Chapter 3
Question Selection in Template-Based Test Paper Models

ABSTRACT

The success of any educational program depends on its evaluation system. Examinations are a part of learning process which acts as an element in evaluation. For the smooth conduct of examinations of various universities and academic institutions, the test paper generation process would be helpful. However, examination test paper composition is a multi-constraint concurrent optimization problem. Question selection plays a key role in test paper generation systems. Also, it is the most significant and time-consuming activity. The question selection is handled in traditional test paper generation systems by using a specified test paper format containing a listing of weightages to be allotted to each unit/module of the syllabus.

RELATED WORK

Automatic test paper/test paper generation is considered as the process of searching test items/questions from a Question Bank (QB) and composing it on the basis of the test paper specifications (Van der Linden, W. J. and J. J Adema. 1998; Lirong, X. and Jianwei, S. 2010). The process of test paper generation needs huge searching space, complex computing and multi-objective optimization. Intelligent algorithms employ the process of multi-

DOI: 10.4018/978-1-7998-3772-5.ch003

objective optimization to compose a test paper. The representative algorithms of intelligent optimization approach generally found suitable for question selection in adaptive testing are evolutionary computation based genetic algorithm and swarm algorithm type (Deb, K.,et.al. 2002; Laumanns, M., et.al.2000; Chen, M.R. and Lu, Z. 2008; Subhashini, R. and Kumar, V. J. S. 2010). In this chapter, three different multi-objective evolutionary optimization approaches namely evolutionary approach, elitist evolutionary approach and elitist differential evolution approach have been discussed. A Multi-Objective Question Selection Algorithm (MOQSA) supported by all the three approaches have been designed for solving the multi-objective optimization problem of question selection in template-based test paper model. The template generated in chapter 2 guaranteed the generation of a test paper with proportionate allocation of weightages to modules of a subject, proportionate allocation of weightages to cognitive processing levels, of taxonomy and maximum marks, but did not assure the quality of a test paper based on other criteria such as time duration, number of questions of each question type, total number of questions, difficulty level of questions on the basis of number of times the question was asked in the previous examination (exposure limit), etc. Hence, it was significant to accept the Test paper Template (QPT) generated in chapter 2 as one of the inputs, and to provide additional question selection constraints specified above and complete the process of question selection in the test paper model (Paul et al, 2014; Paul et al, 2013). Our question selection process includes the following five main steps-

1. Formulate a set of question selection vectors under each cell of the QPT satisfying the module level weightages of the cell.
2. Generate random initial population of question selection vectors using any of the evolutionary approach. Perform selection of Question Set (QS) on the basis of the generated question selection vector population.
3. Evaluate QS and apply Multi-Objective evolutionary approach-based operators such as selection, crossover and mutation to optimize the computing process of question selection.
4. Continue iterative population generation of selection vectors using Evolutionary Approach.
5. Terminate evolutionary approach after the user specified number of iterations or after completion of the optimal question selection process (whichever is earlier).