Problems of building adaptive integrated learning environments

Ildar Galeev, Larissa Tararina, Oleg Kolosov
Kazan State Technological University, Russia
monap@kstu.ru

Abstract

The paper is concerned with a partially integrated environment which supports the main types of teaching and learning activities and provides a high-level adaptivity to the learner due to the proposed architecture of the environment, including an intelligent tutoring system (ITS).

In the current educational practice three types of computer means can be distinguished, which are most often used in computer – assisted teaching and learning process: electronic textbook, containing theoretical material (knowledge) on the subject and generally represented as a hypermedia system; tests to supervise the knowledge received by the learner as a result of studying the textbook; intelligent tutoring systems, providing adaptive assimilation of skills in the process of solving tutorial problems on the basis of the knowledge obtained.

According to the separated components, the process of learning is carried out in 3 stages. On the first stage the learner studies theoretical material, stated in one of the textbooks, using the navigation support. The means of navigation for the textbook can widely vary from the simplest “look-and-list” to advanced ones, which include links of different types (context-dependent, context-independent, from index pages and content pages, on maps, etc.). The textbook can be developed with the help of any tools available to the teacher. The second stage is intended for checking the learner’s knowledge of theory. For this purpose one of relevant tests is used, which was designed with the help of the authoring tools developed. During the third stage the learner solves the problems on the subject under the ITS adaptive control. At each step of this stage of learning, ITS, according to the results of problem solving, takes decisions on: the continuation of learning (the learner is given the next problem adequate to his or her knowledge); successful finishing (the objective of learning has been achieved); emergent finishing of the stage (the learner is directed a new to learning the theory). A convenient graphical interface is used for the concrete direction of learning which is determined and (or) choosing the outer path describing the components of the environment and the order of leaning its components, which are relevant to the learner: the textbook or its chapter, a test or ITS. The inside paths during the third stage of learning are dynamically formatted by ITS in accordance with the results of solving the learner’s problems. An overlay model of the learner’s knowledge is used for the adaptive support of navigation in hypermedia and adaptive presentation of theoretical material. The updating of the “meaning” in the set of pairs “concept-meaning” is carried out according to the test results. In this case the adaptation to the level of the learner’s knowledge is increased at the first stage of learning theoretical material. The new approach to adaptation is connected with the application of the overlay model of the learner’s skills which was implemented in ITS, designed with the help of MONAP-II. Unlike the overlay model of knowledge, the overlay model of skills is represented as a set of pairs “rule-meaning”. In this set the rule is given in the form “IF (condition), THEN (action)”. The set of rules serves to describe the skills necessary for correct solving of tutorial problems. Every rule, used to solve the problem, is described by its own set of concepts. For different rules these sets can be completely coincident, partially coincident or totally different. In the general case the concepts indicated in the text “the condition” of the rule may be logically linked by “AND”, “OR”, “NO”. The “meaning” in the skills overlay model is an integrated assessment of the complete rule assimilation. It can not be used to assess the assimilation of an isolated concept. In this connection it is necessary to conduct the following research: whether it is possible to build the overlay model of the learner’s knowledge using the overlay model of his skills, i.e., to build the set of pairs “concept-meaning” using the set of pairs “rule-meaning”. It is also necessary to evaluate the reliability of this operation. If such a transformation of the skills model to the knowledge model is possible and reliable, then there is a good reason to use the developed technologies of adaptation in educational hypermedia. Otherwise it is essential to develop new adaptation technologies. The solution of the formulated problem will make it possible to rise considerably the level of the environmental adaptation to the learner at the third stage, when it is necessary (or
advisable) for him to turn to the textbook if he has mistakes.