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An Approach for Training Decision Making Competences in a Multi-Modal Online Environment

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Abstract: In this paper, we describe an approach for training decision making competences in emergency situations with the help of a multi-modal online environment. Decision making is an essential aspect of emergency management and a successful response to an emergency situation highly depends on whether decisions are being taken in an effective and timely manner. For this reason effective training programs are needed, in order to guarantee that emergency managers respond adequately to disasters. This paper addresses these needs by outlining and structuring the competences required for making meaningful decisions and by presenting an approach on how these competences can be trained in an online environment.

Keywords: Decision making competences, Competence-based Knowledge Space Theory, personalization, online training

1. Introduction

Decision making is an essential component of emergency management, and a successful response to an emergency situation highly depends on whether decisions are being taken in an effective and timely manner. Decision making in emergencies encompasses a broad range of individual decisions, which may occur before, during, or after an event, from declaring a state of emergency, issuing an evacuation, to specific operational decisions. Acute emergency situations represent decision environments that are dynamic and complex. This is due to the large number and interdependence of variables involved, including: dynamism, uncertainty and intransparency of the situation, information overload or lack of information, time pressure, risk, plurality of goals, and the involvement of multiple players (St.Pierre et al., 2008).

For effective emergency decision making, domain-specific knowledge on emergencies and emergency management is needed, as well as knowledge and competence on a meta-level (metacognition, decision making). While domain-specific knowledge typically refers to the operations during emergencies and the resources needed for these operations, competences on the meta-level refers to decision making in general, targeting the logical structure of decisions and their consequences. In this paper we address the training of these meta-level decision making competences.

2. Decision Making Competences in Emergencies

Decision making constitutes an area of critical thinking skills that is considered essential for students and workers in the 21st century. Decision making competence is a multidimensional construct including a range of key skills (e.g. Finucane & Gullion, 2007). In the context of our psychological framework (Steiner et al., 2015) a set of decision making competences have been defined focusing on the steps of decision making:

- competences related to the forethought phase: e.g. identify the problem, defining the goal, and collecting information
- competences related to the decision phase: e.g. generating and evaluating alternatives, selecting and implementing the best alternative
- competences related to the reflection phase: e.g. evaluating results, attribution of causes, monitoring progress, adapting reaction

For a systematic approach to model decision making competences, we use Competence-based Knowledge Space Theory (Heller et al., 2006), a psychological set-theoretic framework for representing domain and personal knowledge and competences. This theoretical approach establishes a structure on a knowledge domain by capturing the inherent structural dependencies (prerequisites) between the items or competences of a domain. The established knowledge or competence structures may be used as a reference point for realising meaningful sequences of learning, for efficient assessment procedures, and for personalizing learning. The decision making competence metrics allow for a useful assessment method as each can be scored (Gallagher, 2012).

3. Multi-Modal Training Environment

Multi-modal learning has been shown to be more effective than more traditional, single-modal approaches of learning. Kolb & Kolb (2005) describe an experimental learning cycle that integrates abstract concepts and concrete experiences as two dialectically related modes of transforming knowledge. Based on that, we present an approach to train decision making competences in two ways. First, an adaptive and personalized online course is used to train theoretical and conceptual knowledge of decision making competences. Second simulated environments are used to apply and train the application of decision making competences. Both of these environments employ deliberate practice and proficiency based progression. Deliberate practice involves the provision of immediate feedback on the performance of a task or activity for the purpose of skill improvement (Ericsson, 2003). Proficiency Based Progression emphasizes the stepwise approach required for progression from a novice to an expert level of performance (Dreyfus et al., 1986, Anderson & Krathwohl 2001).

3.1 Web-based learning service Compod

Compod is a service that supports the adaptive and personalized learning based on competence structures (Nussbaumer et al., 2015). One of the core components of Compod is the domain model that includes competences, their prerequisite structures, learning objects, and assessment items. The competence structure is graphically depicted, so that the trainee can choose individual competences to be learned next. Learning objects and assessment items related to selected competences are presented to the trainee.

In order to train decision making competences, we have modelled a decision making competence structure and added learning objects and assessment items for their training. The trainee can step through this structure, visit learning objects and undergo assessment items for selected competences. Each time a learning object is visited or an assessment item is solved correctly, the related competence is marked (with different colours). In this way, the learning progress is graphically represented. Traversing through the whole competence structure, the complete domain of decision making can be covered.

3.2 Online simulator

Emergency management training is often done in virtual reality simulators. Such simulators are able to provide a realistic environment with emergency procedures, respective infrastructure, safety environment, fire and smoke propagation, and other components available in a real incident (Louka, & Balducelli, 2001). In order to use these environments for training, scenarios are created, where emergency managers have to respond to incidents and make respective decisions.

In our approach these scenarios are treated in a similar way to assessment items. The decisions to be made in these scenarios are related to the decision making competences as described above. Each time a trainee undergoes a scenario and makes a decision, the actions are analysed regarding the quality and correctness of the decisions taken and any related decision making competences. Then the information on the decision making competences are sent to the Compod service, where the new information is used to update the personal profile of the trainee. This information is then graphically shown in the decision making competence structure (Figure 1). This allows the trainee to go back to the theoretical knowledge of certain decision making competences, and to assess whether they failed in taking certain decisions correctly. The overall goal is to complete the learning objects and assessment items, as well as the scenarios for all decision making competences, which triggers live updates in the Compod system.

4. Conclusion and Outlook

This paper presents an approach to train decision making competences needed for emergencies in two different ways. The Web-based system Compod allows for learning the theoretical knowledge of decision making competences and the online simulator allows for training in emergency scenarios. While the Compod system and the decision making competence structure have already been developed, the online simulator is not yet available. Next steps and future work include the selection of a virtual reality application that enables training in emergency scenarios. These scenarios will be assigned with decision making competences from our domain model and a mechanism that analyse if the correct or wrong decisions have been taken. This information is then sent to Compod, where user information on available decision making competences from assessment items and scenarios are stored and brought together. It is the amalgamation of the decision making task analysis and metric development, web based and simulator learning with deliberate practice and proficiency based progression that converts the multi modal environment from an educational experience to a training programme that allows optimal learning to occur.

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