knowledge to be gained at the conclusion of sessions and select contents that are relevant to them. The Holistic Personas provided for prior knowledge of AIS which was taken into account for the design of e-learning materials. For example *factual* and *conceptual knowledge* materials are included for learners who had no prior knowledge of the subject matter and procedural knowledge materials for advanced learners to reflect and to construct meta-cognitive knowledge.

(4) **Cognitive Process Dimension:** The Cognitive Process dimension considers how learners learn. Cognitive Process dimension has six levels: *Remember, Understand, Apply, Analyze, Evaluate* and *Create* [2]. E-learning resource requirements are elicited from the Holistic Personas as well as educators. The *Cognitive Process* dimensions assist the design of e-learning resources that are context-aware to diverse learner groups who engage with the learning material using different levels of the cognitive processes. For example to encourage learners to learn at the higher rung of the cognitive process dimension, real-life worked-example scenarios [9] were provided.

(5) **Evaluation Dimension:** The Evaluation dimension helps practitioners to monitor the effectiveness of the teaching and learning processes. This study discusses educators as well as learners' reflective evaluation of the Online AIS.

3.2 The Design of Online AIS Learning Resources Using Holistic Personas

We developed an online AIS course, which allows the practitioner to enroll participants, through log files, follow their learning progress and interact with them. This section presents the design of context-aware e-learning resources that teaches Chart of Accounts (COA). The study was conducted between November 2015 and January 2016 and between May and July 2016. In this study we targeted the needs of AIS users who would

attend the study: administrative staff at middle rank and academic staff at researcher and lecturer levels. At the university where this research was conducted, the majority of the users of AIS (about 72%) were female. Hence for this study Holistic Personas, Megan and Kim, represented the users of AIS. Their different perspectives towards AIS influenced the design of the Online AIS study.

The AIS e-learning resources: In this study the effectiveness of the e-learning resources designed based on the Detailed Documentation method (*guided-construction*) and the Holistic Persona and Scenario method (non-guided construction) was studied. The knowledge, cognitive-process and curriculum development dimensions of the 5DREF provided guidelines for the design of e-learning resources. Considering Self-Determination Theory as a teaching and learning strategy, online AIS included various types of e-learning resources e.g. textual documents, visual posters, videos, quizzes, reflective exercises and forums for learners of various learning styles to self-direct learning. The Detailed Documentation method was designed using the direct instruction and scaffolding strategy. 'The learner's activities in the context of instructional dialogues can be referred to as "guided-construction"' [14, p. 82]. Three e-learning resources were textual materials with some visual images. The level of complexity was increased from easy to medium. Learning resources included quizzes and forum. The quizzes scaffolded learners at the cognitive process levels of '*Understand*' and '*Apply*'. The forum was provided for learners to post their work at the cognitive process level '*Analyze, Evaluate* and *Create*' [2] as well as to read and to raise questions. In short, the Detailed Documentation method provided learning resources with step-by-step instructions. The Holistic Persona and Scenario method was designed using Constructivist Learning with scaffolding strategy and Self-determination theory as a teaching strategy. Participants could construct their knowledge by understanding the posters, participate in the quizzes, reflect on questions raised in the forum and interact with peers via forum.

3.3 Procedure

Between November 2015 and July 2016, university employees were invited by the lead author via email to take part in the study. Participation was voluntarily and required completion of a consent form; participation in a pre-study questionnaire about demographics, their pre-knowledge of the university AIS and their ID numbers for enrolment. Participants were randomly assigned into Group A or Group B. Ethics approval was granted by Macquarie University's Human Research Ethics Committee, effective 13/10/2015 (ethics reference number 5201500782).

4 Results

The objective of this paper is to report on how users of AIS select e-learning resources and how practitioners consider the multiple perspectives and multiple characteristics of users towards learning AIS. We present only the results of demographics and e-learning materials that were accessed by participants.

Participants' demographics: Twenty-eight people from all faculties participated in the pre-study survey. Twenty-five people enrolled in the Online AIS. Five people never signed into the Online AIS hence they were excluded from the analysis.

The sample population for group A is 10 participants, for Group B is 10 participants and for the whole study is 20 participants. There were 10 Admin Officers, 2 Finance Officers, 3 Head Department Professionals, 1 Business Manager, 2 IT Officers, 1 Accountant and 1 Postgraduate Student.

Participants' access to each of the learning resources: Each participant accessed at least one e-learning resource. Figure 1 provides a graphic comparison of e-learning resource accessed for both groups. The average number of e-learning resources which participants accessed for Group A was 8.5 and for Group B was 8.10.

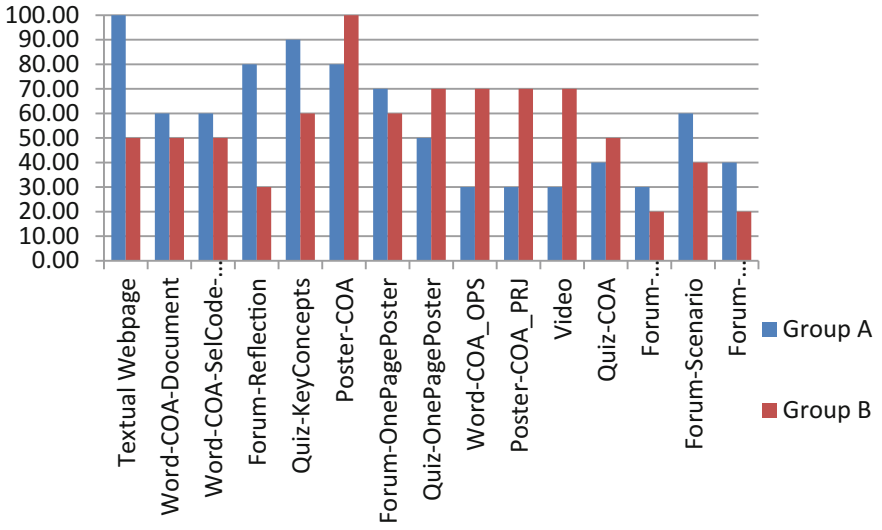

Fig. 1. Percentage of participants accessed learning resources

5 Discussion

The design of CAAISeLA for this study was guided by the five dimensions of the 5DREF [23]: who (the learners), why (the learning theories), what (the knowledge), how (the cognitive process) and finally an evaluation of the study. In this section we reflect on the study, its design and the results obtained.

(1) **The Learners:** The participants were staff at an Australian university. Participants received no financial gains. The highest number of participants for this study was Admin Officers (50% of the sample population) which indicates that Admin Officers think AIS is relevant and they need to learn COA. Participants' selections of e-learning resources indicate that CAAISeLA needs to provide different e-learning resources for different methods of teaching (Fig. 1). For example 90% for Group A

versus 60% for Group B took the core quiz. In the sample population 10% posted in the forum and 30% expressed about their experiences. Others only viewed the forums but did not post. These findings can assist practitioners to design context-aware eLearning resources for AIS users.

(2) **Learning theories (Curriculum development):** The results indicate that most participants in Group A (90%) quickly participated in the core quiz activity that gave them access to the Holistic Persona and Scenario method (Group B materials). Participants in Group B were slower in completing the course content and many Group B participants did not participate in the core quiz and hence did not get access to the Detailed Documentation method (Group A materials) which they would have had access if they finished the quizzes. Hence the participants in Group A who received '*guided-construction*' [6, p. 82] in the form of detailed documents that included step-by-step scaffolding instruction, '*to prompt students to attain the additional skills needed to reach this zone, teachers encourage them to learn by doing an activity*' [12, p. 138], were ready to test their knowledge quicker than Group B who initially received a description of Holistic Persona Megan, a poster and five different learning materials without any direct instruction. The results show (Fig. 1) that Group B accessed videos, a poster of COA for Projects ledgers (Poster-COA_PRJ) and a Word document of COA for Operations ledgers (Word-COA_OPS) much more than Group A (70% each for Group B versus 30% each for Group A). This finding indicates that users' choice of e-learning resources and activities depend on the methodologies used to design course contents. Hence CAAISeLA must have tools that are suitable for various practitioners so that they can design relevant and context-aware e-learning resources for learners. For example, Holistic Persona and Scenario writing would be more suitable to those who are highly self-directed in their learning and have grasp of the fundamentals of the subject because '*learners interpret concepts and principles in terms of the 'schemata' that they have already developed*' [5, p. 22]. It is of interest to note that during the study period, participants were reminded to complete the study. Many Group B participants asked for more time to do the studies and they were active during the study period, but the majority of them did not make any postings. This finding indicates that CAAISeLA should have tools to support the design of e-learning materials that incorporate the multiple-perspectives of learning theories so that practitioners can design context-awareness e-learning resources to meet the needs of the learners.

(3) **Knowledge:** A higher number of participants in Group A completed the post-study survey compared with Group B (90% for Group A versus 50% for Group B). The results indicate that participants found e-learning materials relevant and thus completed the study and gained more knowledge of the university's AIS. Hence e-learning resources that are aware of users' knowledge and their positions in an organization should incorporate input parameters from the learners and educators. For example, certain e-learning resources can be presented when the learner passes a certain level of the quiz test or holds a certain position in the organisation e.g. Accountant or IT Officer.

(4) **Cognitive Process:** The Cognitive Process explains how participants construct new knowledge from the learning resources provided. Quizzes promote conceptual understanding and, applying and analyzing. Eleven participants (64.71%) displayed their participation at the Cognitive Process level '*Analyze*' as they actively participated in the quizzes other than the core quiz and/or posted on the forum. Two participants (10% of the sample population) evaluated and created. The results also indicate that Group B participants might have been overwhelmed with the large amount of learning resources available and hence they were experiencing cognitive overload. Hence the Online AIS can be more effective if it is implemented targeting the mid-level of the Cognitive Process, '*Apply*'. To get learners to the higher rung of the Cognitive Process: *Analyze, Evaluate* and *Create* [2], educators need to have strategies to scaffold learners. For example the e-learning resources are made context-aware according to learners' cognitive processes and display resources accordingly.

(5) **Evaluation:** The results from this study reveal that most participants only viewed the forums and did not post their reflection. This finding is consistent with Nielson's 90–9–1 rule [18] that 90% of users read or observe; 9% of users contribute from time to time and 1% of users account for most contributions. This study has demonstrated that the Holistic Personas provided context-aware design guidelines and helped to predict the behavior of the participants. A noticeable feedback from the participants who completed post-study surveys was that they found quizzes built their confidence in AIS; most participants prefer the Detailed Documentation method and few (30%) posted reflection on the forums which indicates that their choice of learning strategy is guided-construction.

6 Implications and Limitations of Our Findings

Following are some recommendations derived from this study: (1) CAAISeLA needs to provide context-aware e-learning resources to facilitate self-directed learning for various learner groups. (2) CAAISeLA needs to allow learners to select content that are relevant to them. (3) Practitioners can apply UCD methodologies that take into account each learner's choice of learning strategy while designing context-aware AIS e-learning applications. (4) Although Socio-constructivist theory states that interaction between learners and their peers is a necessary part of the learning process [25], the results of this study indicate that learners of AIS wanted to be active but were not ready to interact with others. Hence forums are for facilitators to communicate, to provide model questions and answers and to guide learners. (5) When access to users of AIS is not available, Holistic Personas can assist practitioners to focus on users' needs in the design processes [3]. (6) The 5DREF can assist practitioners in providing context-aware e-learning resources to learners and educators. (7) The context-aware information provided by CAAISeLA can provide e-learning resources that are relevant to educators' teaching methods.

Limitation of our study: Our sample is small and the participants were from one university in Australia; hence care should be taken when applying the results to other scenarios. Further research is needed with larger sample sizes and diverse participants.

7 Conclusion and Future Research

We have demonstrated how Holistic Personas [4] can assist practitioners to design context-aware online AIS learning resources for employees and have provided examples of how Holistic Personas can assist practitioners to design context-aware online AIS learning resources. We have also demonstrated that the multiple-perspectives provided by incorporating multiple learning theories guided by the 5DREF are necessary in designing context-aware online AIS learning resources for diverse users. The novel contribution of this paper is the application of the Holistic Personas to the design of AIS and the empirical findings that extend the multiple-perspectives of the Adult Learning theory, the Self-Determination theory and the Constructivist Learning theory. The empirical findings are in line with the theory of andragogy [13], adults are self-directed learners and would actively learn online if learning resources are relevant and intrinsically motivate them. Context aware AIS e-learning resources need to include quizzes, videos, visual posters, textual documents and guided constructivist learning activities presented according to learners' demonstrated knowledge and preferences. In the context of AIS, reflective learning and scenario writings were too advanced for most professionals and as expected they visited forums only to read [18]. This study has provided empirical support for direct instructions [16] and guided construction. For a future study we plan to include strategies to encourage participants to learn at the higher rung of the cognitive process dimension. In sum this paper extends the literature in the application of personas in general and Holistic Personas in particular, and using the 5DREF to guide the multiple perspectives of e-learning theories and UCD in the design of context-aware e-learning resources for diversified groups of AIS users in working environments. We plan to study the effects of personality traits and intelligence on learners' choice of e-learning resources in future.

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