

AN E-ASSESSMENT SYSTEM FOR MATHEMATICAL PROOFS

ABSTRACT

Due to mass lectures and reduced personal resources, e-assessment gains importance. Typical e-assessment systems focus on multiple choice, inserting short text, and other simple forms of examination. They are not suited for examining creative tasks. In particular, there are very few systems for assessing mathematical calculations or proofs, and the few existing ones have very limited functionality. We have developed the e-assessment system EASy which focuses on mathematical proofs. Moreover, we have evaluated this system in a lecture on data structures and algorithms with more than 200 students.

KEY WORDS

Quality Control and Assessment, Educational and Training Systems, E-Assessment in Mathematics, Handling of Mass Lectures

1. Introduction

Computer-supported learning, also called e-learning, has become vital for many organizations especially in higher education. E-learning is not limited to the distribution of learning contents via the internet, but also includes the regular assessment of the learning progress. Assessments help to identify and to evaluate teaching success. Today, most assessments still take place without computer support. But especially in the face of mass lectures, decreasing resources and low personnel capacities computer-supported assessments help to reduce time and costs. For this reason, e-assessment systems gain importance in academic e-learning infrastructures [1]. Today's e-assessment systems meet a variety of conventional examination requirements. Typically, they offer multiple choice questions, insertion of short text, and other simple forms of questions. They can examine knowledge, but they are not very well suited for checking creative skills such as programming or proving mathematical theorems.

Thus, we have developed an e-assessment system called EASy focusing on mathematical proofs and calculations. The rest of this paper is structured as follows. In Section 2, we discuss the requirements of an e-assessment system for mathematical proofs and mention related work. In Section 3, we describe the design and handling of EASy. The results of an empirical evaluation of EASy will be presented in Section 4. In Section 5, we conclude and point out future work.

2. E-Assessment in Mathematics

The following three different forms of assessment can be distinguished: self-assessment by the student, (weekly) exercises (e.g. accompanying a lecture), and formal examinations (e.g. at the end of a course). From the point of view of the core mathematical features of a corresponding e-assessment system for mathematical calculations and proofs, they are similar. Since we want to gain experience with a prototypical e-assessment system, we will focus on the use in exercises. This allows us to concentrate on the core mathematics and ignore e.g. organizational, security, and legal issues which would have to be taken into account when considering examinations (see e.g. [2, 3]).

2.1 Requirements

E-assessment systems that are supposed to support exercises consisting of the formulation of mathematical theorems, their proof and revision have to fulfill a wide range of specific demands.

Proof Strategy: There is a large number of proof strategies in mathematics such as e.g. different induction schemes, case distinction, estimations, and transformations. An e-assessment system has to provide all the strategies relevant for the considered course. The student has to select an appropriate combination of the predefined strategies for the considered proof.