

Chapter 5

A Grading Data Warehouse Approach to Measuring and Analyzing Learning Performance: From Grading to Competency- Oriented Assessment

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ABSTRACT

E-assessment comprises a variety of activities in and beyond the classroom. However, traditional e-learning platforms support only a part of assessment (e.g., individual and group assignments, the grading of such activities, and student record management). Typically, such platforms lack competency orientation, or face performance issues due to increasing application complexity and usage intensity. To overcome technical limitations and provide a basis for competency-based assessment, the authors present an analytics component that is inspired by data warehouses. The potential of this artifact is elaborated, and the improvements are evaluated through a case study about Learn@WU, the LMS of WU Vienna. Although the focus was competency-based aggregation of learning results, early experiences show performance increases for retrieving simple grades of 45% to 98%. Sample scenarios demonstrate how to define and calculate indicators along activity hierarchies and competency graphs to enable the measurement of learning performance along both generic indicators and competency-oriented assessment.

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INTRODUCTION

Measuring performance (aspects) and observing the progress of a learner – and using this information to guide the further learning path – is at the heart of teaching. Thus, a big corpus of knowledge concerning educational assessment has emerged in pedagogical research fields in general, and in technology enhanced learning in particular. A number of aspects are discussed in the literature. Suskie and Banta (2009) refer to educational assessment as a cyclical “ongoing process of: establishing clear, measurable expected outcomes of student learning; ensuring that students have sufficient opportunities to achieve those outcomes; systematically gathering, analyzing and interpreting evidence to determine how well student learning matches our expectations; using the resulting information to understand and improve student learning.” Educational assessment often differentiates between a formative distinction (‘assessment for learning’) and a summative distinction (‘assessment of learning’) (Rosario Hernández, 2012), and diagnostic assessment (Michel, Goertz, Radomski, Fritsch, & Baschour, 2015), as well as between subjective and objective assessment. Continuous assessment concepts (Nitko, 1995; Romero, Guenaga, García-Zubía, & Orduña, 2014) have become popular as an alternative to systems focused solely on final examinations. According to Terenzini (1989), further dimensions comprise the object of assessment (knowledge, skills, attitudes and values, behavior) and the level of assessment (individual vs. group). One particular aspect of educational assessment is to support and measure the development of competencies, i.e. by defining learning outcomes and assessing the achievement level along criteria (Krause, Dias, & Schedler, 2015).

Learning technologies may support teachers in assessment activities through various features, ranging from quizzes, assignments and surveys, over typical grading functionalities such as points, up to evaluation tools for courses or full study programs (Mödrischer, Spiel, & García-Barrios, 2006). In the classroom situation, educators who have a profound didactical expertise achieve sophisticated assessments through adequate teaching activities. Such teachers observe their students or even apply formative assessment methods in order to improve learning of students before a course ends. In digital environments, however, teachers are often restricted to only a handful of indicators (e.g. test results) for assessing a student’s overall performance. This is especially true when large amounts of students have to be assessed, where a teacher is not able to follow the achievements of all students without tools (e.g. in introductory courses at large universities). Moreover, even these sparse indicators are traditionally aggregated into single marks, resulting in very abstract representations of a person’s knowledge and ability. User interactions with technology are rather ignored, although they could be a valuable source for assessing the learning of students, might even allow to draw conclusions on competency levels of students or help them in successfully achieving learning outcomes (Agudo-Peregrina, Iglesias-Pradas, Conde-González, & Hernández-García, 2014).

With respect to this, at least two trends are particularly important: (a) the notion of competency-oriented education and assessment, and (b) the increase of teaching and learning analytics for using data in order to support students and teachers. This chapter presents a design science research approach for a generic analytics infrastructure – namely a learning performance repository – that is capable to manage the performance of learners not only through results (i.e., points and grades) that are manually entered by teachers but also through user interaction data of a Learning Management System (LMS) that is captured in an automated way. The learning performance repository furthermore enables the mapping of these performance indicators either to grades or to a network of competencies. Additionally, the design

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