

Elementary Level Botanical Item Generation

Cognitive Ability Items

Bloom and his colleagues (1956) defined three domains for classifying teaching objectives: cognitive, affective, and psychomotor. They use cognitive domain to measure human mental skills (e.g. memorization). Many educators use Bloom’s Taxonomy to evaluate students’ cognitive levels of the knowledge. Anderson and Krathwohl (2001) revised the original Bloom’s Taxonomy to a two-dimension matrix which covers knowledge process and cognitive processes of human beings.

Our previous system generates true/false items automatically (Chen et al., 2008). The generated items can be used by teachers to evaluate students’ two basic cognitive abilities: list and describe. The system uses generative grammar and transformation rules proposed by Chomsky in 1957 to generate correct and incorrect statements for constructing the true/false items. This paper describes the automatic item generator which extends the idea to construct multiple choice items to evaluate students’ four cognitive abilities: list, describe, summarize, and classify.

System Architecture

As Figure 1 shows, the automatic item generator needs three steps to construct multiple choice items for the students, and is also an adaptive test system:

1. Teachers can create different knowledge topics for their different courses and/or lessons with Knowledge Map Editor as Figure 2 shows. They can add, insert, delete, and modify concepts stored in the knowledge maps for each topic anytime before their students take the exams.
2. After the teachers create the knowledge maps, the students can take the exams with the Item Selection module. The Item Selection module requests the Item Generation module to construct items according to the concepts retrieved from the knowledge map and stores the items in the Answer Sheet database. Students’ answers are also stored in the Answer Sheet database. As Figure 3 shows, the item generator delivers items one by one after the student clicks on the “ready to take the exam” button. The stem of the multiple

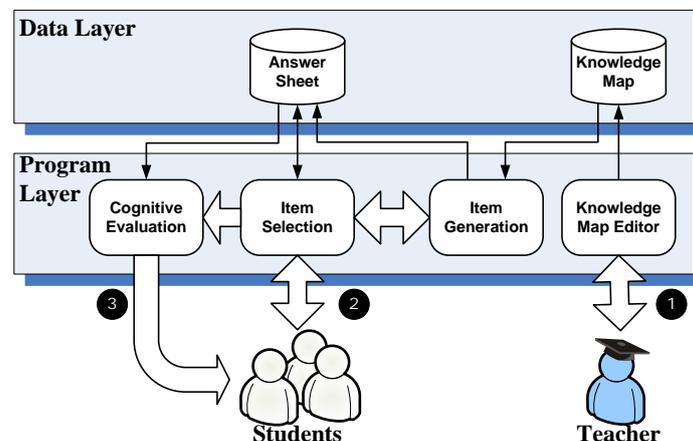


Figure 1: System Architecture of the Automatic Item Generator

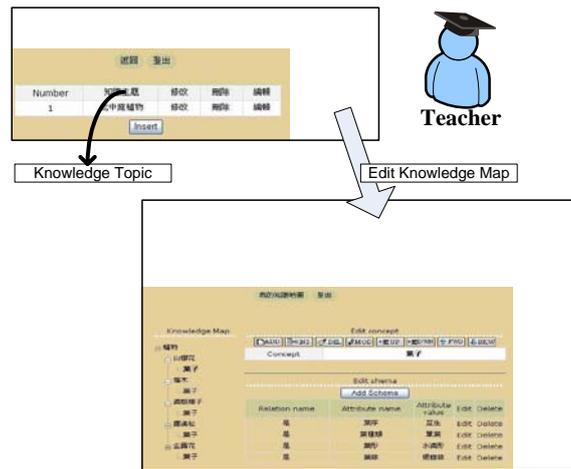


Figure 2: Knowledge Map Editor

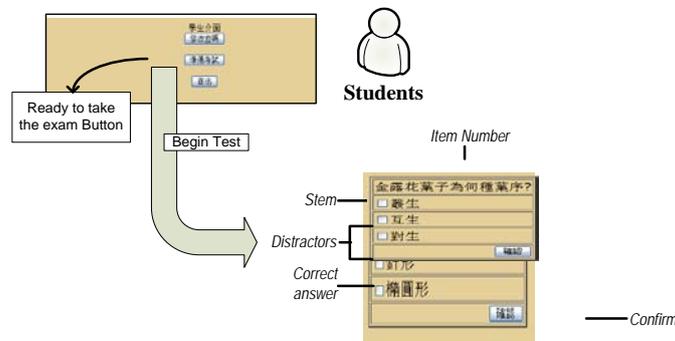


Figure 3: The multiple choice item constructed by the Automatic Item Generator

choice item in Figure 3 asks students to answer what the arrangement of leaves the Duranta has. The correct answer is option 3, and the other two options are the distractors and incorrect answers. The students can check the answers they think are correct and click on the “confirm” button to send their answers back.

3. When the students complete the exams, the Cognitive Evaluation module presents the students the evaluation results about their cognitive abilities toward to each concept.

Experiment and Evaluation

Nineteen fifth grade students (around 11 years old) from the northern part of Taiwan participated in this study at May, 2009. The participants included ten boys and nine girls. The item generator dynamically constructed different multiple choice items of the lesson, “Knowing the Plants”, according to the students’ answers. The students spent 15 minutes in average to write their exams. We conducted an eight-item questionnaire with 5-point Likert scale for collecting the students’ perceptions towards the item generator.

According to the questionnaire feedback, 73.68% of students agree or strongly agree that the Automatic Item Generator is easy to use. Only 15.79% of students indicate that they

encountered difficulty in using the item generator. A really encouraging feedback for us is that 78.95% of students think the items generated by the system are helpful. The teachers also suggested to us to make the item generator insert relevant pictures besides the items in order to reduce the difficulty of the items.

Conclusion

This research extends our previous true/false item generator to build an automatic multiple choice item generator. The new item generator not only constructs multiple choice items, but also constructs the items which can be used by the teacher to evaluate more students' cognitive abilities: to summarize and to classify.

Teachers can use the Knowledge Map Editor to build their own knowledge bases for different knowledge topics and/or courses. The students can take the adaptive exams which cover both of true/false and multiple choice items. When the students complete the exams, the item generator delivers the diagnosis reports to the students.

The item generator also records the students' actions during the exam and we will ask experts and teachers to evaluate the system accordingly. Our ongoing tasks include: (1) analyzing the relations between students' computer attitudes and academic performances; (2) finding the teachers' perceptions in relation to the difficulty of the generated items; and, (3) comparing the students' cognitive abilities as thought of by their teachers and as found by the generator.

Reference

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