Web Application for Evaluating Tests in Distance Learning Systems

Bogdan Walek, Vladimir Bradac, Radim Farana

Abstract—Distance learning systems offer useful methods of learning and usually contain a final course test or another form of test. The paper proposes a web application for evaluating tests using an expert system in distance learning systems. The proposed web application is appropriate for didactic tests or tests with results for subsequent studying follow-up courses. The web application works with test questions and uses an expert system and LFLC tool for test evaluation. After test evaluation, the results are visualized and shown to the student.

Keywords—Distance learning, test, uncertainty, fuzzy, expert system, student.

I. INTRODUCTION

NOWADAYS distance learning is very popular and offers useful methods of learning. Distance learning systems use eLearning methods of learning and teaching. eLearning is based on the availability of a system which allows online courses to be developed and deployed [1]. It offers several advantages especially concerning the management of the courses content [2], allowing the learning paths to be adapted to student's needs. There are also several intelligent systems for e-learning [7]-[10].

Distance learning systems usually contain a final course test or a final test of the entire content of learning courses or materials. Sometimes distance learning systems also include ongoing (particular) tests in individual courses.

Tests in distance learning systems consist of questions and answers. For each question, there are one or more correct answers. Students gradually answer these questions. After answering all question, the test is evaluated.

This article focuses on a web application which allows to evaluate a test using an expert system and show the evaluation results to the student. The proposed web application is appropriate for didactic tests or tests with results for subsequent studying follow-up courses. The article is continuation of paper [3].

II. PROBLEM FORMULATION

Tests in distance learning systems are usually evaluated by a clearly defined algorithm or by a teacher who evaluates specific questions of test.

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Evaluation by an algorithm is quite simple, because the algorithm usually counts correct and wrong answers and compares the number of correct answers with the threshold of success which is represented by a number or percentage. This method of evaluation often ignores other parameters and influences that act upon a student during completing the test.

Output test evaluation is often limited to finding whether the student was successful or not.

III. PROBLEM SOLUTION

For the reasons given in Section I, the web application for evaluating test using an expert system and LFLC tool is proposed. LFLC tool (Linguistic Fuzzy Logic Controller) is described in [4].

The proposed web application was designed using the PHP programming language, HTML5 markup language, and CSS3. Data of tests and their parts are stored in the MySQL database.

The web application works with test questions and student´s answers, starts test evaluation, launches LFLC tool with stored knowledge base of expert system (as RB file) and completes evaluation of the test using outputs of the expert system. The final evaluation of the test is completed for each category of questions (questions are divided to several categories – areas).

The proposed web application is based on a general model of decision making which is more described in [5] and [6]. The web application is also based on approach which is more described in [11]-[13]. The web application is visually shown in Fig. 1.
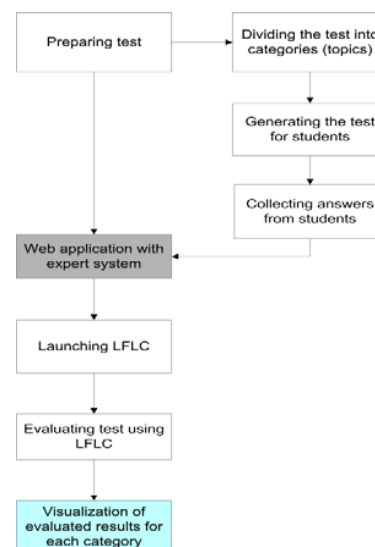

Fig. 1 Proposed web application

A. Preparing Test

The first step consists of three parts and the test is prepared for evaluation using an expert system and LFLC tool. In the first part, we propose to divide the test into categories, because we need to evaluate each category of questions separately. Each category consists of questions which deal with a specific topic. This approach is more described in [3] and [13]. As stated in the introduction, the proposed web application is suitable for didactic tests or tests with results for subsequent studying follow-up courses. For each category, we can assign importance which represents importance of the category for future study. For example, there are a few categories of didactic test for learning the English language:

TABLE I
CATEGORIES OF QUESTIONS FOR DIDACTIC TEST

Category	Area	Importance
C1	Present continuous	Very big
C2	Present simple	Very big
C3	Past simple	Very big
C4	Past continuous	Very big
C5	Present perfect simple	Big
C6	Present perfect continuous	Big
C7	Past perfect	Medium
C8	Future tenses	Medium

In the second part and after creating all questions in all categories, the test is generated for students.

One question of the didactic test is shown in Fig. 2.

1. What time .... he usually ....?

a) ◯ does - finish

b) ◯ is - finishing

c) ◯ did - finished

Fig. 2 Question of didactic test

After test completion by student, answers are collected and stored in a database for subsequent evaluation.

B. Creating Expert System

In this step, the expert system is created. The knowledge base of the expert system consists of IF-THEN rules.

The input linguistic variables are:

- V1 - number of correct answers, values: small, medium, big
- V2 - weight of correctly answered questions, values: small, medium, big
- V3 - importance of the category for further study, values: very small, small, medium, big, very big
- V4 – time spent on questions of the given category, values: small, medium, big
- The output linguistic variable is:
- V5 – necessity of further studies of a given category, values: extremely small, very small, small, more or less medium, medium, big, very big, extremely big

Expert system with knowledge base is created using LFLC tool. Expert system is more described in [3] and [13]. Part of the knowledge base created in LFLC tool is shown in Fig. 3.

V1 & V2 & V3 & V4 --> V5

		V1	V2	V3	V4	V5	Group	Inconsistency	Redundant suc	Redundant ant
2.	☑	me	sm	vesm	sm	vesm				
3.	☑	bi	sm	vesm	sm	exsm				
4.	☑	sm	me	vesm	sm	sm				
5.	☑	me	me	vesm	sm	vesm				
6.	☑	bi	me	vesm	sm	exsm				
7.	☑	sm	bi	vesm	sm	sm				
8.	☑	me	bi	vesm	sm	vesm				
9.	☑	bi	bi	vesm	sm	exsm				
10.	☑	sm	sm	sm	sm	sm				
11.	☑	me	sm	sm	sm	vesm				
12.	☑	bi	sm	sm	sm	exsm				
13.	☑	sm	me	sm	sm	sm				
14.	☑	me	me	sm	sm	vesm				
15.	☑	bi	me	sm	sm	exsm				

Fig. 3 Part of knowledge base in LFLC tool

C. Preparing Input Files for LFLC by Web Application

In this step, we prepare input files for evaluation by the expert system using LFLC. LFLC tool needs an input file for expert system evaluation using specific knowledge base of IF-THEN rules represented by. rb file.

The input file is prepared based on test results loaded for each category. For each category of test results, the V1, V2, V3, V4 values are loaded. An example of an input file for evaluation by LFLC tool is shown in Fig. 4.

```
V1          V2      V3     V4
0.66666666667   0,5    0,5    1
```

Fig. 4 Input file for evaluation by LFLC tool

D. Launching LFLC

In this step, the LFLC tool is launched for evaluation category of test by the expert system using the input file.

LFLC tool is launched by an lflc-run.bat file, which is launched by the web application.

The BAT file contains this source code:

```
@echo off

::
:: Environment settings
::
set dir=%cd%
set lflc=%dir%\hierarchic_base.exe

::
:: SGS LFLC default files
::

:: LFLC knowledge base file
set kbn=test_db.knb

:: LFLC input file
set input=data.txt

:: LFLC output file
set output=output.txt

::
:: LFLC execution
::
@echo on
%lflc%   -k   %dir%\%kbn%   -i   %dir%\%input%   -o
%dir%\%output%
```

After launching the LFLC tool, the output file is processed. Output file contains defuzzified value for V5 output linguistic variable. An example of the output file generated by LFLC tool is shown in Fig. 5.

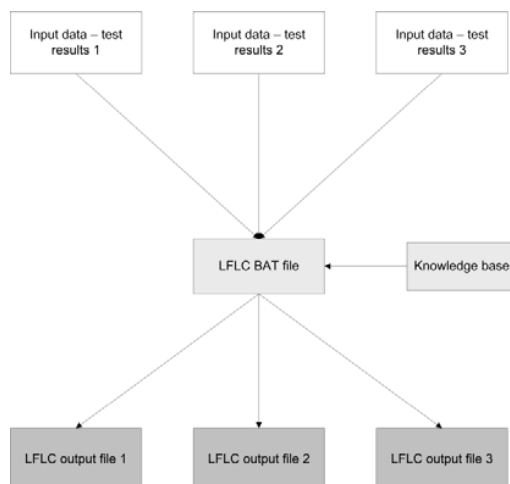| V1	V2	V3	V4	V5
0,666667		0,5	0,5	1	0,565

Fig. 5 Output file generated by LFLC tool

Fig. 6 Process of evaluation using LFLC tool

E. Evaluating Test Using LFLC

Based on the input files and evaluation by LFLC tool, all categories of the test are evaluated. For each category, the V5 value is assigned.

Process of evaluation consists of three steps:

- Loading input data – loading input files prepared based on test results
- Launching LFLC tool by running special BAT file
- Evaluating by LFLC tool
- Processing LFCL output files

Process of evaluation using LFLC tool is visually shown in Fig. 6.

F. Processing LFLC Output Files by Web Application

Subsequently, the LFLC output files are processed by the web application. For each output file, the V5 value is extracted and processed. Based on V5 value, appropriate linguistic value is assigned using a simple formula:

```
if($V5_value >= 0 and $V5_value < 0.075) $result = 'extremely low';
if($V5_value > 0.076 and $V5_value < 0.205) $result = 'very low';
if($V5_value > 0.206 and $V5_value < 0.335) $result = 'low';
if($V5_value > 0.336 and $V5_value < 0.465) $result = 'moreless medium';
if($V5_value > 0.466 and $V5_value < 0.595) $result = 'medium';
if($V5_value > 0.596 and $V5_value < 0.725) $result = 'big';
if($V5_value > 0.726 and $V5_value < 0.855) $result = 'very big';
if($V5_value > 0.856 and $V5_value <= 1) $result = 'extremely big';
```

G. Visualization of Evaluated Results

Finally, results of the evaluated test are shown to the student. The evaluated results contain information about the necessity of further studies of a given category. The student can recognize which categories are more or less important for study.

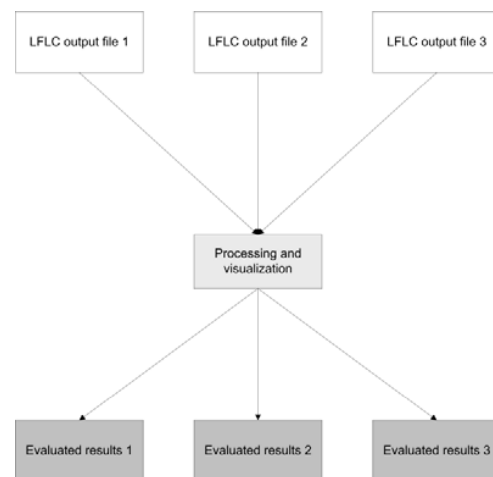Process of visualization of results is visually shown in Fig. 7.

Fig. 7 Process of visualization of results

The evaluated results of the web application are shown in Figs. 8-10.

Test evaluation

Present perfect simple	
Correct answers (in %)	0 %
Weight of correct answers	0
Importance for further studies	7
Time spent on answering with respect to standard time (in %)	0 %
Necessity of further studies	big

Past simple	
Correct answers (in %)	0 %
Weight of correct answers	0
Importance for further studies	10
Time spent on answering with respect to standard time (in %)	7 %
Necessity of further studies	very big

Present simple	
Correct answers (in %)	50 %
Weight of correct answers	6
Importance for further studies	10
Time spent on answering with respect to standard time (in %)	100 %
Necessity of further studies	very big

Fig. 8 Evaluated results of the web application – necessity of further studies: big, very big, very big

Test evaluation

Present perfect simple	
Correct answers (in %)	50 %
Weight of correct answers	6.33
Importance for further studies	7
Time spent on answering with respect to standard time (in %)	349.17 %
Necessity of further studies	medium

Past simple	
Correct answers (in %)	60 %
Weight of correct answers	5
Importance for further studies	10
Time spent on answering with respect to standard time (in %)	98 %
Necessity of further studies	very big

Present simple	
Correct answers (in %)	100 %
Weight of correct answers	5.5
Importance for further studies	10
Time spent on answering with respect to standard time (in %)	195 %
Necessity of further studies	big

Fig. 9 Evaluated results of the web application – necessity of further studies: medium, very big, big

Test evaluation

Present perfect simple	
Correct answers (in %)	100 %
Weight of correct answers	6
Importance for further studies	7
Time spent on answering with respect to standard time (in %)	335.83 %
Necessity of further studies	more or less medium

Past simple	
Correct answers (in %)	60 %
Weight of correct answers	5.33
Importance for further studies	10
Time spent on answering with respect to standard time (in %)	212 %
Necessity of further studies	very big

Present simple	
Correct answers (in %)	100 %
Weight of correct answers	5.5
Importance for further studies	10
Time spent on answering with respect to standard time (in %)	96.25 %
Necessity of further studies	big

Fig. 10 Evaluated results of web application – necessity of further studies: more or less medium, very big, big

IV. CONCLUSION

In this paper, some problems in test evaluation were defined. Then, a web application for evaluating tests in distance learning was proposed.

In future work, it is appropriate to design and implement a complex adaptive distance learning system with test evaluation and personalized parts for each student.

ACKNOWLEDGMENT

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