Tutoring Process And Artificial Intelligence

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***Abstract*—It is argued that the best way to implement artificial intelligence applications is a systematic approach that covers the entire area of action under study, and is based on the appropriate scientific theory, which for tasks related to education is the theory of pedagogy. The statement is illustrated by an example of a conceptual solution to the problem of implementing the learning process.**

Keywords—artificial intelligence, pedagogical theory, systems approach, educational process, learning, tutoring, educational material, set of tasks.

I. INTRODUCTION

We are all witnesses, and some of us are participants, of amazing progress in the interpretation of human thought patterns by information technology. Every day we are faced with how the impossible becomes first possible, and then necessary. The countless number of publications devoted to the use of artificial intelligence (AI) shows what a huge human resource is employed in this area of activity. The speed with which we are increasingly forced to abandon typically human functions in favor of computer programs is so frightening that it contributes to the flourishing of all sorts of speculation and horror stories on this topic. Yet the tangible benefits of AI development make it difficult to seriously resist progress in this area. Including in the field of education. Moreover, AI penetrates into all aspects of the educational process, including its administration, helping students and facilitating the work of teachers.

How do AI achievements penetrate into the practice of the educational system? First, there is an request. The pedagogical community, observing undesirable phenomena in the practice of their work that cannot be corrected by conventional methods, formulate a certain need. At the same time, one way or another there are groups that set themselves the task of satisfying this need. Secondly, teams that have created successful AI applications are looking for opportunities to apply their achievements in a new area, such as education. Both the first and second groups of researchers proceed from observed practice, the shortcomings of which they seek to correct.

Using the example of one rather narrow problem related to the educational process, the author will try to show how much easier the solution of the AI problem is if, when setting the problem, we proceed not from the existing practice of pedagogical activity in some area, but from the requirements of pedagogical theory applied to the complete process, otherwise speaking, the implementation of a systems approach.

II. FIELD OF STUDY

There are many types of AI that help students accumulate knowledge and skills in the learning process. This material is devoted exclusively to the tutoring process. We will not be interested in AI applications that make it easier for students to find the material they need. We will not consider AI elements built into educational material, including such powerful tools as augmented and virtual reality. We will focus on three aspects of the tutoring process:

– detection of irregularities in the execution of tasks,

– detection of gaps in knowledge and skills that the student should already possess,

– generation and presentation of educational material and new tasks to the student, according to his mistakes and gaps.

III. • STARTING POINTS

As is known [1], the tutoring process begins at the moment when a student makes a mistake in completing the tasks given to him. Tutoring may not occur if the student each time independently copes with the tasks accompanying the next portion of educational material. But as soon as a student makes a mistake, the task and process of correcting his possibly incorrect understanding of the piece of knowledge contained in the presented educational material arises. This single error tutoring process is as follows:

– error detection,

– correlating the error with the corresponding fragment of the educational material that must be studied,

– selection or formation of a fragment of educational material and a new set of tasks that is more accessible to the student's understanding,

– presenting a complex of a fragment of educational material and a new set of tasks to the student for assimilation and completion,

– making a decision to limit the number of iterations associated with the same fragment of educational material.

Running this procedure every time an error occurs while completing assignments throughout the course is what constitutes tutoring. Obviously, the process described could be performed by a person, named a teacher. However, given the large number of students in the class, the curriculum, the need to repeat the tutoring procedure as many times as necessary until the error is eliminated and, finally, doing this for each student who made an error seems completely impossible. Although a full-fledged tutoring procedure implemented in practice assumes that, as a result, all

educational material will be mastered by all students, which is undoubtedly a very important achievement. Since such (or anything close to it) effect has not been observed in school practice, it seems that it is in this direction that the creators of AI systems, unfortunately, have not yet succeeded.

IV. Possible solution to the problem

There are two ways to create an AI application that solves a specific problem, namely:

– study the current practice with existing textbooks, problem books, student behavior, the impact of teachers on the process and, based on all this, make incredible efforts to solve the problem;

– on the basis of modern pedagogical theory, create textbooks and sets of assignments that would allow the existing problem to be overcome at the lowest cost.

The author made an attempt to conceptually implement the second approach, as the least labor-intensive. Its main features are as follows:

1. The educational course is presented in the form of interconnected lesson fragments of educational material in such a way that each fragment contains at least three and no more than five elements that require meaningful attention of students. (For example, a fragment devoted to Ohm's law contains the following elements: voltage, current, resistance, their relationship and algebraic transformations as previously studied material from a mathematics course. Moreover, it is the relationship of the elements that reflects the essence of Ohm's law.) This requirement is due to the fact that it will not be difficult for a student to simultaneously hold five different elements in his/her head, which is very useful when studying educational material [2]. If there are less than three such elements, then the student's attention will be scattered. He/she will be distracted because the learning material is not rich enough to keep the student engaged in it.

2. For each lesson fragment of educational material, a set of tasks is created, the purpose of which is to show that if all tasks in the set are completed correctly, it can be argued that the student has mastered the educational material of the fragment. Thus, the set of tasks should contain questions on understanding each element and their relationship, as well as tasks on the necessary transformations that allow you to determine each element through the others. At the same time, it was discovered that since the number of elements in a lesson fragment does not exceed five, a set of tasks covering all aspects of the material being studied will not be too voluminous. In practice it will not exceed 20-25 tasks. This was an additional useful quality of limiting the quantitative volume of lesson-based educational information presented to the student. Each task is supplied with the correct solution - a standard, naturally hidden from students.

3. A software product is created which task includes the following:

– compare the student's solution with the standard,

– if a discrepancy is detected, direct the student to that part of the fragment of educational material that concerns the elements that caused the problem for the student,

– present the student with a modified set of tasks.

This is the basis of the concept of an electronic tutor [2]. The following are the details that ensure the functionality of the entire system. Thus, along with the main educational material of each lesson fragment, more detailed parts should be prepared corresponding to each incorrectly completed task, so that if the task is completed incorrectly again, the student ends up not with the original educational material, but with a detailed one. If this does not resolve the student's problem, the system must acknowledge the failure and pass on the appropriate information to the teacher to resolve the issue.

Once the concept of an electronic tutor begins to operate, it will rapidly begin to accumulate statistics, since both educational materials and their fragments, as well as all sets of tasks and their completion by students, appropriately coded, will become its basis. As the system grows, new educational materials are connected to it, and new generations of students use the educational courses already in the system, the accumulated statistics will become the basis for AI research regarding the quality of the system used in terms of improving educational materials, sets of tasks, and the electronic tutor procedure itself.

Even such a brief and schematic presentation of the concept of an electronic tutor shows that there are no unresolved problems for its implementation in practice. You can just start doing it.

V. Final thoughts

Civilizational progress has led to the fact that in modern schools the main part of the educational process associated with learning has been discarded. Despite the fact that pedagogical science describes a complete pedagogical cycle, containing both the teaching stage and the teaching stage, in practice, in both secondary and higher education, only teaching remains in the educational process. In fact, the task of implementing the learning phase was taken on by an army of tutors, as well as relatives and friends of the students. This solution is out-of-system, it is not available to everyone, but there is no better one yet. Individual attempts to help pupils and students learn all the necessary educational materials remain isolated attempts for now.

The considered example of a conceptual plan for implementing the training stage shows that an integrated approach to creating AI applications greatly simplifies the solutions sought. Reliance on the achievements of pedagogical science, the readiness not only to look for solutions in existing practice, but to subject the entire process under study to improvement leads to the goal easier and more accurately than empirical attempts at partial improvements.

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