An Authoring Tool for Semi-automatic Generation of Self-assessment Exercises

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Abstract. In this article we propose a semi-automatic generator of self-assessment exercises. This work is part of the CLAIRE project the aim of which is to design a collaborative authoring platform for pedagogic content. The proposed generator of exercises allows the author (usually a teacher) to create a model of exercise according to his/her pedagogic objectives. This model is automatically instantiated to produce several different exercises that evaluate the same skills. The learner's answer is automatically and instantly evaluated by the system. He/she thus receives immediate feedback on his/her skills. The distinctive feature of this generator is that the proposed types of exercise are independent of the domain, which allows them to be used for many different subjects and levels. In addition, domain knowledge is used to facilitate the author's task when the model of exercises and the diagnostic are designed.

Keywords: semi-automatic generation of exercises , authoring tool, self-assessment, automatic diagnostic.

1 Introduction

The CLAIRE project [1] (Community Learning through Adaptive and Interactive multichannel Resources for Education) aims at creating an open-source platform for collaborative authoring in the field of higher education. It contains a generator of self-assessment exercises that allows execution of the exercises and automatic diagnostic of the learner's answers. In order to allow the learner to autonomously check his/her level of proficiency in what has been learned on the course, every exercise should have a different version at every new attempt of the learner. However, it is difficult to ask the author to write many versions of each exercise. Thus, we propose using a generator of exercises.

Several generators of exercises exist but none of them match all the features we require: the exercise is different every time; the author has total control of the exercise content and is ensured that the exercise matches his/her pedagogic goals; the generator of exercises can be used in different subjects and levels; the answer diagnostic is automatic and immediate; designing an exercise is not excessively time-consuming for the author; designing an exercise requires no technical skill. This article describes the solution that we propose in the context of CLAIRE.

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The article is structured as follows: section 2 is a succinct state of the art of the generators of exercises. Our proposition is explained in section 3. Lastly, section 4 concludes the article and describes the further directions of our research.

2 Generators of Exercises: State of the Art

We can classify the generators of exercises in three types. The first one contains the **automatic generators** like in the microworld APLUSIX [2]. With this kind of generators, many exercises are created automatically but the author has no real flexibility.

The second class of generators of exercises contains the **manual generators**. They allow the author to define precisely the content of the exercise and all his/her preferences. Such a generator can be found with the authoring tool GenEval [3]. Unfortunately, we cannot use a manual generator of exercises in order to meet our need for a large number of different interactive self-assessment exercises.

Semi-automatic generators of exercises combine the advantages of the two previous classes of generator. The most relevant work regarding our needs is the GEPPETOp (GEneric models and Processes to Personalize learners' PEdagogical activities according to Teaching Objectives - Paper) approach [4] that makes it possible to define and generate exercises in a semi-automatic way and which can be used in many fields. GEPPETOp is designed to produce paper exercises and requires some improvements to feet our context: we want to generate interactive exercises with automatic diagnostic.

3 The Generator of Exercises of CLAIRE

3.1 Architecture

The architecture of our proposition is presented in figure 1. The upper block is composed of the levels of representation of the exercises. The mechanisms that manipulate these exercise representations are in the central block. The lower block contains the resources and the knowledge used in the exercise creation process.

The resources are the "raw material" needed to build the exercises. They can be, for example, texts, pictures or multiple choice questions. Each resource is characterized and enriched by metadata such as a caption or annotations on different zones of a picture. The domain knowledge (see 3.2) is knowledge concerning a subject and is independent of the type of exercise.

The author creates the model of exercises[1] using a dedicated tool based on the knowledge of types of exercise[2]. This exercises model creation tool helps

[1] A model of exercises contains constraints and preferences of the author about the content of the generated exercise. For example: "I want a cloze test with one of these texts, removing the following words: if, then, else, switch.".

[2] What is called "type of exercise" is the form of the question. For example, the following types of exercise can be found: "right or wrong", "cloze test" or "translation".

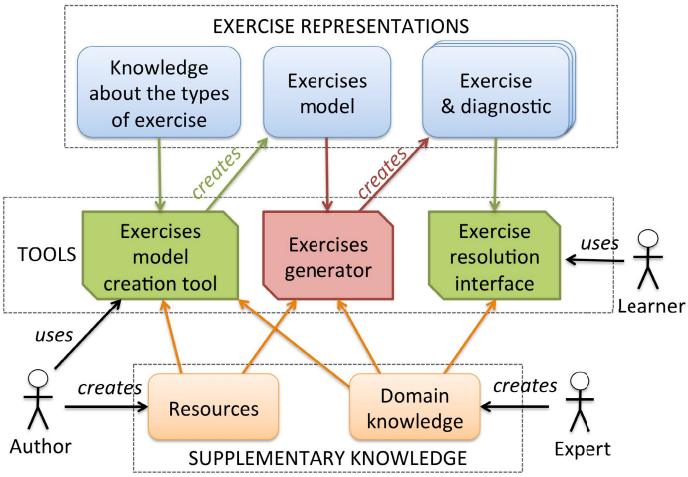

Fig. 1. The architecture of our approach

create the model, especially using the domain knowledge. It also generates some exercise examples to check that the exercises are created as expected. Finally, this tool facilitates access and choice of the resources and allows the author to create new ones.

The generator receives as input a model of exercises that it instantiates to generate output exercises (and their diagnostic) without human intervention. The exercises follow the model and thus the author's preferences. The exercises are given to the user through the resolution interface. This tool formats and displays the exercise, collects the learner's answer and gives him feedback on it.

3.2 Domain Knowledge

The domain knowledge is specific to a subject, a context or a field but it is independent of the type of exercise in which it may be used. For example, it can consist of the list of the key words of the C programming language, a way of detecting the gender of a noun (in foreign language), the value of a constant, etc. Depending on the type of knowledge, the form can vary: constant value, computation formula, rule, enumeration, etc.

Such knowledge is used at two different levels. Firstly, it facilitates the exercises model creation because this knowledge can be used instead of defining it again and again for each model of exercises of the domain. Moreover, it reduces the risk of author errors. Secondly, the domain knowledge can be used for the diagnostic of the learner's answer (cf. 3.3).

The creation of domain knowledge is independent of the creation of the models of exercises and not every author will wish to spend time on it. This task is performed by an expert in the domain who has the technical skills to create domain knowledge.

3.3 Diagnostic

In our approach, the learner answers online and receives an instant diagnostic of his/her answer without human intervention. In the case of an exercise with many possible right answers, it can be a problem. Sometimes, it is difficult to ask the author to provide all the right answers because they can be too many. To solve this issue, rather than generating a solution to the exercise (when the exercise is generated), we generate a model of solution that covers all the right solutions. This information about the acceptable answers comes (1) from the model of exercises in which the author has specified the tolerance and variations of the answer or (2) from the resource that is used which encloses a model of the acceptable solutions.

4 Conclusion and Future Work

In this article we present the self-assessment exercises generator of the CLAIRE platform. This generator is semi-automatic and it creates interactive exercises with automatic diagnostic. This generator allows an author to create a model of exercises which is instantiated by a generator to create many exercises that evaluate the same learner skills. The learner answers the exercise through a computer interface and obtains an immediate diagnostic of his/her answer. This solution is an interesting compromise between the authoring tools to create an exercise in total accordance with the author's choices and the automatic generators able to create many exercises of the same type on a given theme.

The first experiments we carried out in the laboratory allowed us to validate the architecture of the generator. It will soon be tested when CLAIRE is fully operational. This will allow a larger scale validation in real conditions.

The generator of exercises being independent of the domain, domain knowledge does not exist at the beginning. Its acquisition is thus a very important issue. At present, only manual creation is supported and carried out by an expert. We would like the author, especially if he/she is not a computer scientist, to be assisted in the definition of domain knowledge as he/she builds activities.

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