

E-learning material for teaching logic

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Abstract: At every domains of our life we use more and more electronic devices. The education cannot be an exception. Over the past decades, the importance of e-learning constantly increased. In addition to its cost-efficiency we believe that the most important property of the e-learning is: it is a user-centered system, which means that the student may proceed at its own place in the curriculum. It allows students to try things out, participate in courses, tests and simulations like never before, and get more out of learning than before. In this article, an e-learning environment is presented, which enables agri-informatics students to learn or recall the basic concepts of mathematical logic necessary for the course Expert Systems. According to the questionnaire the students like the e-learning materials, and would like to use it at other subjects, too. They don't want to replace the standard lectures with e-learning materials; they would use them as additional material to lectures and practices.

Keywords: e-larning, logics, Moodle, SCROM

1 Introduction

As technologies evolve the use of e-learning is increasing. This compels us to reflect on what exactly is the reason for this success. Various studies shows that advances technologies can enhance learning depth, involve learners with the material, increase material retention, and improving education quality (El-Bakry, 2009) (Saleh 2010).

In the case of e-learning the learning material is available by computers and we can use the advantages of the Internet. Namely the student can communicate with the teacher or with each other, and this kind of communication is very cheap. The student can get answer for their questions within minutes, and the answers of all the questions can be made available for the others. Frequently the other students give answer the questions before the teacher, so the teacher/tutor became the education-organizer and not a knowledge distributor. In the case of e-learning, students are more involved in the learning process than they were involved at pervious methods. The freely organized learning time of e-learning is good for the learners, and the less contact hours are better for the institutes in economical sense. The popularity of the e-learning produced countless programs for the administration of the education. Many software developer produced programs to manage the educational process,

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keeps records of evolution of the students. The Faculty of Agricultural Economics and Rural Development at University of Debrecen (UD) have begun to use such software in 2008 (Herdon, 2009). We have chosen Moodle, which is very common in Hungary and at abroad, as well. Of course at setting up Moodle we considered the experiences from all the world, to learn from others mistakes and do not repeat them (Bakó-Lengyel 2009), (Lengyel, 2010). The use of Moodle became popular among of teacher of the faculty because it facilitated the teachers' work and made it possible for students to reach the curriculum easier as before. Nevertheless most of the teachers only use it for publish the handouts in PDF format or presentations, and some of them use on-line tests for exams. Real e-learning curriculum has not been made, yet.

Our agro-informatics students' curriculum contains the subject Expert System. The expert systems are software, which can give advices, can answer questions, and express the deductions used for answers. These answers are competitive to the answers of real experts. The usage of expert systems is profitable in many areas, even in agriculture. Our students can connect the experts of agriculture and programmers of expert systems. At teaching the Expert System course we realized that our students have no prior knowledge about logic, and hence they cannot understand the background of the programming languages of Prolog and Clips. We assumed that by using an e-learning curriculum at the beginning of the course they can learn the logical concepts quickly and efficiently. In this article we will describe the structure and content of this curriculum and show the difficulties and problems we encountered. In the last part of the article we present the student's opinion about this curriculum: This kind of teaching material motivating them, or not; the material is colorful, flexible enough and they really would like to use such material, or not?

2 Technical details

As we wrote before our faculty use the Moodle system. Therefore we needed to choose such a tool which can export the material to the Moodle's format. Moreover we took into considerations that we should follow the standards, because this enables to us, to use our material in a different learning environment, too. Finally we chose the SCORM content-package and the editor eXe. A SCORM content package is a self-contained ZIP file containing certain contents defined by the SCORM standard. One package can contain HTML pages, pictures, scripts in JavaScript, Flash movies and anything else that a browser can show. The Moodle enables to include SCORM content packages easily in our curriculum. The eXe eLearning XHTML editor is an open source WYSIWYG authoring environment. It is an easy-to-use tool which enables teachers to publish professional looking web pages without knowing XHTML, and can export them in SCORM package format.

3 The structure and content of the curriculum

Our goal, as already mentioned in the introduction, was that the agro-informatics students get a tool, to learn the logical concepts necessary to understand the main ideas of Expert Systems. Figure 1 shows the structure of the first part of the curriculum.

The first to items on Figure 1 clarify the concepts of sentential logic and show their position in the science. On these pages we used that the Moodle and eXe provides us that the links can point to the Wikipedia articles, for example. Hence our students are one-click-away from the history of Logic, Artificial Intelligence and Expert Systems.



Fig. 1. The structure of the first part of the curriculum.

The first page of Sentential Logic contains the theory. We supplied this page with examples and colors hoping that our students understand the theory. The next two pages contain multiple choice questions, which allow students to practice the theory of the previous page. Finally we insert a self-assessment test, which allows the student to assess how the material learned. Of course the Moodle notify the teacher about the result and the date of this test for each student. Hence the teacher can see that his/her students have understood the material, and which are the problematic parts in it.

The theory of the *sentential logic* contains the concepts of predicate, meaning and functional value of logical connectives (Figure 2.)

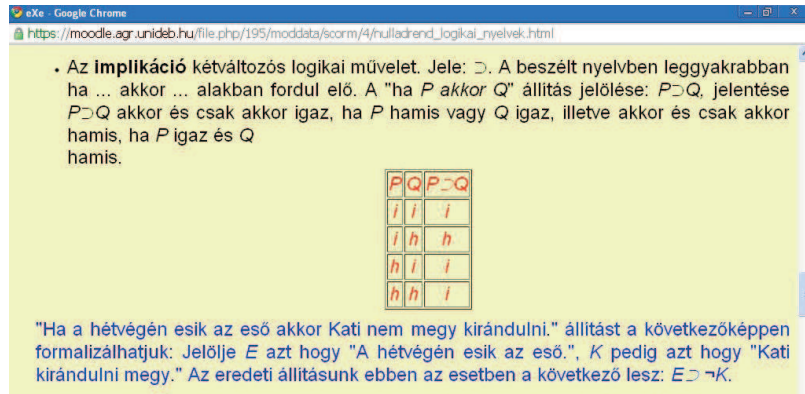


Fig. 2. The definition of the implication.

We gave an example for determining the logical value of a logical expression, for the formalization of Hungarian sentences. In the Figure 2 we show how can we formalize the statement *If it rains this weekend, then Katie did not go hiking.* After the theory there is a link to an activity. Here the students need to fill the truth table (Aszalós, 2009). On this webpage a program generates a random formula, and the user only needs to determine the results of the connectives. When he fills the whole table, the program checks the solution, and deletes all values depending on some incorrect answers (Figure 3).

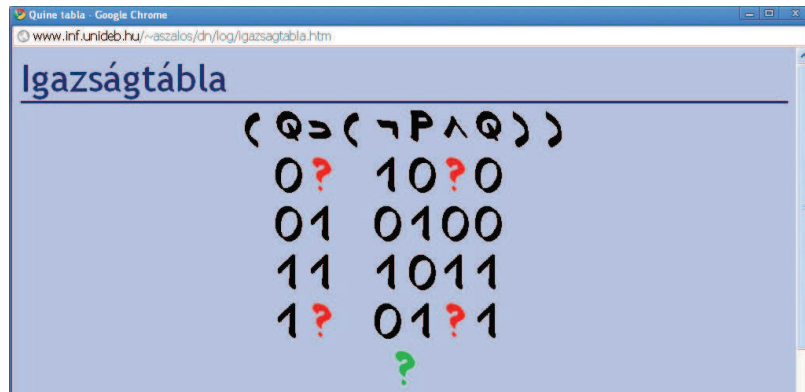


Fig. 3. Determine the truth values at question marks!

The following three tests help students to deepen their skills. The first test (Figure 4) includes two kind of problem for formalize simple claims:

- There is one sentence and three different formulae. The students need to find which one is the correct.
- In reverse we have one formula and three sentences. Which sentence describes the formula?

The student can solve these examples only if he formalizes the sentences. The example shown on Figure 4 is asking the student to decide which the correct formalization of the following statement is: *If it rains and the sun is shining, there is a rainbow unless there is just noon?*

As I mentioned before on this page there are examples in which a sentence should be formalized. Let us denote *it's raining* with R, *I'm on the beach* with B, and *I sunbathe* with S, respectively. What is the meaning of this formula: $R \supset (\neg B \wedge \neg S)$?

1. If it is raining then I'm not on the beach and I not sunbathe.
2. If it is raining it is not true that I'm beach and I sunbathe.
3. If it is raining then it is not true that if I'm on the beach then I sunbathe.

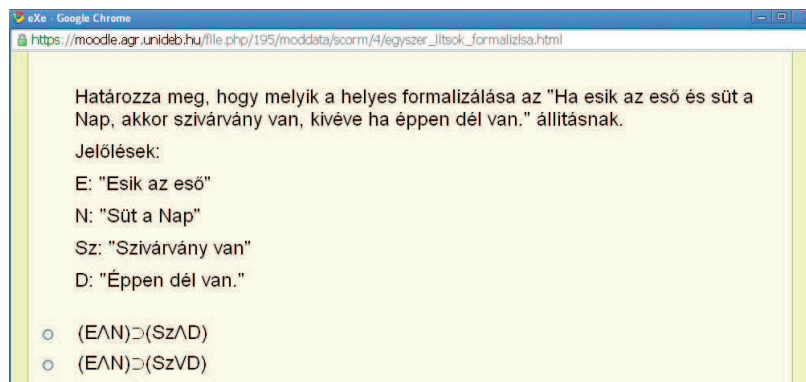


Fig. 4. What is the correct formalization of this sentence?

In the case of the second test: "Tests for determining truth value of sentences" there is given a formulae and the truth values of the variables. The student needs to decide that the formula is true or false in this case (Figure 5). To solve the example we need to determine the truth value of the formula. For example: What is the truth value of the formula $((A \supset B) \wedge C) \supset (C \vee A \supset B)$, if A and C are true, and B is false?

1. True
2. False

If we give the correct answer the system write out: Congratulation! In the other case it gives the correct answer.

$$\begin{array}{cccccccccc}
 ((A & \supset & B) & \wedge & C) & \supset & (C & \vee & A & \supset & B) \\
 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 0
 \end{array}$$

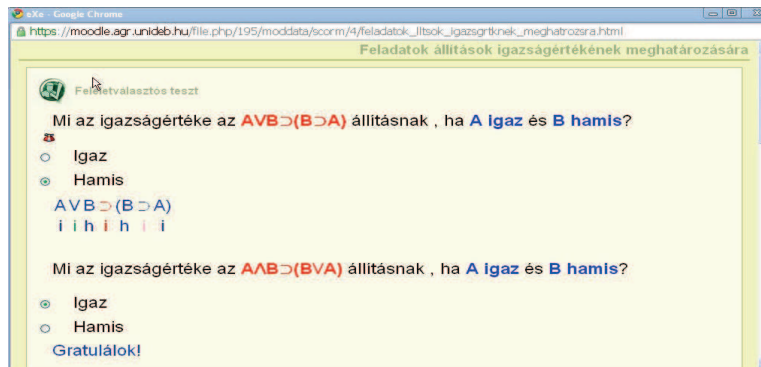


Fig. 5 Truth value of a formula at a specific case.

The third series of examples help to practice the truth value of formulae, too. There are given three formulae, and the student needs to decide which formulae have most true value in the main column of their truth table (Figure 6). To solve the example we need to determine the truth tables of each formulae. If the student gives wrong answer, the system shows all the truth tables.

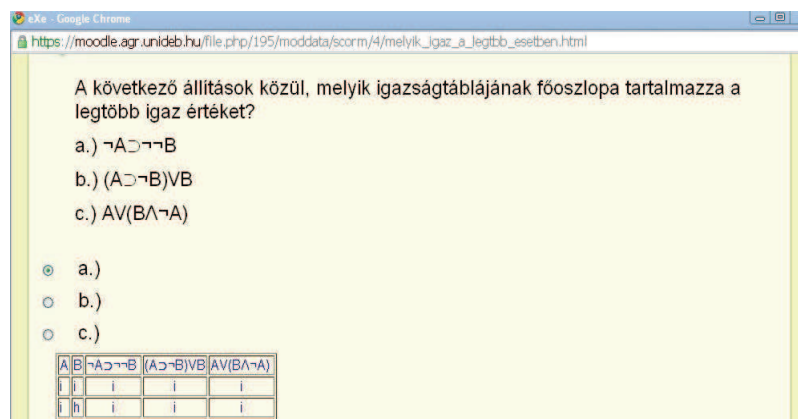


Fig.6. Which truth table contains the most true values in its the main column?

This module ends with a self-evaluation test. This test informs the student and the teacher get information about how the student managed to learn this module. The self-evaluation test contains examples similar to previous tests, but the students don't get the correct answers immediately at solving examples, just a percentage of correctly solved tests after all the tests (Figure 7).

Unfortunately the system doesn't particularize which answers was wrong and why, just shows the percentage. Since the problems of self-evaluation test practically the same as the problems of practicing, we recommend our students don't continue with the next module before he reach 100%, but to return to the practice tests.

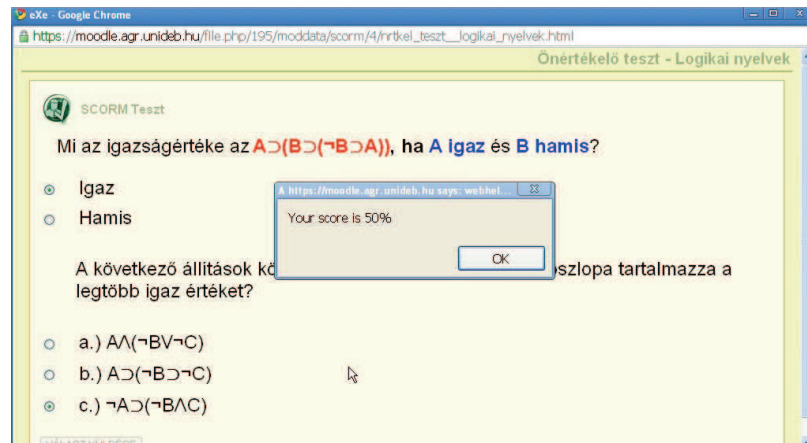


Fig. 7. Self-evaluation test

4 Experimental Results

Before we prepared further modules we were interested in the opinions of the students to fix the module which has been written, and to utilize it to level up. The students were asked to assist them in learning such a curriculum, this kind curriculum is flexible enough for them, there are disadvantages of such a course and last but not least, what form they like to learn. Our hypothesis was that a big part of students like the e-learning material, they regard it flexible, they would like to use in education, but they still need the classroom lectures with the teacher's explanation.

Since now we have only 19 agro-informatics students, we asked other kind of students, too. We provided to them an hour to read and test the e-learning material, and after we asked them to fill a questionnaire. After the evaluation we concluded that there was no significant difference in agro-informatics and other students' answers, so the questionnaires after it were processed together.

The first question of the questionnaire was about the relation of the e-learning curriculum and students' motivation. Specifically: motivate you a similar e-learning curriculum in different subjects to learn?

As Figure 8 shows the response of students justifies our hypotheses. 92 percentages of them answered that such a curriculum would motivate them.

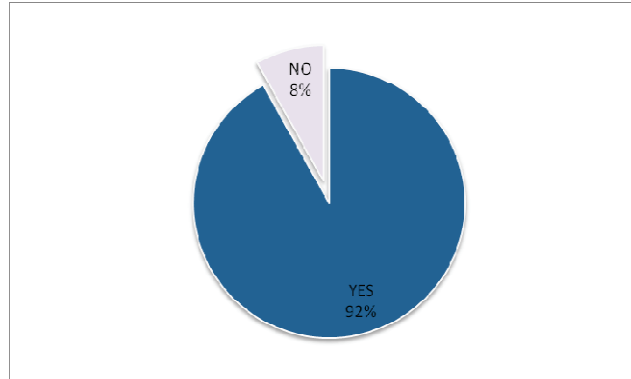


Figure 8. Motivate you a similar e-learning curriculum in different subjects to learn?

From those who answered yes, we asked what subjects they would like to learn by using e-learning curriculum. As Table 1 shows the majority of students marked mathematics, statistics, finance and all subjects. Students usually marked several options.

Table 1. What subjects they would like to learn by using e-learning curriculum.

Mathematics	Statistics	Finance	Microeconomics	Economy of enterprise	All subjects
44%	48%	19%	18%	6%	23%

The second question asked our students about flexibility of the learning process. Specifically, what do you think, how flexible this type of learning process? The responses are rated on a 5-point Likert scale. The range of the answers was from not at all (0) to very much (4). As the Figure 9 shows most of the students find more flexible the e-learning (44%+45%=89%)

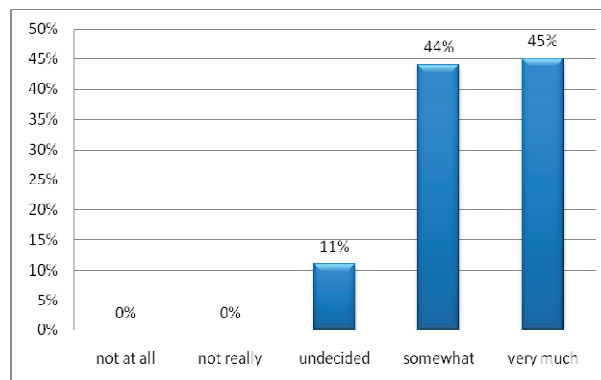


Fig. 9. What do you think, how flexible the e-learning material?

The third question asked our students “Are you consider more atmospheric and more colorful such an e-learning material based course than a standard?” The responses are rated on a 5-point Likert scale, again. As the Table 10 shows most of the students (71%) consider more colorful such a course.

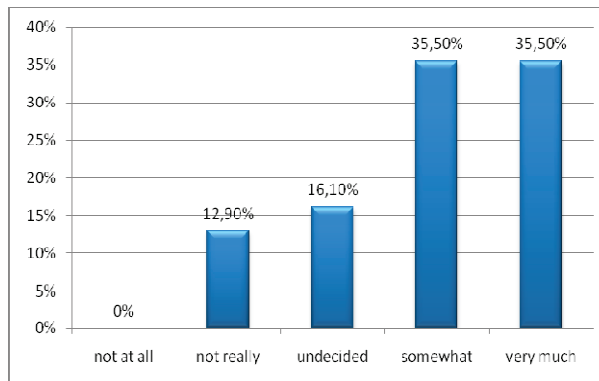


Fig. 10. Are you considering more atmospheric and more colorful such an e-learning material based course than a standard?

The fourth question asked our students “What do you think there are disadvantages of such a course, and what are these? As the Figure 11 shows most of the students (65%) thinks that there are no disadvantages of the e-learning courses and some of them (35%) miss the teacher's explanation.

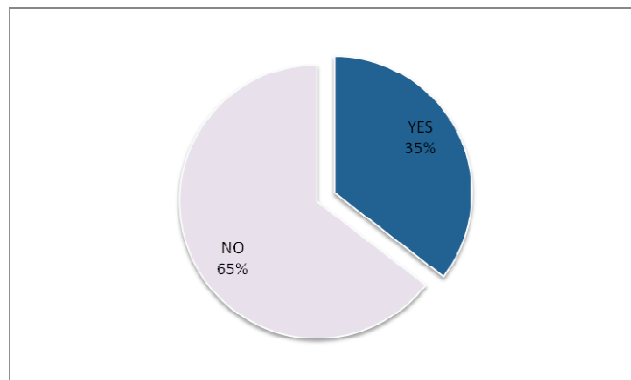


Fig. 11.What do you think there are disadvantages of such a course, and what are these?

The last question asked our students how they can learn the material. The options were:

1. by traditional classroom lecture, and traditional paper-based lecture notes
2. by traditional classroom lecture and e-learning material

3. by e-learning material with the help of the forum and chat, where the questions responded within a short period of time by the teacher and discuss their problems with other students.

The students have chosen the options 2 and 3.

As the Figure 12 shows most of the students (81 percent) would like to use the traditional classroom lecture and e-learning material together.

By our opinion, if we had the chance to ask the students in correspondence studies, these answers may have been moved in the direction of e-learning. Of course, we will ask students of correspondence studies as soon as possible.

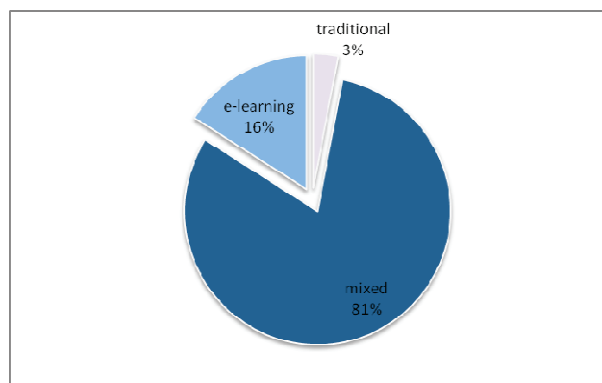


Fig. 12. How should you learn the material?

In summary, the students confirmed our hypothesis: 92 percentages of them treat helpful e-learning material, 71 percentages of them treat such courses more colorful, 89 percentages of them found that the learning process more flexible. They would use e-learning material to learn mathematics, statistics and finance. 23 percent of them would use it for each subject, too. The answers for the last question shows that the full-time students do not want to give up on the classroom lectures, but would combine it with the e-learning material.

5 Conclusion

At University Debrecen we developed e-learning material to teach logic. Our faculty use Moodle as e-learning environment, so we need to use a tool which compatible with this system, and follows the standards. Finally we had chosen the eXe editor, but we are not completely satisfied with it. Unfortunately it is not possible to select problems randomly from SCROM packages exported from eXe, the student needs to solve all the examples.

Note that it is much harder to prepare problems in SCROM format, than in the standard way. But according to the students' responses the students are more motivated, they like the e-learning materials, and the self-evaluation helps to students and to the teacher to see his own progress, or the progress of the whole group. The

motivated students and more practices give better results. This fact discovered by students, and they would like more e-learning material from other subjects, too. This motivates us to produce other e-learning materials.

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