Chapter 16
Concept Science Evidence-Based MERLO Learning Analytics

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ABSTRACT

This chapter is about Concept Science Evidence-Based MERLO Learning Analytics, an educational informatics system based on the teaching and learning methodologies described in the chapter on "Learning in the Digital Age with Meaning Equivalence Reusable Learning Objects (MERLO)" (Etkind, Kenett, & Shafrir, 2015). It collects, documents, analyzes, and reports data gathered from implementation of a pedagogy for conceptual thinking and peer cooperation in elementary, secondary, and post-secondary educational institutions, as well as from learning programs in private and public organizations.

INTRODUCTION

Concept Science Evidence-Based MERLO Learning Analytics is an educational informatics program that collects, analyzes, and reports data generated from implementation of a pedagogy for conceptual thinking and peer cooperation (Etkind et al, 2015). This pedagogy brings into focus the learners' attention on meaning by using learning activities with different representations of conceptual content that may – or may not – share equivalence-of-meaning.

The chapter covers the following topics: The first section titled BACKGROUND presents recent developments in learning analytics, showing how *Concept Science Evidence-Based MERLO Learning Analytics* is different from earlier learning analytics informatics that mostly focuses on technological issues, such as digital content delivery and interactive learning support. The next section (THE MAIN FOCUS OF THE CHAPTER) discusses three interactive streams of learning activities in this novel pedagogy: (1) Interactive Concept Discovery (InCoD) with semiotic searches of a Knowledge Repository (KR) of digital documents relevant to the course content (Shafrir & Etkind, 2011). (2) Formative and summative assessments with Meaning Equivalence Reusable Learning Objects (MERLO) (Arzarello, Kenett, Robutti, Shafrir, Prodromou, & Carante,

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2015; Etkind, Kenett, & Shafrir, 2010; Etkind & Shafrir, 2011; Shafrir & Etkind, 2006). (3) Development of learners' meta-cognitive and higher order thinking skills: cooperation; knowledge of being observed; reflection and self-evaluation (Nowak et al., 2011; Donovan & Bransford, 2005; Bloom, Krathwohl, & Masia, 1956; Anderson, Krathwohl, & Bloom, 2001). The third section (SOLUTIONS AND RECOMMENDATIONS) describes learning outcomes of pedagogy for conceptual thinking and peer cooperation. These are documented and presented in Concept Science Evidence-Based MERLO Learning Analytics at the learner and instructor levels, as well as at the level of educational institutions' policy making.

BACKGROUND

Learning Analytics

Learning analytics uses big data, a term characterizing *the exponential growth and availability of large data sets, both structured and unstructured* (http://www.sas.com/en_us/insights/big-data/what-is-big-data.html). Such data is used for: *measurement, collection, analysis and reporting of information on learners… for purposes of understanding and optimising learning and the environments in which it occurs* (Buckingham et al, 2012; p. 4. This is now a recognized, evolving trend in educational informatics:

Learning analytics integrates and analyzes "big data sets" available in educational contexts to gain a better understanding of student engagement, progression, and achievement (Lockyer et al, 2013; p. 1441).

Learning analytics often focuses on technological issues, such as digital content delivery and interactive learning support:

The focus of this research is primarily over the development, testing and evaluation of the educational content over small form factors devices in order to provide an interactive form of learning support… The metadata presentation forms the learning analytics system, which will serve as the performance benchmark for the educators, technology developers, education administrators and stakeholders (Abhyankar and Ganapathy, 2014; p. 345).

Learning analytics 'dashboards' include data on learners' classroom activities and outcome variables such as: *Time spent; Social interaction; Document and tool use; Artifacts produced; Exercise results/quizzes* (Verbert et al, 2013; p. 1505). Several 'toolkits' were constructed to facilitate documentation of these activities and reporting to the teachers (Dyckhoff, Zielke, Bültmann, Chatti, & Schroeder, 2012). It is important to note that these variables are recorded by tracking learners' traditional learning-related activities, but do not follow a specific pedagogy that guides these activities. For example, 'Time spent' and 'Exercise results/quizzes' are often a reflection on rehearsal and memorization of facts; and 'Artifacts produced' often include solutions of standard problem sets and essays summarizing events and processes described in the course textbook. In these learning tasks *the student's mind is being used as a storage-and-retrieval system, a task for which it is not particularly well adapted* (Box, 1997, p. 49).

Attempts to introduce pedagogical aspects in eLearning platforms and computer based learning in general have been published by Bell and Glen, 2008, Andrews and Haythorntwaite, 2007, and Aung et al, 2008.

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