Educational Requirements for Mobile Applications in Nursing: Applying the User-Task-Context Matrix to Identify User Classes and Contexts of Use

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Abstract. Mobile applications are increasingly being deployed in healthcare and nurses are expected to use them during their education, practice and during training of patients. In this paper we describe how an approach to modelling user needs known as the user-task-context matrix has been applied to help guide in developing requirements for new mobile applications as well as for selecting applications to be used in different aspects of nursing and patient education. The approach involves first brainstorming the different classes of users of an application and then specifying possible tasks the application can be used for. In addition, different contexts of use of the application are then specified. Application of the method is described for improving understanding of user needs in both design and procurement of healthcare apps related to nursing education.

Keywords. Nursing informatics, mobile applications, education, user requirements

1. Introduction

In health education there is a need to expose students to a range of information technologies that they will use once they graduate. The use of mobile applications in nursing education programs is also becoming more widespread. Students are expected to understand how to use mobile devices and health care applications to provide patient care. Internationally, mobile computing competencies have been identified as being a competency that needs to be acquired to work effectively in health care [1]. This has arisen from the need of clinicians to be able to document clinical care at point of care at the bedside using mobile phones, tablets and/or wireless carts. Such pressures have given rise to a need among nursing faculty and school educators to effectively identify how to educate nursing students about the use of mobile devices at point of care effectively. Despite these needs there are few frameworks that support nursing faculty and health informatics professionals in understanding how software could be used to

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train nursing students about mobile applications and mobile devices. In this paper we extend the work of Kushniruk and Turner [2] in the application of the user-task-matrix to supporting nursing faculty and health informatics professionals in identifying users and uses of mobile applications to support student nurse learning.
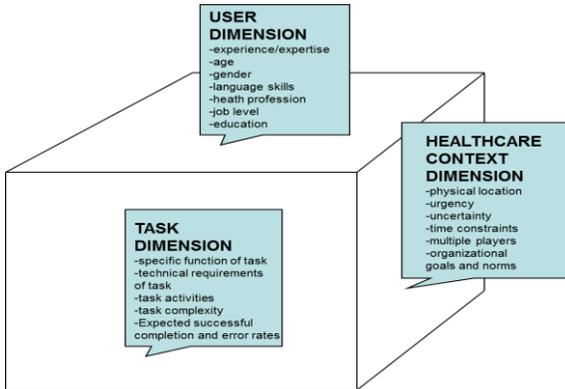
2. Background: Review of the Literature

With the introduction of health information technologies such as electronic health records, personal health records and mobile health care apps, health care software is used at point of care in the hospital and home care settings. The modernization of health care has also fueled demands for health information technology literate (i.e. eHealth literate) student nurses [3]. In response to these pressures national nursing accreditation bodies have developed nursing informatics competency statements with the aim of encouraging colleges and universities who train nurses to integrate these competencies into their curricula [4]. In addition to this we have seen the development of varying strategies to support nursing faculty in integrating these competencies [3,4]. There is a need to develop frameworks that can be used at a faculty level during curriculum meetings in conjunction with health informatics/information technology staff. Such an approach could facilitate across the board nursing faculty and school level integration of competencies across a curriculum with the introduction of point of care mobile software used in healthcare settings.

Over the past several years, there have been many mobile software applications that have been suggested for nursing student use. In extensions of this work nurse faculty have also begun to examine the role of mobile health applications as a tool that nursing students can use to support patient wellness and chronic disease management activities. In terms of possible uses, such digital tools can be used by student nurses when educating patients about the quality of mobile health care applications and as interventions, prescribed by a physician, for a period of time with the known benefit of improving some patient outcomes. In addition to this work researchers are beginning to identify opportunities for using mobile applications in the process of patient care. Here, nursing students would learn about how a mobile application can be used to document the patient's current health status (e.g. documenting vital signs), record medication reconciliation activities, medication administration or to document nursing care. In this paper we describe an approach that can be used to identify the types of software that students and faculty would benefit from in the varying contexts of an undergraduate nursing program.

3. The User-Task-Context Matrix

We employ the user-task-context matrix (described below) in identifying requirements for mobile health applications and devices for nursing students. The matrix can be used by nursing faculty to identify requirements for nursing education and use of mobile health applications in different contexts of use. In order to specify the types of users of a health application (either under development or actively deployed), the types of functions or tasks that can be achieved using the application, and the range of contexts the application can be used for, the authors of this paper have created the User-Task-Context Matrix. This extends a formalism known as the user-task matrix, to include a third dimension – namely context of use (an essential consideration in

healthcare) [2]. In developing requirements for a health information system or application the matrix can be used to help define three dimensions: (1) the user dimension, which delineates the type or classes of users that use an application or system, (2) the task dimension, which specifies the type of tasks that different users are expected to be able to do using the system or application, and (3) the context of in which users carry out specified tasks (see Figure 1).

USER DIMENSION
-experience/expertise
-age
-gender
-language skills
-heath profession
-job level
-education

HEALTHCARE CONTEXT DIMENSION
-physical location
-urgency
-uncertainty
-time constraints
-multiple players
-organizational goals and norms

TASK DIMENSION
-specific function of task
-technical requirements of task
-task activities
-task complexity
-Expected successful completion and error rates

Figure 1. User-Task-Context matrix (adapted from Kushniruk & Turner, 2012)

Table 1 shows an example of how the concept has been extended in this paper to consider educational uses of mobile eHealth applications by different types of nurses. Along the left-hand side of the table is the list of possible classes of users of mobile applications in nursing. Along the columns of the matrix are the different tasks (or functions) that mobile applications could be used for in nursing education. The cells of the matrix specify the contexts in which a specific user group could use a mobile app for carrying out tasks. For example, in Table 1 the user group "Nursing students" could use a mobile application as a reference source in the classroom (in Context 1) or in the clinical setting (in Context 3). Applications can then be designed (or selected) in order to meet the needs of nursing students in these two different context by specifying use cases or design scenarios for each user-task-context combination.

4. Applying the User-Task-Context Matrix

We are currently using the user-task-context matrix to guide the development and specification of requirements for new systems and mobile apps being developed. This involves specifying the use of that device or application in terms of type of users, type of tasks and contexts of use. For each combination of user-task-context, specific use cases can be developed that describe scenarios (or examples) of that particular combination, and these can be used for driving development of storyboards for application design [2]. These scenarios can be used to guide the design of systems and applications. The scenarios can also be used to create clinical information processing scenarios (CLIPS) that can be used when testing already developed products to see if they meet educational needs and objectives in terms of users, tasks and contexts.

Table 1. User-Task-Context for differing possible uses of mobile apps in nursing education.

			TASK			
USER	*Use of mobile app as reference tools*	*Use of mobile app in documenting*	*Use of mobile app to learn how to perform a procedure*	*Use of mobile app for deploying quizzes*	*Use of mobile app to demonstrate technology to students*	*Use of mobile app in training patients for use*
Nursing students	**Context 1** – in the classroom **Context 2** – on wards **Context 3** – in the clinical setting	**Context 1** – documenting while on practica **Context 2** – documenting in labs **Context 3** – documenting in clinics	**Context 1** – in the classroom **Context 2**- in labs **Context 3**- in the clinical setting	**Context 1** – in the class **Context 2**- in labs **Context 3** – during take home exams	**Context 1** – in the classroom **Context 2** – in simulation labs	**Context 1** – in the office **Context 2** – in a patient's home
Lab instructors	**Context 1** – teach evidence-based practice **Context 2** – to test students	**Context 1** – to teach documentation in labs	**Context 1** – demonstrating procedures in lab **Context 2** – demonstrating procedures during practica	**Context 1** – giving tests in class **Context 2**- giving tests in labs **Context 3** – giving take home exams	**Context 1** – in class **Context 2** – in simulation lab	
Teaching faculty	**Context 1** – as reference during lectures **Context 2** – as reference during labs **Context 3** – to test students	**Context 1**- teaching documentation in class setting **Context 2** – teaching documentation in clinical settings	**Context 1**- teaching procedures in class setting **Context 2** – teaching procedures in clinical settings	**Context 1** – giving tests in class **Context 2**- giving tests in labs **Context 3** – giving take homes	**Context 1** – in the classroom **Context 2** – in simulation lab	
Research faculty	**Context 1** – to provide patient interventions that include references	**Context 1** – to enter documentation during research studies	**Context 1** – testing and evaluating ways of teaching about new procedures		**Context 1** – demonstrating a mobile application	**Context 1** – studying a mobile application
Practicing nurses wanting continuing education	**Context 1**- to update knowledge	**Context 1** – to learn how to document using mobile apps	**Context 1** – to learn about new procedures			**Context 1** – in office **Context 2** – in a patient's home

We can also use the user-task-context matrix to derive a checklist for matching educational apps to user needs in terms of tasks and contexts of use. In addition, for systems under development, the user-task-context matrix generated during requirements gathering can be used later in the SDLC (System Development Life

Cycle) for creating scenarios that can be used to test a resultant system (to ensure it meets user and educational needs for different tasks and contexts)

From our work we have arrived at the following sets of steps for creating and applying a user-task-context matrix:

1. **Brainstorming a list of user classes** (e.g. nursing students, faculty, IT staff) – this can be done by setting up focus groups with faculty, students and IT support staff.

2. **Brainstorming a list of tasks the application can support in educational settings** – for development of new applications, envisaged tasks the application would be expected to support are listed.

3. **For each user-task combination, brainstorming different possible contexts** – here the possible settings where the application could be used by different type of users are delineated.

4. **For each user-task-context creating one or more scenarios of use** (i.e. use cases) - these scenarios typically consist of page long descriptions of typical examples of a use of the application by a particular type of user in a particular context.

5. **Testing assumptions of the user-task-context matrix** – this can involve brainstorming to check that all users, tasks and contexts are defined (in a focus group).

6. **Application of the User-Task-Context** – We can use the matrix to help identify requirements for new software to be developed (as well as using it to identify potential commercially available software) that would support nursing education for different types of users in different context by creating testing scenario (or CLIPS) for each user-task context combination as described above.

5. Discussion

In our current work we are applying the approach described in this paper to guide the design of new applications through a process of scenario-based design. For example, we are prototyping a range of mobile apps for use in nursing education as a reference tool for varying types of nursing students and faculty, for each of the varying contexts described in our user-task-context matrix. The approach is leading to more informed discussion about type of user, uses and contexts in which healthcare applications can be embedded in nursing education. We are also employing this structured framework when considering purchase of commercially available applications and software systems (for use in education and practice) by using the framework to test candidate systems for use by particular users for particular tasks in different contexts of use.

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