

Collaborative Development of Knowledge-Based Support Systems: A Case Study

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Abstract. We investigate a user-driven collaborative knowledge engineering and interaction design process. The outcome is a knowledge-based support application tailored to physicians in the local dementia care community. The activity is organized as a part of a collaborative effort between different organizations to develop their local clinical practice. Six local practitioners used the generic decision-support prototype system DMSS-R developed for the dementia domain during a period and participated in evaluations and re-design. Additional two local domain experts and a domain expert external to the local community modeled the content and design of DMSS-R by using the modeling system ACKTUS. Obstacles and success factors occurring when enabling the end-users to design their own tools are detected and interpreted using a proposed framework for improving care through the use of clinical guidelines. The results are discussed.

Keywords. Evaluation, clinical decision-support system, user-driven development, dementia, knowledge modeling

Introduction and Study Organization

The purpose of this study is to investigate how the development of practice may include the user-driven development of ICT-tools, which aims at supporting the improvement of collaboration and care. We put in this paper a particular focus on the potentials of user-driven development by investigating an actual scenario when end-users participate in re-designing a knowledge-based support system as part of their development of practice. This study explores a period of development of the local dementia care in a city in Asia.

Six physicians and local stakeholders used DMSS-R [1] in their daily practice, a generic knowledge-based support system for dementia care. DMSS-R is generic in the sense that it is primarily based on the international evidence-based consensus on how dementia diagnosis need to be assessed and is consequently, not necessarily adapted to local practices. The physicians were considered typical for the target user group (dementia represents a minor proportion of their patients, and consequently, they had minor to moderate skills in the dementia domain). Additional three physicians (two local and one external) who are considered experts in the domain participated in the hands-on modeling of knowledge content using the prototype ACKTUS [2].

An action research and participatory design methodology was applied. Observations and interviews were conducted as part of qualitative evaluation studies

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and activity analyses. Documentation made by the local experts of focus group discussions during the period were analyzed and supplemented with interviews with the experts. Three sessions with the domain experts were video-recorded and notes were taken. Data was interpreted using the framework of Cabana and colleagues [3].

1. Results and Discussion

Several changes in the physicians' views on details in DMSS-R over the period of time of use were observed. Towards the end of the period, the results had converged into a set of arguments for changing and/or keeping some features as it is. However, a unified view was not reached during the period. In total, there were 26 specific features that were subjected to discussion. The different motives expressed by the physicians for using or not using parts of DMSS-R can be identified in a perspective of behavior change [3]. They identified three categories of barriers to using clinical practice guidelines; 1) *knowledge-related*: lack of awareness and familiarity, 2) *attitude-related*: lack of agreement, self-efficacy (belief in one being able to perform a behavior) and outcome expectancy, inertia of previous practice (readiness for change), and 3) *behavior-related*: external barriers (guideline-, environment-, and patient-related). The physicians in our study expressed the following, interpreted into the three categories.

Knowledge-related: 17 features that seemed to have no diagnostic importance or importance for intervention were suggested to be removed due to time constraints. The general physician is typically not familiar with neurological phenomenon and symptoms, due to the way medical training is organized in the country. A conclusion that was drawn was that if the DMSS-R requires neurology examinations to be performed, this will simply not be done. It was also observed that in some of the patient cases the physician did not read the explanations of concepts, which were included for educational purpose. *Consequence*: Ten features were necessary features for differential diagnosis according to the underlying clinical guidelines.

Attitude-related: 11 of the 17 features were considered too difficult for the general practitioner to assess and were suggested to be removed also because of this. Some arguments for changing the content of DMSS-R were proposed for the purpose to maintain current routines (e.g., remove features that require that a relative who knows the patient is interviewed). Thus, the readiness for change may be at an early stage in some individuals. *Consequence*: A major purpose with the current design of the DMSS-R system is to support knowledge development in users, potentially visible in a change of routines. The attitudes towards this aspect were diverse among the participants. While a few wanted to keep features for educational purposes and valued the additional explanations, others were not interested to read these or learn how to assess features they were unfamiliar with. Motivations for this were that they were not considered vital for diagnosis, or were not considered to lie within their expertise.

Behavior-related (external barriers): the physicians schedule between 15-20 minutes for each patient, which gives little room for changing their procedure when meeting a new case of suspected dementia. Therefore, a major desire was to reduce the number of items to investigate and enter into the system. 11 features that capture the results from examinations that are typically not done by the primary care physicians in the local context were suggested to be removed. *Consequence*: Five features concerned radiology, which are included in clinical guidelines for a majority of the dementia diseases and strengthen diagnoses significantly in the cases when they can be done.

To summarize the consequence analysis, adjusting the system as suggested would weaken the guideline-based support for discriminating between diagnoses, and weaken the educational perspective of DMSS-R.

The two local experts collaboratively adjusted the content of DMSS-R according to the requirements that had emerged in discussions with their colleagues. They used ACKTUS for this purpose and provided motivations for each item in the process. As a result, a majority of the suggested changes were made, while another set of items remained unchanged (e.g., three features necessary for diagnosis were kept in DMSS-R, acknowledging the underlying guidelines). It became clear to them how the diagnostic power was decreased as they removed significant parts, since they were able to test their results as they proceeded with the knowledge-modeling task.

The re-designed DMSS-R was evaluated by the external domain expert. The weakening of the diagnostic support was observed, partly caused by the exclusion of seven of the suggested ten significant features. The expert was highly unwilling to accept changes that would make the system deviate from the clinical guidelines and consequently affect the diagnostic power. A synthesis of the results was made and DMSS-R was again re-designed with the aim to serve as a flexible compromise to meet the diversity of opinions among the participating physicians.

To summarize, there are methodological challenges when end users participate in the design of knowledge-based support systems, in particular when knowledge turns out to be limited in individuals. Tools such as ACKTUS that allow each end user to understand the consequences of design choices made, to test the results and to collaboratively create a common understanding of the problem space and body of knowledge are essential. An advantage in involving the end users is that we were able to collect more information about the potential obstacles that may have prevented a successful implementation of the improved dementia care in the community. We found the framework defined in [3] highly useful for exploring motives and obstacles for changing behavior related to knowledge-based support applications. The physicians in our study expressed a combination of both knowledge-related and attitude-related motives for maintaining or removing features from DMSS-R. In particular, the lack of self-efficacy was associated to the knowledge-related motives. The major reasons for proposing changes to DMSS-R were associated to external barriers such as time constraints and other resource constraints such as available equipment, which are factors that may be difficult for the physician's to alter. The motivational factors detected in our study motivate also the strong focus to maintain the educational purpose with DMSS-R, and to pursue with the educational plan in the community. In fact, we argue that the key factor to a successful implementation is the combination of an educational plan in the community, and a decision-support system tailorable to the individual physician and his level of knowledge, readiness for change, attitudes and context of practice.

References

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