

LEARNING ANALYTICS AND OPEN LEARNING MODELLING FOR PROFESSIONAL COMPETENCE DEVELOPMENT

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Abstract

One challenge faced by workplaces is having enough relevant data to support data-driven decision making related to the further education/training of their employees, to identify competence gaps within their work force, and to contribute to organizational learning. We propose that data driven decision-making can be supported by the combination of competence mapping, collection of assessment and performance data from various sources, learning analytics of the data, and visualisation of the results in an open learner model (OLM). In the iComPass project we work with two learning scenarios to study this challenge: health care workers studying for a Master in Organization and Leadership; and, the on-the-job training of firefighters. The project builds on, and extends, ideas from the former EU-project Adapt-It, and on a learning analytics approach and an OLM developed from the EU NEXT-TELL project. This paper elaborates on our approach.

1. INTRODUCTION

In order to ensure active and participating citizens and a competitive workforce, modern societies need to have a continuous focus on education and training. The challenges are many. One challenge for educational and training organisations is to maintain an overview of their competence needs and the competence development of individual learners, and groups of learners (Bull, Johnson, Alotaibi, Byrne & Ciernak 2013) in order for decision-makers (e.g., students, employees, instructors, leaders, etc.) to make informed decisions about learning, teaching, management, and organizational development. By investigating how to support data-driven decision-making by individuals, instructors, and leadership through a combination of competence mapping, data from multiple assessment and performance sources, learning analytics, and visualization of the learning data in an Open Learner Model (OLM), the iComPass project aims to develop a unique approach to planning and monitoring professional competence development. In this paper we describe the background for the project, the problem area, and our research approach.

2. BACKGROUND NEEDS

The iComPass project arises from the needs of two professional education/training situations that want to raise the quality of their education and training, and improve decision-making related to their students/employees and their organisations. Scenario 1 is a Master programme for Organization and Management (Health and Welfare line) at Sogn og Fjordane University College (SFUC). Scenario 2 is the education and training of firefighters, organized by Sotra Fire and Rescue Service (SFRS).

The Master programme (Scenario 1) combines formal learning and on the job competence development. The professions for which they educate their students have a demand for highly qualified health care professionals with leadership competences. During the part-time study the students attend lectures, write a master thesis, and use their professional background (i.e., from where they are currently working) in order to complete their education. When finished, the students have competence to assume 1) a leadership position within their field of specialization, 2) administration positions within the healthcare sectors, or 3) independent positions with leadership responsibilities. Based on scores from previous results from the NOKUT Study Barometer (Lid 2012), which examines student opinions about many aspects of their studies, SFUC needs to:

- evaluate and further develop their curriculum to include:
 - i. competences that are relevant for their students' future practice (in particular leader competences) and
 - ii. competences that enable the students to have a critical reflection over their on-going and future practice and the ability to improve it
- be able to maintain an overview of each student's competence development.

In Norway, potential firefighters are recruited from vocational schools with a focus on careers such as carpentry or masonry (Scenario 2). The Fire and Rescue Service is responsible for the education and training of these potential firefighters and also for the training that is further required to ensure that the firefighters maintain extreme skills and meet intensive fitness standards. The SFRS comprises emergency response professionals and specialists engaged in an enormously wide range of tasks, from the rescue and protection of people and property during fires, smoke outbreaks, accidents, to giving courses and informing on fire safety. SFRS needs:

- to maintain an overview of the competences of individual fire fighters, teams, and the brigade as a whole in order:
 - i. for individuals to have an overview of their competence, for example, certification;
 - ii. for team leaders to make daily decisions about their team, and
 - iii. for the organisation leadership to both ensure that they meet all the national rules and regulations, and to carry out strategic development.

Although the two cases at a first glance seem very different, they have many similarities. Both units where the cases are anchored, have a need to address quality issues, to focus on student/employee learning and work, and ensure that competence goals within their education and training are tightly tied to their current and future professional practices. To be more specific, our first workshop with the informants from SFRS and leaders in hospitals/municipal health care (former master students) respectively, revealed that an overview of competence needs at three levels is required: 1) Organizational level, 2) Team level, and 3) Individual level.

As far as we ascertain, our approach is unique in professional competence development in that it investigates how to support data-driven decision-making by individuals, instructors, and leadership through a combination of competence mapping, data from multiple assessment and performance sources, learning analytics, and visualization of the learning data in an Open Learner Model (OLM), (Bull & Kay 2007) and investigates how this supports learning and managerial decision-making. We will:

- Develop competence maps in the fields of practice
- Identify and provide resources and ICT tools that support assessment of these competences
- Evaluate learning analytics and data mining methods to provide evidence for, and analyse, the learner's competence model

- Explore and evaluate how to best visualise learner competencies to enable self-reflection (individual) and the identification of gaps in competence (individual, group, organisation levels)
- Foster in-service decisions makers' professional development
- Investigate how competency maps can be used for decision-making and organisational development

3. KNOWLEDGE STATUS

EU policy objectives promote standardisation of competences, through the European Framework for Key Competences for Lifelong Learning, which is a reference tool for EU countries and their education and training policies, and reflects an increasing trend towards an evidence-based policy. Norway is no exception, and has a focus on competence development within several sectors, including education, health and safety (NOU 2012, NDCP 2013).

But what is competence? The definitions are many. In the article "What is Competence?" from 2005, Le Deist and Winterton (2005) distinguish between the concepts 'competence' and 'competency'. While 'competence' generally refers to functional areas, 'competency', from their point of view, addresses behavioural areas. The usage is, however, inconsistent. The authors argue for using a *multi-dimensional framework*, a holistic typology, in understanding the combination of knowledge, skills and social competences that are necessary for particular occupations: cognitive competence (knowledge and understanding), functional competences (skills), social competence (behavioural and attitudinal) and meta competence (different from the other dimensions and is concerned with facilitating the acquisition of the other substantive competences). Another approach to the concept is that of van Merriënboer and Kirschner (2013) who define 'competency' as a combination of complex cognitive and higher order skills, highly integrated knowledge structures, interpersonal and social skills, and attitudes and values. Acquired competencies can be applied in a variety of situations (i.e. transfer) and over a limited space (e.g. lifelong learning).

Collecting and analysing information from learners for the purpose of making decisions about individuals, groups, and organisational development is not new, but it is often not done in a systematic or thorough way. Many institutions and organisations experience logistic challenges in collecting this kind of data, analysing it, and maintaining an overview of competence status and development.

Building upon our previous research in an EU project, NEXT-TELL (Reimann, Bull, Kickmeier-Rust, Vatrapu & Wasson 2016, Wasson, Hansen & Mor 2016) that focused on assessment and an OLM to support formal learning, we apply and adapt our approaches for adults and workplace settings. An OLM facilitates both self-reflection on the part of learners, and instructor planning and decision-making (Bull, Wasson, Kickmeier-Rust, Johnson, Moe, Hansen, Meissl-Egghard & Hammermuller, 2012). An OLM is similar to student progress and performance reports, however, it does more than report progress, it models and externalises competences and skills. An OLM is built on a learner model (LM), a representation of a learner's skill and abilities inferred while the learner interacts with learning material in an intelligent tutoring system (ITS). State-of-the-art research is extending the use of OLMs (beyond ITSs) to situations where there are multiple data sources, both automatic and manual, feeding its learner model (Morales, van Labeke, Brna & Chan 2009, Reimann, Bull, Halb & Johnson 2011, Bull & Wasson 2016), analysing with learning analytics (Kickmeier-Rust & Albert 2013), and visualising the learner's competences in various ways (Reimann et al. 2011, Bull et al. 2012, Bull & Wasson 2016).

A challenge in workplace situations is how to collect evidence of competence development. Our initial research has identified in particular, data from learning activities, formal testing, certification, wearables for tracking training and exercises, and evaluation of incidents (in the case of fire fighters), can be analysed using analytics algorithms and provide evidence of competence and competence development. The results are used to build a learner model, which can be visualised as an OLM (see Figure 1), for the learner/worker, instructor, or leader to use for planning and managerial decisions.

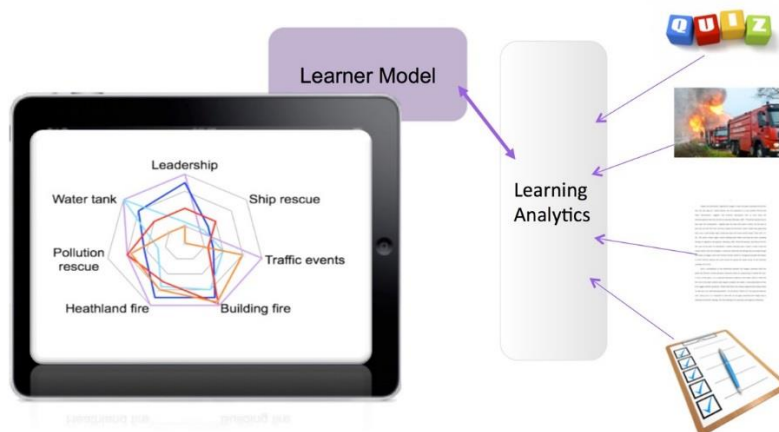


Figure 1: Analysis of Learning and Work Activities feed into a Learner Model and visualised

4. RESEARCH QUESTIONS AND METHODOLOGY

Can learner models and visualisation of competences, for individuals, groups, and the organisation as a whole, help to improve decision-making about training needs? Can such tools increase the ability to assess and identify competency gaps and address those gaps through training and competence development before they become problematic?

iComPass will employ design-based research and study the effects of the designs, by iterations of designing, developing, and evaluating. During the design phase we will employ interviews, concept-development, and focus group sessions with users. During the development of methods and tools we will utilise small-scale prototyping with usability testing to test specific aspects of tools before committing to a particular design. At that point agile development methods will be used. After the tools are considered complete we will carry out evaluation studies.

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Facts

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Web page: <http://uni.no/en/uni-health/technology-for-practice/icompass-inquire-competence-for-better-practice-and-assessment/>

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