From Face-to-Face Learning to E-Learning through Blended Learning: An Educational Image-Based Software

TZOUVADAKIS IOANNIS, STAMOS ATHANASSIOS
School of Civil Engineering
National Technical University of Athens (NTUA)
Zografou Campus, Iroon Polytechneiou str. No 9, 15780 Athens
GREECE

Abstract: In the current paper the software and the teaching and examining procedure for the class "Safety and Health on Engineering Worksites" is described. The class is taught in undergraduate university studies and it focuses on worksite organization in terms of time and space, in order to secure, along with the continuous flow of work, the safety of personnel (Accident Prevention Program – APP). The experience acquired over 17 years teaching this class with the traditional method, where professor and students are present in a classroom, is transferred to a new software program that in the first phase assists teaching (blended learning) and replaces traditional examination methods and at a later stage will allow long distance electronic teaching.

Key-Words: Internet, engineering education, e-learning, e-examinations

1   Introduction

Electronic learning has developed rapidly over the last years, since beside the teaching benefits (time management, access to remote libraries, long distance communication with people having similar scientific interests, economic benefits, etc) it now offers a multitude of relevant tools (ePortfolios, MP3 Players, web-based teaching materials, hypermedia, multimedia CD-ROMs, web sites, discussion boards, collaborative software, e-mail, blogs, wiki, chat, forum, computer aided assessment, educational animation simulations, games etc) that assist in it's growth.

Despite all the advantages and the plethora of relevant tools, the disadvantages (isolation, technological problems, etc) create obstacles and often eliminate electronic learning from the educational process. For example, when the students study with their personal computer in their private room, they can not share opinions, or ask questions to their colleagues or to the instructors. They are also often discouraged by problems, however small, with the installation of the program, such as a missing dependency. The operation of the program might also cause minor problems, such as slow or broken Internet access, which may also prove discouraging to many students.

It is certain that electronic learning, in cases when it is not feasible to replace traditional teaching, but also in cases where distance learning is not applicable for the particular field of learning, it can still offer useful tools that can be exploited in traditional teaching. In this regard, a special software program was developed, based on the principles of electronic learning, which aims at assisting traditional teaching with classroom presence and at the same time offers a transitional stage towards electronic learning. This software program, its development and potential are presented in the following sections.

2   Course Subject – Problems – Observations

2.1   Course subject

The main thematic points of the course " Safety and Health on Engineering Worksites" are:
- National and European legislation
- Safe worksite job implementation   (methods and techniques)
- Worksite organization (time and space)
- Organization methods for personnel/work groups
- Management of unexpected situations
- Individual and collective   - means and safety measures
- Accident reporting – extracting conclusions

The aim of the course is to supply future civil engineers with the required theoretical background in order to evaluate worksite hazards and the techniques and methods to prevent, minimize and manage them.

2.2   Procedure of Face-to-Face learning

The course has been taught in the traditional method with class presence for a number of years and it includes:
- lectures
- reading material (books, papers, etc)
- viewing material (slides, video, etc)
- discussions between professor and students
- worksite visits

Student examinations are held in the form of an individual test that includes:
- Short Answer Questions (SAQs)
- Multiple Choice Questions (MCQs)
- Modified Essay Questions (MEQs) based on images of worksites
- Extended Matching Questions (EMQs)
- True-false questions

2.3   Problems – observations

From the teaching and examination process, it was observed over the years that actual worksite pictures (building sites, road construction sites, etc) offered an exceptional tool for the students' understanding of the theoretical background and additionally they showed to great extent the measure of assimilation of the theoretical background in combination with the individual possibility of observation and estimation of a certain situation. Thus began a long period of experimentation. In the beginning pictures, carefully selected, were used for the estimation of various situations of worksite activities. In continuation students were asked for the evaluation of positive and negative observations and a hierarchy of these based on the basic theoretical principals and values as well as the taking of initiatives and the formulation of action priorities for the lifting of negative worksite situations as these were presented in the picture. Along the course it was found that the exploitation of pictures from real worksite helps in the following:
- in the sharpening of observation skills of the prospective engineer
- in the application of theory under real conditions
- in promoting participation
- in showing off trainees skills

In this phase, many individuals asked to receive pictures that were used in teaching and examinations, for their own personal practice. Thus the idea was born to use the Internet as means for the creation of an educational circle of remote learning courses and at home exercises.

Figure 1A (left):
Random worksite activity. The student should assess the situation and propose measures and counter-measures.
Figure 1B (right):
The proposed measures should be:
1.   hole cover behind the worker or use of safety belt

2.   safety helmet
3.   safety gloves
4.   special boots

Each proposal has also a grading value, according to the priority of intervention. The priority is the sequence of the implementetion of the proposals.

Figure 2A (left):
Another random worksite activity. The student should comment on the appearnce and the activity ot the worker.
figure 2B (right):
The proposed measures should be:
1.   the worker does not use individual safety measures:
    - helmet
    - safety glasses
    - special boots
2.   odd use of the cutting tool

3   Software

3.1   Structure – Appearance

On the left side of the computer screen an image of the worksite is shown. In the background of the image an invisible square grid operates, the dimensions of which can be defined by the examiner in combination with the details of the picture that is shown. Marginally the grid could be understood as a pixel. Every cell of the grid is defined and the examiner can assign positive or negative values, be it in a scale of percentage values. These values are determined by the examiner based on each projected image.

The examined defines points or regions in the image in which he recognizes situations with different degrees of danger. The examined marks these regions with the mouse pointer and assigns a percentage value (i.e. 10%, 30%, 50%, etc) and a positive (+) or negative (-) sign. If the marked area represents a single point in the image, then a cross appears to define the point. If the marked area represents a region then the region is outlined by a visible line. Next to the point or inside the region, the percentage value that the examined suggested appears and depending on the sign all entries appear in green if positive and red if negative. It is apparent that in an image not only the unacceptable situations should be shown, but also those that are

subject to praise or imitation. Therefore the examined can evaluate in an image both positive and negative subjects, which makes observation more difficult (there is no prejudice towards subjects for a negative critique).

To make sure that the examined is not acting based on chance, for every point or region marked a number is assigned. According to this number, the examined justifies his choices with data from theory or legislation.

Development of this software program was realized with the Python programming language, with the Toolkit Tkinter and web libraries and is based on the free software Thancad, which is published under GPL license. The software is independent of operating systems (Windows, Linux, MacOS, etc). For security reasons, the application was chosen to be a client server application. The free software Thancad was chosen as a base for the development of the present implementation, because it employs functions and processes similar to known commercial CAD packages, with which most engineers in training are accustomed.

3.2   Possibilities

Each page is a test of knowledge and observation. Reaction time must be defined and appear on the page either as a stopwatch counting towards zero, or as a graphical image of variable area (bar, circle, hourglass etc). In the defined time the examined must be able to change opinion erasing or canceling their choice as many times as necessary. After the completion of the defined time the software adds up and evaluates the final choices and evaluates the effort. The work can be printed with the data the examined was required to give the software at the beginning of the process, as well as the date and time. In this manner there exist written data of the examination for record keeping. Concurrently with the printing of the document the software saves the effort (pre-selection) and erases the choices of the examined preparing the page for examination of the next individual. The evaluation of the attempt can be automatic and the results of the examination can appear on the printed document. Criteria for grading can be the location and correct evaluation of points or regions of the image according to the examiner. The location of a controversial region but an incorrect evaluate of the region could potentially remove points form the examined. There also always exist the possibility of the examined to determine and evaluate something, which may have been missed by the examiner. For this reason it was judged necessary to print the attempt (test) and the examiner as an individual to confirm the automatic correction from the program.

3.3   Prospects

In a more advanced version of the program the examiner would be able to determine the grid for each image (even better the permanent possibility to define the grid equal to a pixel) and assign positive or negative values to regions or points.

The images with their predefined values could be part of an image library and be inserted in the program in the above page either in a random or a predefined order. A user-friendly image manager could make it easier for the examiner to add or remove images of differing formats (jpg, tiff, etc) in the library or to group them in similar subject modules. It could also assist the examiner in defining regions and points and assigning values to them.

It is apparent that this form of training and examining and the software developed is not limited only to training and examining on worksite subjects, but can be useful in many other educational fields.

4   Conclusions

It was observed through the traditional teaching method with classroom presence that the use of real images of worksite conditions is a useful tool for the training of prospective civil engineers in safety and health on engineering worksites. Real worksite images help sharpen the prospective engineer's observation skills, help in the implementation of theory under real conditions, in promoting participation and in showing off the trainees skills.

For the exploitation of these elements, an educational software was developed which uses images of real worksite conditions both for course teaching and examining. The interaction between this electronic learning tool with traditional classroom teaching is hopeful both for exploiting electronic learning methods in traditional teaching (blended learning) and for the prospects of complete electronic distance learning.

The program has been tried for a semester with the participation of about 100 students which were split to 3 groups. The program was operated in the PC laboratory of the school and the instructor was always there with the students. Each computer was shared by 2-3 students, so that they could easily share their opinions and ask questions one to another. This also proved to be something like extreme programming [8], as the more advanced students were operating the computer while the others were watching, and later they switched roles. Furthermore, the instructor was always there to give advice and answer questions. This encouraged the students for the first few hours, as they were getting accustomed to the program. Also, some network problems were quickly resolved by the instructor.

The results of this experiment were encouraging. The students showed much more interest to the lesson than before. In fact, when asked, the students thought that the process was more like an entertainment than a lesson. Much more teaching material was covered than

before, and the students got an invaluable experience. Future plans include electronic library creation, image management of different formats (bmp, tiff, jpg, etc) and video utilization.

References:

[1] Marcia C. Linn, Philip Bell, Elizabeth E. Davis, Internet Environments for Science Education, Lawrence   Erlbaum Associates, 2004

[2] A. A. Stamos, Thancad: 2dimensional CAD for engineers, EUROPYTHON 2007, Vilnious 9-11 July

[3] http://en.wikipedia.org/wiki/Blended-learning

[4]   http://en.wikipedia.org/wiki/Electronic_lea- rning

[5] http://thancad.sourceforge.net

[6] K.F.H.Murell Man in his Working Environment Chapman et Hall, Ergonomics, Londres

FR.VEIL La Fatigue industrielle et l'Organisation du Travail, Le François, Paris

[7]   A.Chapanis,W.R.Garnaer,C.T.Morga,   Applied Experimental   Psychologie:Human   Factors   in Engineering Design, Wiley, 7e ed. Londres et New York

[8] Kent Beck, Extreme programming eXplained: embrace change, Addison-Wesley 2000, Reading, MA, ISBN 0201616416 9780201616415