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Procedia - Social and Behavioral Sciences 228 (2016) 608 – 613

Procedia
Social and Behavioral Sciences

2nd International Conference on Higher Education Advances, HEAd´16, 21-23 June 2016, València, Spain

Ten good reasons to adopt an automated formative assessment model for learning and teaching Mathematics and scientific disciplines

Alice Barana[a], Marina Marchisio[a]*

[a]*Department of Mathematics, University of Turin, Via Carlo Alberto 10, 10123 Torino, Italy*

Abstract

This paper will analyze an educational model for automated formative assessment developed at the Department of Mathematics of University of Turin for learning and teaching Mathematics and scientific disciplines. The model is provided through an automated grading system which, empowered by the engine of an advanced computing environment, allows the creation of algorithmic variables and open mathematical answers, recognized in all their equivalent forms.

The adoption of automated formative assessment brings many advantages to learning. Easily available assignments, immediate feedback, adaptivity, the chance of learning from mistakes turn assessment into a fundamental enhancement in education; the intrinsic "rigidity" of technology can also have positive results on students' path to knowledge. Automated assessment brings innovation into teaching: time saved in grading can be used to improve materials and activities, teachers easily get information about students' learning, they need to change their approach and to attend trainings; sharing and collaboration among teachers are facilitated.

Results obtained by the application of automated formative assessment in several class experiences are discussed and data about emerged satisfaction and criticisms are shown.

Peer-review under responsibility of the organizing committee of HEAd´16

Keywords: Advanced computing environment; automated formative assessment; e-assessment; e-learning; mathematics; virtual learning environment.

* Alice Barana. Tel.: +39-6702880; fax: +39-6702878.
E-mail address: alice.barana@unito.it

Peer-review under responsibility of the organizing committee of HEAd´16
doi:10.1016/j.sbspro.2016.07.093

1. Introduction

While Digital Natives, according to Prensky's prediction (Prensky, 2001), are conquering the technological universe, Digital Immigrants are committed to transforming all the facilities in order to satisfy the new necessities. E-learning and web-based technologies are spreading across the educational world, providing online courses for primary education, high schools, universities and professional training. With the birth of the first Massive Open Online Courses (MOOCs) offered by Harvard University in 2011, the global e-learning market reached $35.6 billion and the annual growth is estimated at 7.6% (Docebo, 2014). E-learning is widely considered as a leading factor for the development of education and economics, as it helps to deliver lifelong learning, to shorten the distance between instruction and work and to reduce costs. (SMEs & e-LEARNING Project, 2015). Within this framework, researches on innovative didactic methodologies have been stimulated, and has brought a true revolution in teaching and learning. The role of teacher has changed and different learning environments have been taken into account. Moreover, assessment has acquired relevance, since it fosters engagement and motivation, besides being able to raise scores and create standards. The University of Turin is breaking into this scenery developing an innovative model for formative assessment for Mathematics and scientific disciplines based on automated evaluation (Barana, Marchisio, & Rabellino, 2015). This paper will analyze and discuss the advantages and criticisms of this model and discussed and some relevant results of its application will be reported.

2. Tools for automated formative assessment

E-learning courses are based on the idea that students can access resources and activities at their own pace according their needs. Being forced to wait for the teacher's feedback after submitting an assignment is an obstacle to the independence of the students in organizing their own learning. A tool which automatically grades answers and provides individualized feedback is essential in the implementation of an e-learning or blended course. Within the online courses of the Department of Mathematics of the University of Turin the automated assessment system Maple T.A. has been adopted, due to its suitability for Mathematics and scientific disciplines. Thanks to the advanced computing environment, the engine behind the question execution, it is possible to create variables based on algorithms, random mathematical formulas and graphics. Open mathematical answers are accepted and grading algorithms can be implemented to verify if the given answer matches the correct one independently of the form: this allows to go beyond the multiple choice modality, develop different and complex cognitive processes, and test true skills and competences (Barana & Marchisio, 2015). Questions can be collected into assignments and proposed to students; online courses offered by the University of Turin are provided through the learning management system Moodle integrated with Maple T.A.: the automatically graded assignments can be mixed with the other activities of the courses. Maple T.A. gradebook, where all the students' results are recorded, is integrated with the Moodle one.

The Department of Mathematics has designed an application of Maple T.A. for the formative assessment and it has started to spread it. Through several projects and collaborations with schools and educational institutions at local, national and international level, the university is training numerous teachers to the use of this educational model and is supervising experiments in blended and e-learning courses.

3. Ten key strengths of the automated formative assessment model

An automated testing system undoubtedly fits the purpose of prognostic evaluation, detecting gaps in students' preparation before attending a course and checking if all the contents have been correctly acquired. It is able to return remarkable results when it is applied to the formative evaluation (Scriven, 1967) in order to perform an assessment not only for learning – in opposition to the assessment of learning – but also for teaching (Hattie & Yates, 2014). The designed model of automated formative assessment proposed by the University of Turin has the following features – listed below – which can be considered ten key strengths useful to enhance the teaching and learning of scientific disciplines. Let us start examining the point of view of students.