Education in Accounting using an Interactive System

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Abstract: This paper represents a summary of a research report and the results of developing an educational software, including a multi-agent system for teaching accounting bases and financial accounting. The paper describes the structure of the multi-agent system, defined as a complex network of s-agents. Each s-agent contains 6 pedagogical agents and a coordinator agent. We have defined a new architecture (BeSGOTE) that extends the BDI architecture for intelligent agents and we have defined a mixing-up relation among the accounts, presenting the way in which it can be used for testing students.

Keywords: Computer Aided Education, Multi-Agent System, Artificial Intelligence, Accounting Education

1. Computer Aided Education in Accounting

The contemporary accounting schools is one based on competences, but we need to make the distinction between the assigned competences of an accountant while practicing his job in his office and the competences achieved by a university professional training program [1].

The International Federation of Accountants [2] states very well the competences that should be acquired after graduating a professional training program on accounting. One of our research purposes is to establish the skills that should be acquired by studying "The Bases of Accounting". These competences will be acquired by the students as a result of teaching some learning units and we consider that the accounting analysis is a key element in learning the accounting.

The Computer Aided Education facilitates the student's access to more information well organized, variedly structured that can be viewed in different variants. Obviously, this way of education uses the new information and communication technologies in a direct way, but the pedagogical effects are the result of using different interactive software. When it comes to the Computer Aided Education the main role is played by the student and it takes into account his/her heredity, experience, perspectives, training, talents, abilities and needs. The using of the educational software on the accounting is motivated, in our opinion both by the

pedagogical factors and by the dynamic of the financial-accounting legislation, the permanent need for new specialists, and the new valences of the accounting profession.

There are some international achievements in the field of using the interactive systems and e-learning in accounting, like [3], [18], [19] that highlighted the differences between an interactive educational system and a real teacher. Thus, we need to include the intelligent technologies in the educational software in order to make them efficient and as real as possible to teachers.

2. ContTest - The Multi-agent System for Accounting Education

Certain software applications (Jennings, 98) need the use of some intelligent agents that are autonomous and flexible programs designed to reach their goals without the further intervention of the programmer. In our opinion, in some situations there is necessary to endow the intelligent agents with new characteristics, closer to those of a human agent. Thus, we consider that for humanizing a software agent, it is necessary to integrate an affective subsystem (Bartneck, 03), (OCC, 88), (Pfeifer, 88), (Bates, 92), and the agent should be endowed with a "body" either in real or in the virtual space. In the virtual space it can be a conversational agent, which can behaves smartly if we will add to it some new elements: feelings, temperament, gestures and movements close to those of a human being (MSA, 02).

Even though the intelligent agents have many advantages, some problems are distributed or they are very complex and they cannot be solved by a single agent. Thus consider the necessity of grouping the agents into multi-agent systems, which can be organized in different ways. We developed an original way of organizing the agents into groups, in a multi-agent system with pedagogical purposes.

The multi-agent consists of many *s-agents*, which are small multi-agents systems, each *s-agent* dealing with an educational competence in the discipline to be learn. The multi-agent system was embedded in the educational software ContTest, which has the pedagogical functions of teaching and assessing the students' knowledge on „Accounting bases" and partially on „Financial accounting".

To represent the accounting knowledge in our system, the representation of accounting entries uses the regular expressions, which are the most adequate for representing the accounting knowledge, because:

- They help to define the rules of recording the transactions very exact.
- They help non-specialists to learn the rules from financial accounting.
- This meta-language allows the developing of programs for testing the people who learn the accounting.

Based on this formalism we designed an intelligent agent which will automatically generate problems of financial accounting and their answers too.

The system contains many groups of agents (s-agents), one s-agent per educational unit, and every s-agent contains agents with exact pedagogical tasks: teaching, testing, assessing etc. Each s-agent of the system has sensors that perceive the environment of the agent, and effectors through the agent acts on the environment.

This is why, in the case of a s-agent, the environment is given by the actual student's competences (abilities and knowledge). The sensors are mechanisms (questions, tests etc.) through which the agent in charge with achieving a competence can measure the degree in which that competence has been achieved; that means how much the student has learned up to that moment. The effectors are mechanisms (explanations information etc.) for improving the degree of the accounting competences of the student.

We noticed that every s-agent cannot act alone, so we grouped the s-agents into a multi-agent system. Because the acquisition of a competence is permanently correlated with the acquisitions of the others, the s-agents have to communicate and cooperate, because their common goal is to teach the student.

Each s-agent has seven atomic agents with specific pedagogical tasks. If at the level of the entire system, the nature of the cooperation between s-agents is related to the content of the teaching subject (The Bases of Accounting) then at the level of each s-agent we should have a didactical cooperation.

In fact, there are six s-agents that deal with six pedagogical aspects, no matter the learning unit or the capacity that should be achieved by the student and a coordinator agent is responsible for intermediating between these six agents:

- The agent for initial and permanent assessment generates questions and obtains correct answers, but it also expects the student's answers. This agent has a layered architecture, every layer dealing with the checking of achieving one competence.
- For the agent dealing with the teaching of the content of a lesson, we used the Microsoft Agent technology for animating a character and the multimedia technology too; for example we used video clips with a real person teaching a lesson. Mixing these two technologies can be very useful.
- The agent for exemplifications was created in a similar way with the agent for teaching and the information for exemplification can be presented under different forms. The examples can be short or long focusing on different aspects that can lead to a better understanding of the theory of accounting.
- The agent for generating problems for the student creates Romanian texts for questions, exercises and problems, depending on the instant learning unit. We have come to the conclusion that although generating the questions with two variants of answers is the easiest, generating of some problems is more efficient didactically speaking. Generating the problems is also more complex, because it means: generating a text in Romanian, generating some sums and mathematical expressions and generating the correct answers.

We developed an evaluator of mathematical expressions used in generating some financial accounting problems, based on some patterns that have used regular expressions. The agent that checks the student's answer has a multi-layered architecture and each layer analyzes the way the student answers the question that has been asked by the test-generating agent.

3. Results with ContTest

There follows the presentation of a screen images taken during the using of the application; these images emphasizes different aspects from during teaching using this educational software (Figure 4, 5).

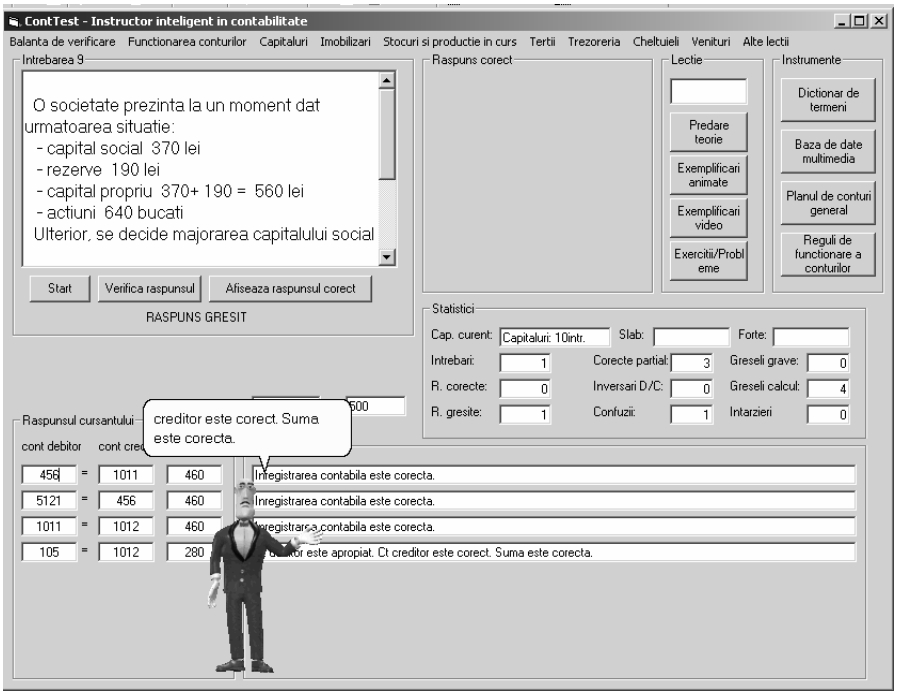

Fig. 1. Verifying the accounting entries

This agent will do a series of tasks, such as: statistics on the right answers, wrong answers, partially correct answers, inversions, confusions, big mistakes, calculation errors, delays, weak spots, strong spots etc; giving marks, scores, penalizing the student; expressing some feelings (satisfaction, dissatisfaction, sadness, happiness, hope, fear etc.). We considered necessary to design original affective agent architecture (Be SGOTE) that allows feelings to be expressed.

Sometimes showing some statistic data is not the best way of feedback that can be given to a person who learns something and solves some problems. It is recommended that after asking simple questions or after short periods of testing the teachers should show their attitudes towards the student's results through verbal ways or even through their mimic and gestures. These ways can show the satisfaction or dissatisfaction towards the student's results or hope and fear for reaching or not reaching the initial goals.

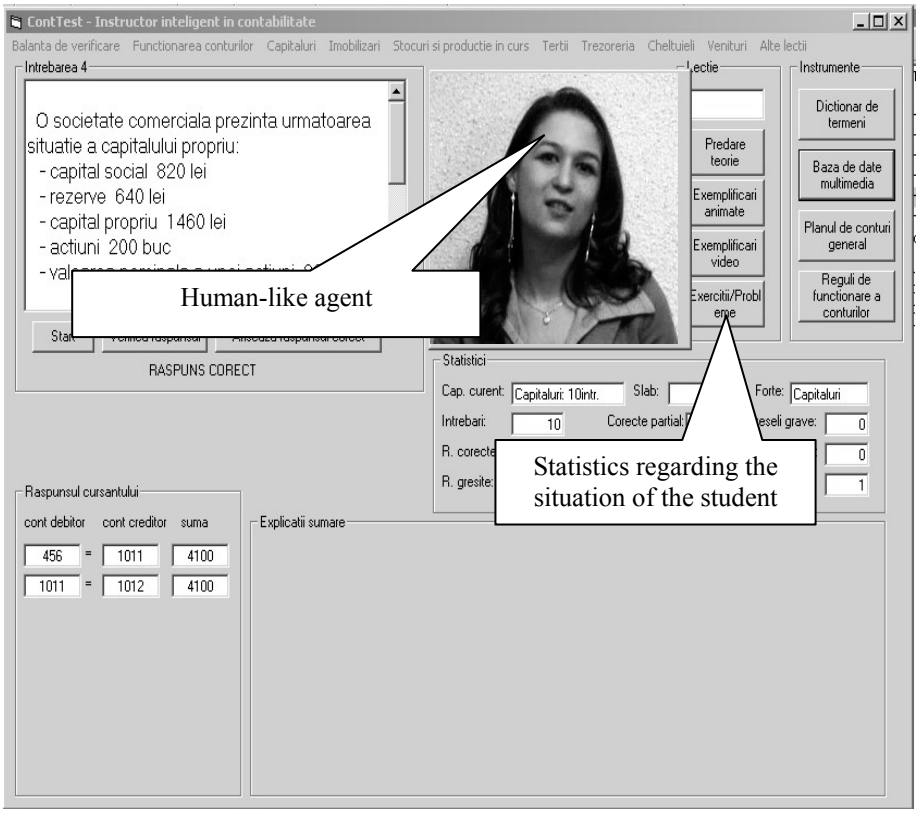

Fig. 2. The human-like agent, expressing sentiments about the state of the agent

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The agent for grading the student should express feelings or emotions and the feelings can differ from one agent to another the way they differ from one teacher to another depending on the teacher's temperament. The coordinator agent plays a

fundamental role in the well working of the s-agent of which it is part of, because it gives the control to each of the other agents and, besides this, it holds the communication with the other agents. The coordinator agent also deals with solving the special events, such as the sudden break of the running application, a special error etc. After presenting the structure of each agent from an s-agent, we show the way in which an s-agent works (see Figure 1).

In the theory of intelligent software agents there are a lot of architectures like the BDI (Beliefs, Desires, Intentions), the architectures with layers or the architectures coming from logic ([6]).

The Rao and Georgeff's BDI architecture is considered one of the best, because it is very natural and many concrete software agents use it. On the other hand, this architecture ([4]) presents some deficiencies, because no kind of temperamental characteristics are implemented in it. So, in the same situation, two BDI agents will have the same behaviour. We know that in the real world this assumption can not be true.

The human beings are influenced by their temperament, which can make the agent to express its emotions.

We will present a type of architecture for intelligent agents that are able to express emotions, even to show its temperament. It is an extension of the classic BDI architecture. The basic concepts of this architecture are: Beliefs, States, Goals, Temperament and Emotions

We made a pedagogical experiment at the University of Bacău, involving 100 students. The experiment has proven the efficiency of using the ContTest program for didactic purpose. The students were divided in two equal groups; first group followed the traditional education (with a real teacher) and the second was assisted by ContTest. In the exams session, all students were examinated by a real professor. Their results (on a scale from 1 – minimum to 10 – maximum) can be seen in figure 8.

There are some parts in which the ContTest system can be improved by:

- generalizing the agent for providing the tests in such a way as this agent should be able to also provide other kinds of problems, in Romanian and following different models;
- generalizing the agent for checking the answers in the way of adapting it to the new variants of the problems;
- improving the agent for exemplification in order to allow the generating of more examples;
- adjusting the system to a distributed work environment (intranet, Internet).

Based on the instant achievements and on the possibilities of improvement, we can conclude that the ContTest system detains a structure fit for interactive accounting learning.

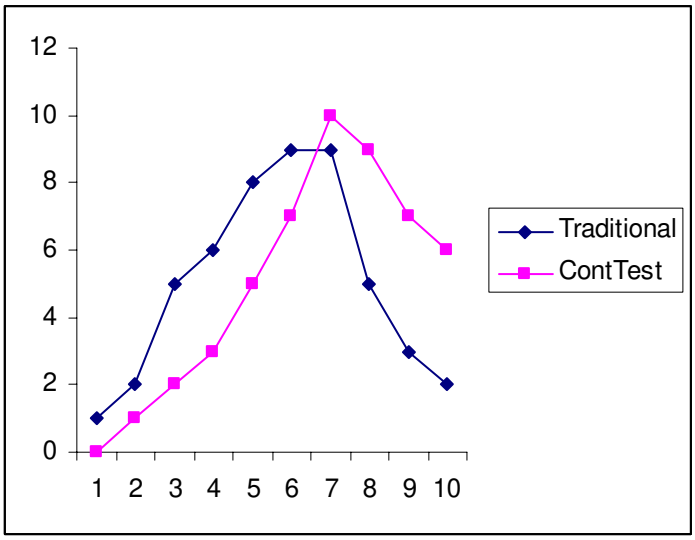

Fig. 8 Results obtained by the two groups of students both with traditional and ContTest method

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