

# E-Nursing: Experience Platform for Improving Nursing Performance

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## Abstract

*Nurses gain knowledge and experience through the performance and on the job learning. They improve their professional level by gaining more experience from "what they learn" in practical situations. Hence, the quality of their performance is improved through on-the-job learning, i.e. learning by doing over time. The focus of this paper is on the extraction and the formalization of nursing experience, using a semantic based framework. Experience based Nursing Portal (E-Nursing) is established with a premise that an interactive nursing environment requires knowledge-based approaches. The nursing knowledge portal is used for integration of nursing experiences by means of dynamic nursing profiles. Nurses with different professional levels transfer their experiences into the portal repository. Those experiences will be gathered in a standard context, documented and used for evolutionary revision of the nursing ontology by domain experts. Thus the E-Nursing facilitates the knowledge transfer to novice nurses, and acquiring of experience from expert nurses. The innovative characteristic of the concept is related to incorporating the both types of knowledge, explicit and implicit. E-Nursing, thereby, provides a tool to document, represent, and formalize the experiences of nurses obtained within the nursing process during their professional lifetime.*

## 1. Introduction

### 1.1 Experience

Experience is personal perception and the accumulation of knowledge through participating in an event or activity, and analyzing the feedbacks. It is a special kind of knowledge "a person acquires by being involved" in a job or an event (Schneider, 2009). Frensch and Sternberg stressed that experience is acquisition of special knowledge when a certain task is performed whether experiences are rational or used intentionally (Frensch and Sternberg, 1989). When a person, for instance, performs a specific task, she may face to some problems or challenges. Then she tries to figure out the problem. The human intellectual process deploys historical data stored in her mind and uses the human intellectual tools like skills, creativities, intelligence and innovativeness. Finally the person might come up with some solution alternatives, whether they are correct or incorrect. Through applying her decision, she will gain experience. Therefore experience can be considered as a specialization of knowledge to resolve a problem with a certain level of uncertainty or inaccuracy (Sun and Finnie, 2005). Experience, such as success stories or feedback can be formalized as a source of Best Practices and Lessons Learned to create new

knowledge or refine existing knowledge. The European Commission expressed that experience is coming from "the interrelationship of education, training and employment and building bridges between formal, non-formal and informal learning", and practicing a certain situation (European Commission, 2008). Schneider defined an experience as a three-tuple consisting of (1) **An observation:** monitoring the situation and what really happened, (2) **An emotion:** remembering the experience for either avoiding or repeating the performance refers to gained experience, and (3) **A conclusion:** when the new experience identified as a solution, the prior question of "why to do it" got its desired answer (Schneider, 2009). Therefore experience can be used in future as a Lesson Learned and/or Best Practice.

### 1.2 Experience Management

Experience Management (EM) is a "special kind of Knowledge Management (KM)" (Bergmann, 2002) in the scope of managing human related gains i.e. specific knowledge or instruction to perform a certain task. In this context, Bergmann introduced a basic EM model. This model consists of three components as (Bergmann, 2002):



**Knowledge Kernel:** containing *experience base*, *reused-related knowledge* and *vocabulary*. The experience items, for instance, nursing experiences gained within implementing a care plan, are formalized and structured in *experience base*. In *reused-related knowledge*, general knowledge (i. e. description of the condition of the patient) about the reuse of a certain experience in a specific situation is stored. *Vocabulary* is the basis of all knowledge and experience which defines information entities to represent experience, and reuse-related knowledge.

**Problem solving cycle:** a shell around the kernel, supports problem solving process by reuse of experience which includes the procedures and steps to approach a solution independent of its accuracy. First of all the *problem acquisition* elaborates and describes the problem. Then existing experience in *experience base* is *evaluated* and *retrieved*. Afterward *experience adaptation* refines the retrieved experience to better suit the problem. At the end, *experience representation* disseminates the adapted experience to the user.

**Development and maintenance methodology:** outer shell of EM model, consists of *technical, organizational and managerial process*. They “address the acquisition and maintenance of experience and knowledge in the kernel”, and also the aforementioned processes in the *problem solving cycle*. Of course the model encompasses a lack of providing a standard context for gathering experiences. In addition, the above components do not consider the risks associated with inaccuracy or uncertainty of the accumulated experiences. Thereby one cannot justify how to assure quality of knowledge. Experience has a repeated life-cycle, which starts with identifying experience holders. Since experience often is implicit, it must be elicited and become explicit. After storing an experience, very important step is to compare, evaluate, refine and purify it to be formalized as a Lesson Learned or in the highest level as a Best Practice (Schneider, 2009), (Atzmüller, 2007). The Best Practice or Lessons Learned should retrieve and match to a new/existing problem (e.g. treatment of patients suffering a new type of influenza). Finally the formalized experience can be reused when it is disseminated in a structured form like the FAQ or Wiki. Dealing with new problems, the formalized experience should be maintained and updated regularly. Also invalid and outdated experience should be removed from the experience base (Sun and Finnie, 2005), (Atzmüller, 2007).

In addition, evaluated experience should be transformed into explicit knowledge. This process is a unique feature of the EM. Since each experience is a case, Case-Based Reasoning (CBR) is well-suited to the representation of EM (Reuber, 1997). In CBR terminology previous experiences that are stored in the experience base (i.e. case-base) are indicated as a case (Sun and Finnie, 2005). The classic CBR approaches the problem solving cycle in certain steps as follows (Aamodt and Plaza, 1994):

- **Retrieval of** similar cases detected in the case base to the current problem,
- **Reuse** of the solution of retrieved case. Here, maintaining the experiences plays a major role.
- **Revise of** the adapted solution to solve the problem by the user using the domain experts.
- **Retain** of the revised solution as a new case for further problem solving.

Obviously CBR cycle covers some parts of EM specially the *retrieve* and *reuse* phase (Bergmann, 2002). In addition, *revise* is an integral part of EM to validate and verifying experience by domain experts (e.g. superiors or senior advisors). As mentioned earlier, *retain* can be considered as a maintenance and updating the experience base by adding/removing new experience/invalid and outdated experience respectively.

## 2. Background

### 2.1 Importance of Experience in Nursing

Nurses are responsible for diagnosis and treatment of patients with high quality. Being a qualified nurse needs not only knowledge and hard/soft skills, but also collecting experience within the job (Adib Hagbaghery et al., 2004). The professional job role contains knowledge, skills, and experiences learned through performing. Nursing education is not completed in nursing schools and universities. The important part of obtaining “know-do” (i.e. knowing how to do a certain task) is achieved by clinical experience. Nurses should be able to apply and implement “what they learned” in practical situations (Adib Hagbaghery et al., 2004). In the real world, they face to “theory-practice gap” (Sharif and Masoumi, 2005). This gap and the desired qualification level will be filled within learning by doing in hospitals and clinics. Improving performance depends on both nursing (scientific) knowledge and experiential learning (Benner et al., 2009). Learning from particular cases within performing a specific task is at the heart of



clinical wisdom teaching (Benner et al., 2009). Experience has a close relationship to job performance (Reuber, 1997). In addition, Job experience is positively related to job knowledge, so called “*knowing how to perform the defined tasks*” (Schmidt et al., 1986). Dreyfus noted that the quality of performing nursing tasks is changed by addressing learning from experience over time (Dreyfus, 1982). Learning experience needs intelligence, openness and responsiveness by the learner and teacher (Benner et al., 2009). Within performing a task, experiences are elicited from rules of thumb (Benner et al., 2009). These rules have been developed and modified over time, based on further experiences which enable nurses to continually improve their professional levels from novice to expert (Benner, 2001). Benner classified nursing profession in five levels based on their experience as follows (Benner, 2001):

*Stage 1: Novice:* The nurses in this stage learn theoretical knowledge. They know how they should perform a task theoretically. However, they have not gained experience from doing yet.

*Stage 2: Advanced beginner:* At this stage their performance has improved to an acceptable level. The nurses consider more objective facts and use more rules of thumb. The nurse still feels overwhelmed by the complexity of the tasks and needs more experience.

*Stage 3: Competence:* The nurses have more experience, and coping with different situation leads them to achieve competence. They are not completely sure that their decisions are the best one. They even face to some mistakes and learn more by doing.

*Stage 4: Proficient:* The nurses gained different negative and positive experiences by involving in the different situations. They apply their experiences as self-learned rules and principles. Nevertheless, they do not have enough experience performing all tasks in the best way automatically.

*Stage 5: Expert:* The expert nurses know “what need to be achieved”, “how to achieve the goals” and tackle complex problems. They do what inexperience has worked. They know completely and apply it automatically with high level of self-confidence.

As Benner discussed, the difference between the defined stages is the level of experience (Benner, 2001). Therefore the more practice, the higher performance quality. Adib Hagbaghery et al., (2004) argued in their empirical study that a nurse needs support of the other nurses to improve her performance (Adib Hagbaghery et al., 2004). The unity is an important factor in the development of the professional role to disseminate new findings and experience, and ultimately avoid occurring or repeating undesirable performance. Gaining experience is an everlasting cycle. Since nurses practice every day clinical tasks, they gain (moderately) new experiences. Furthermore, nursing schools can maintain and update their curriculums, and learning materials in a long term, through adapting (new) revised experiences (Sellman, 2010). For instance, nurses have lots of success/failure stories which share with each other as cases. Some nurses may transfer their stories to the other colleagues, especially the beginners. And some practitioners have an opportunity to hear or read the experience stories, but what happened to these stories as knowledge assets of clinics and hospitals. The challenges of collecting and eliciting the stories are not negligible. In addition, self-experiences can be misleading due to the diversity of situations and patients.

## 2.2 Basic Scenarios for Exploiting Nursing Experience

KM tools should be taken into account to store, visualize, retrieval and exploit knowledge and experience in assisting nurses. Hsia et al., 2006 proposed an integrated KM model which emphasizes using “knowledge directories (such as an e - portal), search engines, and visualization (such as PACIS) to view other patient information sources” (Hsia et al, 2006). In this way, the core of EU founded Med-Assess project (Med-Assess, 2014) is assessment of nursing competences and qualification with regard to recommendation of appropriate learning material for improving detected competence gaps (Khobreh et al., 2013). Based on the described challenge in the field of nursing, Knowledge Portal (KP) is a capable tool to make the experience accessible for nurses and let the experience holders share their findings with the others (Staab and Maedche, 2001). The portal specializes in a certain domain and address community of users (Staab and Maedche, 2001). KPs mainly consist of knowledge transfer, storage, retrieval, integration and also creation components by providing access to knowledge holder, user and

domain expert (Loebbecke and Crowston, 2012). In the context of national funded project, NeuroCare, KP is supposed to enhance knowledge about diseases such as dementia, furthermore to encourage users to exchange their experiences (Hardy et al., 2014). It is multilingual and would enable caregivers, patients and their relatives to manage home care and improve mutual communication (Hardy et al., 2014). Section 3 presents an architecture model in regard of managing nursing experience to retain and reuse nursing knowledge asset, so called Experience based Nursing Portal (E-Nursing).

### 3. System Architecture of E-Nursing

The E - Nursing platform consists of a KP to manage nursing experience life cycle. The primary aim is to elicit the new/existing experience from the expert nurses, and transfer it to the beginner levels to improve the level of their performance. The secondary aim is to provide feedback for nursing schools to detect knowledge gaps in vocational education and training of nurses and upgrade the curriculums in the long term. The system architecture of E-Nursing is illustrated in Figure 1.

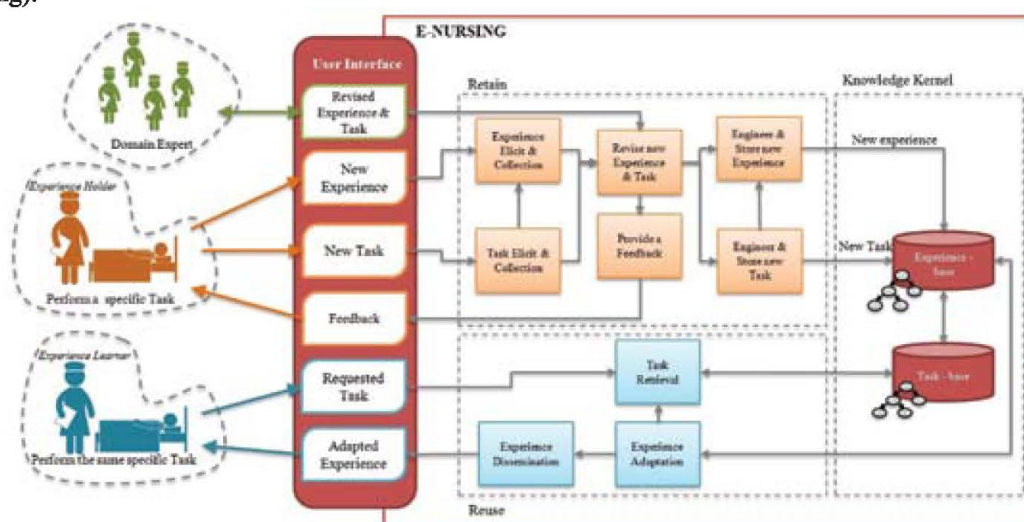


Figure 1: System Architecture of E-Nursing

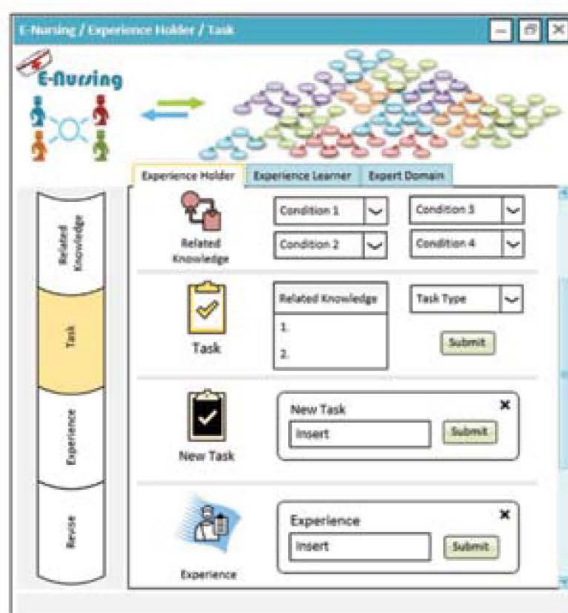


Figure 2: Screenshot of "Experience Holder" page from E-Nursing Portal



It consists of four modules, namely *Knowledge Kernel*, *Retain* and *Reuse* and *User Interface*. Generally E-Nursing communicates with three types of stakeholders, *Domain Expert*, *Experience Holder* and *Experience User*. *Domain Expert* is a group of nursing experts (not limited to nurses and can include physicians and educators) who are developing nursing curriculums, or serving as highly qualified supervisors. They take place in the top of professional level. In E-Nursing, *Domain Expert* will be involved to tune and revise the given experiences and tasks extracted from *Experience Holder*. *Experience Holder*, who carries new experiences or/and new tasks, will fill out the related forms towards elicitation and collection of *New Experience* and *New Task*. *Experience Learner* is a person who faces a problem or challenges for performing a certain task. She needs existing experience to improve her level of knowledge and ultimately on-the-job performance. In addition, *Experience Learner* can be a practitioner who wants to study and learn existing experiences for performing tasks. *User interface* facilitates making contact with others to collect input and/or transfer output using the following features: **Elicit and Collect Experience and Tasks** from *Experience Holder*, **Transfer Experience and Task** which revised by *Domain Expert* to *Experience Learner*, **Collect Requested task** from *Experience Learner*, **Learning Adapted Experience** provided for *Experience Learner* as a learning material. Figure 2 shows a screenshot of the *Experience Holder* page to highlight the features and aspects which are designed to collect experience of a nurse refers to a certain task. At the back-end of the E-Nursing the *Knowledge kernel*, *Retain* and *Reuse* have been implemented using a CBR life cycle which is described in following sub-sections.

### 3.1 Knowledge Kernel

E-Nursing deploys two KBs for establishing the semantics between experiences and tasks. E-Nursing KBs are used ontology to formalize and represent a specific domain of the interest in a formal way. The ontology engineering approach for developing E-Nursing KBs refers to Sure's Methodology (Sure et al., 2009). It consists of five main steps, namely (1) *Feasibility study*, (2) *Kickoff*, (3) *Refinement*, (4) *Evaluation*, (5) *Application and evolution*. According to this methodology, two E-Nursing KBs; *Experience-base* and *Task-base*, are developed.

*The Experience-Base*: includes the collection of experiences that are elicited from *Experience Holder* to clarify what she has gained through performing a certain task. As mentioned earlier, each experience can be considered as a case in the CBR cycle, which is supposed to represent or address a specific knowledge (Bergmann, 2002). Different experience may be connected for performing a task. However, one lesson might have a higher priority than the other.

*The Task-Base*: includes all nursing tasks. These are discussed in (Khobreh et al., 2013). It is structured, based on nursing process consists of five phases of assessment, diagnosis, planning, implementation and evaluation (Ammenwerth et al., 2001; Fiechter and Meier, 1993). E-Nursing tasks will be verified by interviewing with nurses and also nursing literature such as Nursing Intervention Classification (Bulechek et al., 2013). To sum up, the E-Nursing KBs facilitate to define Description Logic T-box through creating ontologies.

### 3.2 Retain

The main concern of this module is maintenance and updating *Experience* and *Task-base* after evaluation by *Expert Domain*. *Retain* process starts with *Eliciting and Collecting Task* from the *Experience Holder* and also *Eliciting and Collecting Experience* gaining within performing the task. The inputs are collected in a standard context as a textual input. Afterward *Domain Expert* should *Revise new Experience and Task* to evaluate, refine and tune the inputs. If the collected task exists in the *Task-base*, just adding related experience should be done for updating the *Experience-base*. Otherwise, the new task should be added to the *Task-base*. This component transfers experiences to explicit knowledge which will be used later as a draft of learning materials by *Experience Learner*. Here, the important component is evaluation of new experiences or new tasks by *Domain Expert*. It is the cold point of the system which can make interrupt for E-Nursing. However the solution is to actively involve domain experts who support the system. In addition, refers to the revision of *Domain Expert* appropriate feedback should lead back to the user or the one who shared his/her experience as a reward. Considering the ownership of the intellectual capitals and ethical issues, this aspect should be handled in practice by developing a disclaimer and terms of ownership.



### 3.3 Reuse

*Reuse* module consists of *Task Retrieval*, *Experience*, *Adaptation* and *Experience Dissemination*. First of all the requested task by *Experience Learner* should be retrieved from *Task-base*. Afterward the tagged experience from *Experience-base* will be adapted for the task. Finally the *Adapted Experience* will be transferred to *Experience Learner* as an additional input channel for drafting the learning material.

### 4. Conclusion and Future Work

This paper discusses the importance of experience for improving nursing tasks and transmits in nursing professional levels. It also addresses how EM can manage elicitation, storage and reuse of experiences in similar situations. In particular the system architecture of E-Nursing is proposed, using a screenshot from E-Nursing portal. In fact, E-Nursing portal provides a communicative environment for nurses to exchange their experience, receive feedback from domain experts and ask assistance for performing a task toward improving their performance. The reason for developing E-Nursing platform is due to the importance of integrating nursing experiences, and also lack of existing structured online system in this field. Progressive research project of Med-Assess, contributes into providing and recommending learning materials refer to lack of competences for job performing (Khobreh et al., 2013). However, it has not addressed the challenge of nursing experience management, and does not deal with assuring long term reliability of the system by means of maintaining and updating of nursing knowledge from nursing experiences. Collecting new nursing experience might also lead to develop a new learning material. Hence, E-Nursing facilitates making new knowledge from gathered experiences. In addition, nurses can modify and correct their rules of thumb by receiving E-Nursing feedbacks. By now, E-Nursing is designed for nurses; however the authors have planned to extend it for physicians as well as educators. In this context, physicians can receive the nursing experience which is worthwhile for treating and caring the patient. This might improve doctor-nurse communications, and ultimately influences on the job satisfaction of nurses. In the domain of application, one of the major challenges of E-Nursing is ownership of experience, and data privacy in regard to ethical issues corresponding to extraction of experience. In addition, the participation rate is another matter of E-Nursing. As a consequence, it must be addressed

that “experience” is only a portion of knowledge. The entire supply chain for improving nursing performance depends majorly on assessment of the level of explicit knowledge. Nevertheless, learning might differ from person to person, based on (but not limited to) intelligence, creativity, openness and cultural values. The former aspect regarding assessment of explicit knowledge is the major goal of our progressive research in Med-Assess project (Khobreh et al., 2013), and the latter is considered as an open issue for future research.

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