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Supporting understanding of students’ learning via visual self-assessment

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1. Summary

Understanding students’ learning is crucial to the development of teaching. The most common systematic approach to understanding students’ learning has been summative course feedback, gathered after each course. However, students do not seem to be motivated to give this summative feedback after courses, with answer rates as low as 30 percent at Aalto University. Based on our observations, this is partly due to the timing and quality of current methods: students do not themselves benefit from any possible developments to the course. We soon realised that we merely need to develop a more dynamic culture of giving feedback during a course and started a project called Dynamic Course and Programme Level Feedback. We use a concept mapping tool to collect data from students during a course. This data is then visualised as dashboards that serve as feedback for teachers and enable adaptive teaching.

2. EXTENDED ABSTRACT

The emerging field of learning analytics attempts to improve students’ learning by collecting, analysing and reporting data about learners and their contexts (Siemens 2013). Different kinds of visualisations, such as learning analytics dashboards (Verbert et al. 2013), are central in learning analytics, aiming to support students’ self-regulated learning (e.g. Panadero 2017). Concept maps and other types of node-link knowledge mapping tools form another widely used category of tools for supporting the learning process and the evaluation of learning. These different formats can be used in complementary ways to enhance motivation, attention, understanding and recall (Eppler 2006).

In this paper, we demonstrate how concept maps can be used to visualise learning both on the course and curriculum level. Instead of having students create a concept map, we build concept map templates in advance, based on curriculum structures (see also Willcox & Huang 2017). The structure is four levels deep: 1) Degree programme (e.g. MSc Education on Ship Design), 2) Field (e.g. Safety-based Ship Design), 3) Course (e.g. MEC-E2003 Passenger Ships) and 4) Course topics (e.g. History of cruise ship design).

The concept map template files are given to students, after which they update their concept maps weekly and conduct cognitive-emotional self-assessment; see simplified example in Figure 1. By cognitive-emotional self-assessment, we refer to students’ judgements of learning (Nelson & Dunlosky 1991) on the topics defined by the teacher, their topic emotions (Boekaerts & Pekrun 2015) toward the topics and their identified cross-links (Novak & Cañas 2008) between different topics. Students can also create new topics and comment on their learning processes or course arrangements in the concept map. The updated concept map files are then returned as assignments in our Learning Management System (LMS). Typically, one concept map includes tens of courses, several hundreds of concepts and tens of cross-links.

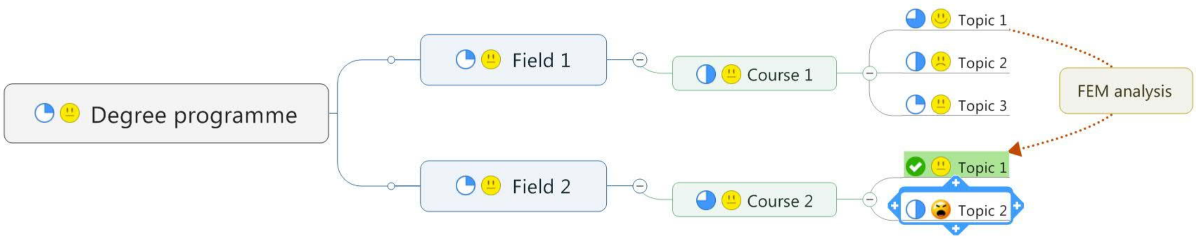

Figure 1 Simplified example of concept map. Selections are made with clickable icons: judgement of learning (0, 25%, 50%, 75%, 100%), emotion (happy, neutral, sad, angry). Cross-links are marked by drawing relationships and naming them (FEM analysis).

The input from all students is also assembled and visualised as learning analytics dashboards for students and teachers, resulting in a dynamic feedback tool. To visualise the data of hundreds of concept maps in a meaningful way, data from concept maps must first be extracted and aggregated. We prepared a Python script to extract essential data from concept map files (XML) into CSV-files to enable feeding them to a business intelligence software. As a result we get visual dashboards (see Figure 2) that help a teacher to adapt his teaching based on student self-assessment data.

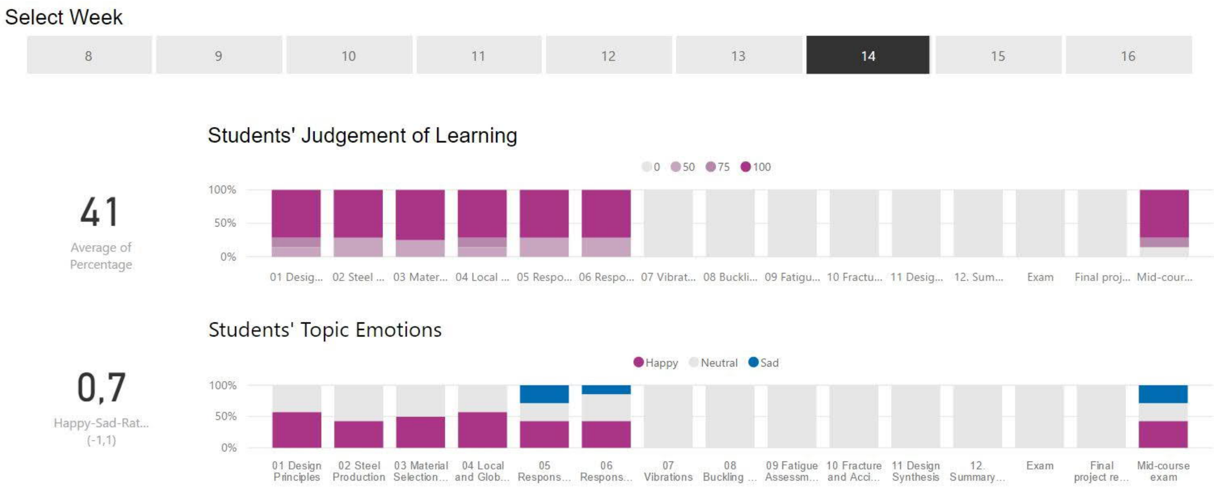

Figure 2 Example of an analytics dashboard built with self-evaluation data from concept maps.

As a part of the Aalto Online Learning pilot project (Kauppinen & Malmi 2017), our method has to date been piloted and in use on eight university courses to date, resulting in about 400 concept map files. To study the effects of concept mapping and dashboards, we interviewed students and teachers and made observations from students' concept map files. A key insight from the student interviews was that the visualisations help students put their personal opinions and experiences into a larger perspective. On the teachers' side, self-assessment data has turned out to be sufficient feedback for adaptive teaching, i.e. to better serve the student group in question.

In our future work, we will develop this methodology further and integrate it with the IT infrastructure of our university. As of year 2018 we are also starting a new scientific research project to further investigate the effects of the presented methodology.

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Ville A. Kivimäki is a project manager at the Aalto University School of Engineering in Finland. He graduated as Master of Arts from the University of Tampere in 2007. He has later deepened his academic background through university pedagogical studies and programming and he is currently working towards his Ph.D. He has worked at the University of Tampere as Research Curator and at Aalto University as Planning Officer and Team Leader, in different administrative positions related to curriculum work, pedagogical development, student success and retention. He is currently teaching a personal development course in Aalto University and working as an educator at the University of Tampere in service design and productisation. He has organised workshops on student success, service design, personal development and learning analytics. He currently serves as a project manager for two projects (Dynamic Course and Programme Level Feedback System, T4: Teach, Thousand, Track, Target) aiming to enhance student-teacher relation and to advance students' academic achievements. LinkedIN: www.linkedin.com/in/ville-kivimaki

Joonas Pesonen received his master's degree from the University of Helsinki in 2013, majoring in mathematics with minors in education, psychology and computer science. During 2012-2017 he worked at CSC - IT Center for Science, building Finnish national education data infrastructure in close cooperation with the Ministry of Education and the National Agency for Education. In 2017, he co-founded Rapida Ltd, a company specialising in educational data science. His personal key competency areas are learning analytics, data visualisation, data architecture and mathematical modelling.
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Jani Romanoff is a professor of marine technology at the Aalto University School of Engineering. He received his D.Sc. degree from Helsinki University of Technology in 2007. He has a vast background in research of marine structures and computational design methods and received the World Cultural Council Young Researcher Award in 2014. He has also been active in developing international M.Sc. programmes in marine technology which are based on Problem-Based-Learning and career-oriented coaching of students towards life-long learning. The programme is internationally recognised and Prof. Romanoff received the School of Engineering Award for Achievements in Teaching for his work in 2012. Prof. Romanoff has educated 8 Doctors of Science and 7 post-docs, one of whom currently holds a professorship. He has also instructed over 50 M.Sc. theses and 20 B.Sc. theses. This instruction is strongly connected with research, where he has published over 130 scientific journal and conference papers with his colleagues, mentees and students. He is currently participating in the Aalto Online Learning A!OLE project on dynamic course feedback with the objective to develop a platform for the continuous development of one's own learning.

Heikki Remes is a professor of marine technology and a vice director of the Master's Programme in Mechanical Engineering at Aalto University. Prof. Remes has 15 years of teaching experience. He has educated six Doctors of Science and supervised roughly 40 master's and 20 bachelor's theses. Prof. Remes has participated in the development of two new master's programmes as well as the marine technology curriculum. He is a member of Teaching Competence Assessment Group of the Aalto University School of Engineering. He has received a teaching award for the development of the Shipbuilder's Learning Portfolio. He has published roughly 100 scientific journal and conference papers.

Tomi J. Kauppinen is a project leader and docent at the Aalto University School of Science in Finland. He holds a habilitation (2014) in geoinformatics from the University of Muenster (WWU) in Germany and a title of docent (2014) and a Ph.D. (2010) in media technology from Aalto University. From April 2014 to September 2014, he was appointed as the Cognitive Systems Substitute Professor at the University of Bremen in Germany and, since 2015, he is a Privatdozent at WWU. He has been active in the areas of information networks, for instance by developing information visualisation approaches, opening and sharing data and creating semantic recommendation and exploration tools with artificial intelligence (AI) and knowledge representation techniques. A central theme in his work and teaching is data science and information visualisation applied to spatiotemporal phenomena and supporting the understanding of related cognitive processes. He has published or edited 100 papers/books and organised several international tutorials and workshops on information visualisation, linked data, spatial thinking and learning. He is currently project leader of the Aalto University wide strategic development project, Aalto Online Learning A!OLE.