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PowerFee—Training and testing students in power engineering web application

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Abstract

The world of education is continuously changing. New information and communication technologies have appeared as an important component of the actual teaching/learning strategies. We arrived into a new era called e-Learning period. Nowadays, e-Learning has become a viable alternative to traditional methods, adopted by many educational institutions, especially because of the advantages offered by the possibility of continuous training. In Romania, these teaching/learning strategies face rapid development. This paper presents a software-tool developed in Delphi environment—PowerFee—used for periodical training and testing students via Internet. According to intern rules of the department, all students must accomplish a given number of training-tests every semester to ensure the proper assimilation of the new information. To optimise this process, the program can be reached via local network using a user name and password. A comparison between results obtained by classical teaching/learning methods and ones achieved by modern e-Learning techniques is presented.

Keywords: E-Learning, chi-square test, teaching, training.

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1. Introduction

Specific to the information society, due to fast technological progress, a global desire for higher education and the elimination of boundaries between students, new perspectives have been opened in educational practice. One such method involves the use of an approach focused on training in the educational process. e-Learning is the term used to define educational systems in which a central role is occupied by new information and communication technologies.

Used initially as a generic term referring to the development of a paperless environment for providing flexible education, e-Learning has become more than a simple experiment. Studies and experimental projects have shown that using e-Learning with new information and communication technologies offers the possibility to significantly improve the educational process.

E-Learning has become a viable alternative to traditional educational techniques. It has been adopted in many schools, particularly because of the advantages offered by the possibility of continuous training.

Within the power engineering field, several numerical methods are used to solve a large number of problems. In this context, this paper presents a software tool developed in Delphi environment—PowerFee. It focuses on solving several applications in the power engineering field. The educational software tool is designed for students within the field of electrical power engineering at BSc and MSc levels, used for periodical training and testing (Kilyeni, 2013).

According to intern rules of the department, all students must accomplish a given number of training-tests every semester (to self-assess their knowledge) to ensure the proper assimilation of the new information, procedures and regulations for the final verification.

This software-tool has been developed in a professional way, with a powerful didactic accent. This program tries to respond in a better way to the following requests (Kilyeni, Barbulescu & Simo, 2013):

- To assure a uniform character for the structure and utilisation of this program, and efficiently use the facilities offered by the Delphi environment.
- User-friendly interface with an efficient help system.
- Professional character regarding the optimisation problems solving and elaboration of specialised software.
- To assure some powerful didactic qualities regarding user interface allowing the students to follow the algorithms mechanism.
- Uniform structure of user interface for all programs.
- To assure maximum flexibility regarding the visual results: from final results or computing evolution to the most detailed aspects of the computing process.
- To assure easy access to the desired results (final or intermediary).
- To intercept and diagnose errors of any nature by the program, avoiding 'program crash' due to data errors or due to those by non-allowed operations or entering an infinite cycle.

Following, we will discuss the essential elements of the software-tool and user interface.

2. PowerFee software

The PowerFee software is used for periodical training and testing students from Politehnica University Timisoara, Power Systems Department, via Internet. It is designed for electricity consumption pricing for households.

The program solves the problem itself and related issues like creating and updating the database, saving and loading database. The software is developed in Delphi environment, fully benefitting from the Microsoft Windows specific interface features (Thangaraj, 2014).

The program can be reached via local network using a user name and password.

After the database is loaded, using the tariff computation methods menu, the user can calculate several types of tariffs (Figure 2). Depending on the selected option, the user is prompted to enter further information.

Because of its future mission, the students must be very well prepared both theoretical and practical and in subject with all the changes in the regulations and national standards. With the option from the tariff actualisation menu (Figure 3), the users can perform updates regarding new regulations, standards or other primary information.

The results are provided in several ways. They can be exported in different file formats (according to the user's desire), view on the display (Figure 4) or graphically displayed (Friedrichsen, Klobasa & Pudlik, 2015).

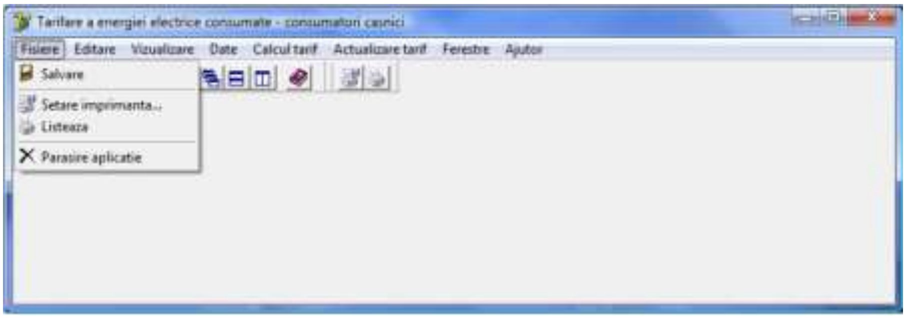

Figure 1. PowerFee software—main window

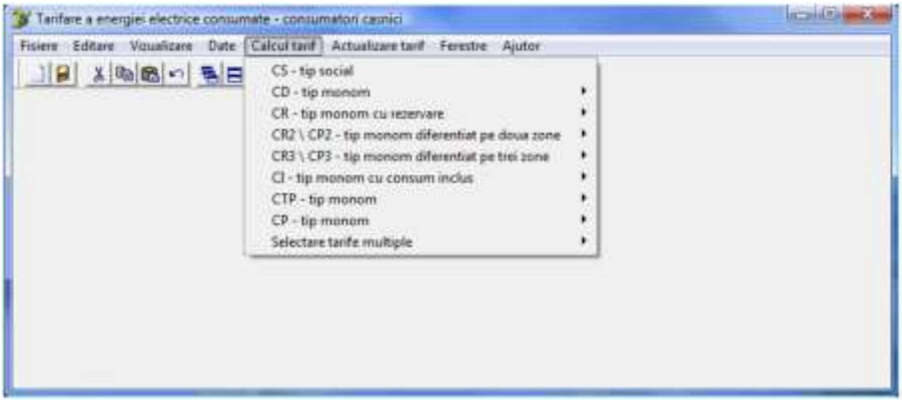

Figure 2. PowerFee software—tariff computation methods menu

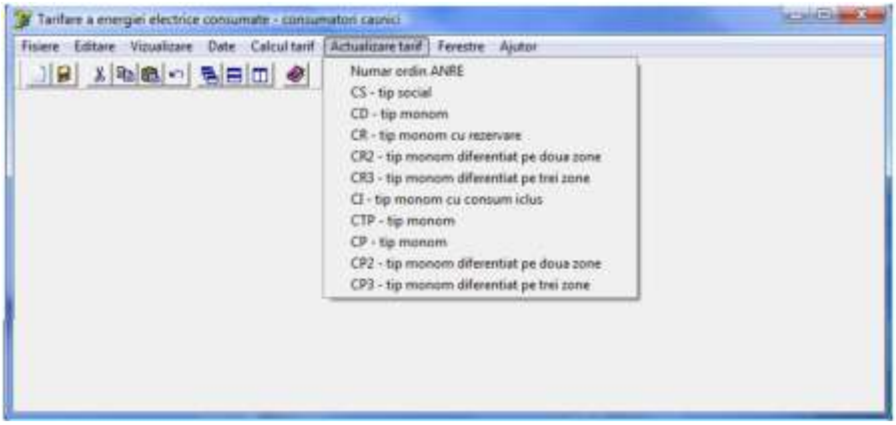

Figure 3. PowerFee software—tariff actualisation menu

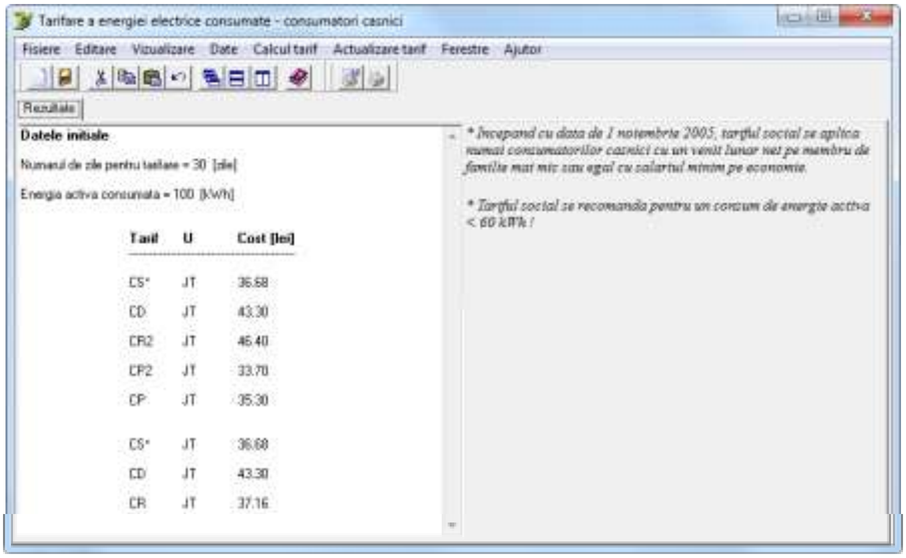

Figure 4. PowerFee software—results window

3. Case study

Our team, through this case study wanted to see the evolution of different groups of students during a semester, regarding the new information acquiring using different teaching-learning techniques, both classical and modern methods (Tanwar et al., 2015).

The assumptions on which our case study is based is that more credible results can be obtained combining classical and modern teaching-learning techniques than once obtained using only classical or only modern methods.

The participants in this case study are third year students from Electrical and Power Engineering Faculty, Politehnica University Timisoara. Eighty participants, 21 years being the average age, 34% women and 66% men. The students were divided into four groups of 20 people, heterogeneous in terms of their levels of knowledge.

The case study was extended to a semester (14 weeks), during which the students were divided into four groups of 20 (G1, G2, G3, and G4).

The teaching-learning methods were distributed as follows:

- Participants from group G1 attended a laboratory course where the content was submitted using the reciprocal teaching (Palinscar) classical method. It is about an instructional learning strategy. When the students are familiar with the method, they will play a teacher role. This technique in centred on four learning strategies used by anyone who makes a study of text on social issues or scientific. These strategies are as follows:
  - summarisation;
  - asking questions;
  - clarify the information;
  - prediction.
- In case of students from group G2, the same content was submitted using the Jigsaw method (mosaic). It is about individual and collaborative learning techniques, used as an aid for teaching and requires a flexible algorithmic process within small activity groups. The steps in this process are as follows:

  - the formation of heterogeneous groups;
  - the presentation of the topic and its division into sub-themes;
  - the formation of expert groups, presentation of instructions and clarification of tasks;
  - the study of material in the experts' groups and preparation of responses to those in the home or original group (this is the time for experts to teach their teammates);
  - the restoration of the original groups and the presentation of answers to the teams of experts;
  - individual testing;
  - assessment of teamwork and recognition of their merits;
  - summarise the position and arguments of a work group and the writing of an individual work.
- Group G3 received the login information in our software tools, the material electronically and tutorials. During the case study, they had no contact with any teacher on this topic.
- Group G4 participants received the material in the same was as participant from group G3. After 4 weeks of independent study, they attend a laboratory course where all contents were taken with teachers using classical teaching-learning techniques.

At the end of the semester (after 14 weeks), a final evaluation was done measuring the level reached by each participant and by each group.

The final results interpretation was done in two steps:

- in the first step, the grades of students were divided into three categories:
  - small grades—[1–4] range;
  - medium grades—[5–7] range;
  - high grades—[8–10] range.
- in the second step, the differences between groups regarding the grades distribution were analysed using chi-square test for our hypothesis confirmation.

The obtained results, regarding the grades distribution in each group are synthesised in the following table

Table 1. Results—grades distribution

Grades	Group G1 (%)	Group G2 (%)	Group G3 (%)	Group G4 (%)
High [8–10]	35	45	50	55
Medium [5–7]	25	25	40	35
Small [1–4]	40	30	10	10

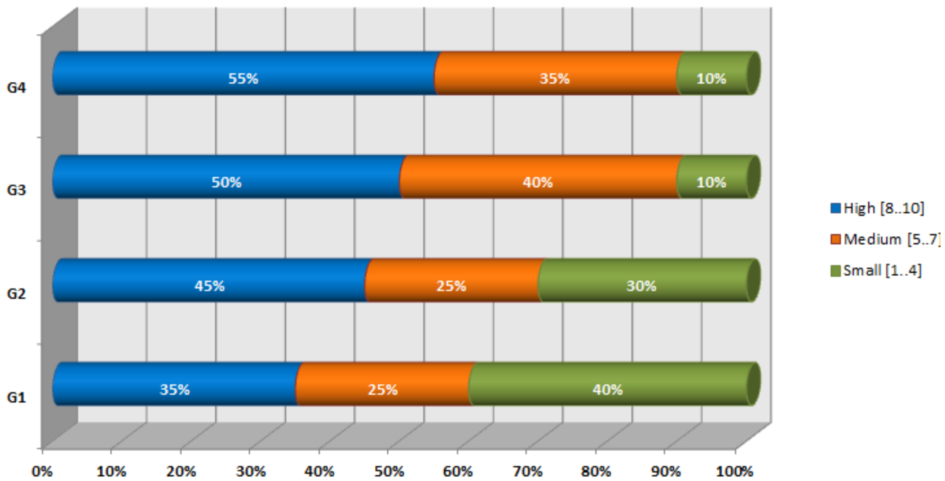

Figure 5. Graphical representation of the group's results

Further on the differences between groups were analysed, regarding the level reached by each of them. The obtained results were performed using the chi-square test to see the whole problem in probabilistic terms.

Table 2. Expected results—chi-square test

Grades	G1–G2	G1–G3	G1–G4	G2–G3	G2–G4	G3–G4
High [8–10]	$\chi^2 = 1.13$	$\chi^2 = 3.39$	$\chi^2 = 3.39$	$\chi^2 = 2.26$	$\chi^2 = 2.26$	$\chi^2 = 0.57$
Medium [5–7]	$\chi^2 = 0.96$	$\chi^2 = 2.87$	$\chi^2 = 2.87$	$\chi^2 = 1.91$	$\chi^2 = 1.91$	$\chi^2 = 0.48$
Small [1–4]	$\chi^2 = 1.91$	$\chi^2 = 5.74$	$\chi^2 = 5.74$	$\chi^2 = 3.83$	$\chi^2 = 3.83$	$\chi^2 = 0.96$

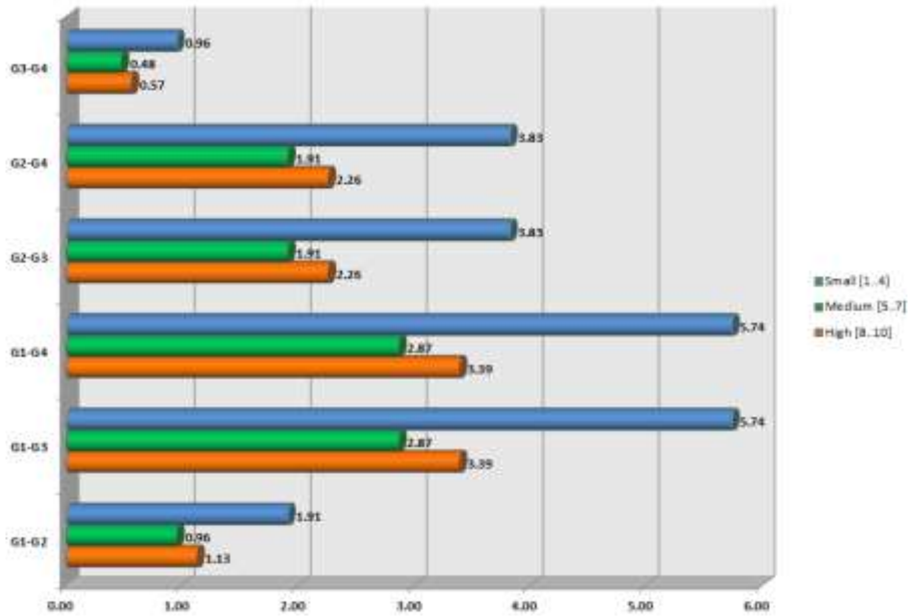

Figure 6. Chi-square test results

4. Conclusions

After analysing the result with the chi-squared test, we obtained 0.6025874 values for *p*. So, our hypothesis is confirmed because the deviation is small enough that chance alone accounts for it. This value means that there is a 60% probability that any deviation from expected results is due to chance only. This is within the range of acceptable deviation.

Significant differences can be observed between groups G1, G2 and G4. Students from group G4 obtained fewer low grades and more high grades compared to groups G1 and G2.

In this case, the results lead us to conclude that combining traditional and modern methods is more successful for training students. Using traditional methods together with modern ones, students can achieve better performance.

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