Chapter 9

Designing and Randomising Multiple-Choice Questions for E-Learning in Mathematics Using MVGEN

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ABSTRACT

MVGEN is a multi-version question generation tool that allows creating multiple-choice questions with a large number of versions and multi-version tests using different randomisation techniques. These techniques include simple randomisation through shuffling of lists with keys and distractors or random selection of options from lists with several keys and distractors, but also more complex randomisation of parameters and variables using association tables. In this chapter, examples of multiple-choice questions in higher education mathematics are presented, and the design and randomisation techniques are explained.

INTRODUCTION

In higher education Mathematics and in STEM (Science, Technology, Engineering and Mathematics) education, where courses usually have a very high number of students, multiple-choice questions (MCQs) are the most common and the most widely used question type in e-learning and e-assessment but also in the traditional face-to-face learning and assessment. In order to create in a simple and fast way a high number of question versions and test versions for learning and examination, the multi-version question generation system MVGEN is an adequate tool, since it not only allows to create randomized multiple-choice questions in the standard LaTeX language, but also permits to control and dominate the entire exercise generation process in an easy way.

The purpose of this chapter is to provide a short presentation of the question generation system MVGEN and to explain how multiple-choice questions can be designed using different randomisation techniques. Simple randomisation techniques, such as random selection of options from lists with several keys and distractors or shuffling of lists permitting a random display of options are explained, as well as more complex randomisation using random parameters and association tables. Once a multiple-choice question has been built, a different version of that question can then be obtained by: 1) just shuffling the order of the choices, where the choices themselves remain the same; 2) shuffling the order of the choices and permitting different choices; 3) generating a similar question by changing e.g. an element of the stem together with the key and distractors. Examples of multiple-choice questions from Mathematical Analysis are presented to exemplify the different randomisation techniques.

Regarding the online distance course design and multimedia in e-learning, it is of utmost importance to have available technology and methods for the implementation and construction of online course materials for learning and assessment. This chapter contributes to this end by presenting MVGEN as a flexible tool for the design and construction of multiple-choice questions in higher education Mathematics and by presenting and explaining different randomisation techniques for MCQs. The ideas and techniques can be implemented using also other exercise generation systems. Furthermore, it serves to reflect about the challenges associated with the design and the generation of multiple-choice questions in Mathematics. In particular, problems associated with the randomisation of questions are addressed, that instructional designers and teachers face when building versions of questions for courses with a high number of students.

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