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Web based e-learning platform as a source of the personalised teaching materials

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Education and research trends

ABSTRACT

Purpose: The goal of this work was to develop further the educational platform of the Internet Students Teaching Centre (ISTC) - the e-learning system based on the available state-of-the-art internet technologies (HTML, CSS, PHP, MySQL) with the possibility to generate the personalised PDF documents.
Design/methodology/approach: The paper presents the process of working out the educational materials package in PDF format, generated from the lecture notes (PowerPoint), instruction sheets with test problems (Excel), and knowledge tests (Hot Potatoes). Educational materials are generated dynamically on the e-learning platform, i.e., individually for each student. A detailed example is included of working out the PDF document format and its automatic generation along with the course student certificate using the PHP scripts.
Findings: The efficient method of assisting remotely the e-learning students acquiring skills and knowledge at a varying pace has been developed, providing them with the personalised support.
Research limitations/implications: Extensive testing has to be carried on big students groups, more course materials have to be developed and uploaded onto the e-learning platform.
Originality/value: Possibility of creating the personalised documents is the first stage in generating the programmed course materials, which - after verifying student's knowledge and determining his or her arrears - are automatically sent to the student, containing more detailed explanations on required topics.
Keywords: Computer aided teaching; E-learning; Course management system; Dynamic PDF

1. Introduction

Educational platform of the Internet Students Teaching Centre (ISTC) is the e-learning system based on the available internet technologies (HTML, CSS, PHP, MYSQL). Relational database was developed during the e-learning platform development, whose goal was storing and managing information pertaining to courses, students, and teachers. Connection of the database from the internet browser was carried out using the PHP scripts. Problems were solved during the software development, connected among others with generation of the didactic materials from the database onto the platform, as well as saving students' marks from the approved tests, and finally sending this information directly to the students [1-3]. The main goal of the educational platform is making the didactic materials available to students, needed for acquiring approvals of the subjects within the Framework of the course selected by the student and verifying the knowledge acquired by him or her during the course. The course materials are worked out basing on the electronic materials prepared in advance (Word, PowerPoint), which are converted into HTML or PDF formats and made

available to the particular group of participants of a given course [3]. One of the most popular materials delivery method was used to make them available to the student, i.e., uploading them to the server as files that student can download to his computer after setting up connection with the e-learning platform. He or she gets in this way a document which has been common for users that have the access key to it [4-7].

One of the many ways to improve the e-learning platform and adjust it to the needs of the particular course participant was making it possible for the student to download the documents custom compiled for him or her from his or her own account on the educational platform, instead of being restricted to use documents common for the entire student groups. These documents might be generated dynamically, i.e., generated as the effect of some student's action. An example might be a certificate attesting that a student has completed the test verifying his or Her knowledge from the particular syllabus part with the positive mark.

Such certificates may be created at the beginning of each course, for every participant, and then to store it on the server, giving each student the access key to it only after passing the test. However, such solution consumes a lot of time for preparation of certificates, as it has to be done separately for each course participant, the more so, as it has to be done in May courses in which a big number of students participate [3, 6-8]. Another solution was adopted – generation of the personalised documents using the PHP scripts [9]. This approach makes it possible for each ISTC platform user to obtain printouts of documents compiled just for him or her, even with the personal data – if needed, which are generated automatically from the HTML page form [10, 11].

2. Problem description

Main design requirements are discussed below pertaining to organisation of exams and posting their results to the students on the ISTC e-learning platform using generation of the personalised documents.

The exam has to be carried out consisting of a set of problems uploaded to the e-learning platform in the form of tests. The approval score will be calculated after completing the tests, and the positive result will give the base to generate the certificate confirming approval of the subject. The information on how to get or print the document will be waiting for the student after completing the exam and entering the *Student's Room*. The student, having entered the *Student's Room* [1], can print the certificate with his name, exam date, mark, and signature of the person responsible for the subject and/or can save this document on his computer.

The project scope included working out format specification of the document confirming passing the exam [12-14]. The following important features were required:

- Ease of design.
- The document should contain other elements than just text, like vector and bitmap images.
- Small size, so that its generation and download were very fast.
- Difficult to forge.
- To be used on many operating system platforms, as the students may use various hardware and software.
- No need for the students to install any additional software to view and print the documents.
- Document should look the same on any students' computer, regardless of hardware and software platform they use.
- Very good printout quality.

Formats that might be used for the exam certificates or other personalised documents might be of the following types: ASCI text, HTML, Microsoft Word or other text editor, RTF, PostScript or PDF. The specific features of these formats are listed in Table 1. PDF format was selected taking into account the above mentioned features of the required document PDF [13].

Table 1.
Available document formats [12]

Format	Advantages	Disadvantages
ASCII	• no compatibility problems, • small file size, • ease of design, • generated quickly by relevant scripts;	• scant formatting possibility, • no images, • no copy or editing control – making them susceptible to tampering;
HTML	• format control, • possibility to attach objects (images), • compatibility with many operating systems and software, • ease of design and generating by scripts;	• limited printout formatting, • poor appearance consistency on different platforms and varying print quality;
Formats of text editors, e.g., Microsoft Word	• ease of design and strict control of the printout appearance, • tamper proof due to password protection;	• files size may be big, • dynamic generation by PHP scripts impossible;
RTF	• easy page layout design including printout formatting, • vector and bitmap graphics may be attached, • document exchange format among many programs, • printing possible;	• threat of unauthorised modification, • big file size in case of complex documents;
PostScript	• precise formatting (text, images, fonts), • coherent high quality listings independent of hardware and operating systems;	• big file size, • additional software required;
PDF	• possibility of retaining the arbitrary source document formatting, • coherent high quality listings both on screen and in printout, • compression possible, • security control.	• most of the software used for generation of PDF documents is commercial.

3. Results

The developed solution consists of two elements: flexible course exams system and document generation software. The course exams are based on tests composed of various problem types (true-false and multiple-choice quizzes, jumbled-sentence or gap-fill exercises) which are taken out of the database and scrambled at every test load, so the student cannot guess what problems and in what sequence will be presented to him or her. The exam mark is assessed based on problem results and is saved in the database.

Simultaneously the print ready certificate is generated, which the student can download from the *Student's Room* [1-3]. The certificate is the document confirming passing the exam, stating relevant information about the student, exam results, and signatures of persons responsible for carrying out the exam; moreover, it is tamper proof thanks to the adequate protection features.

The second element of the solution is the certificate generating software. The document in the PDF format may be created in two ways (Figure 1) – based on PDF template or by using the external PHP functions libraries making it possible to generate PDF documents [9,13]. Conversion of the original static document saved in the PDF format into a template is carried out using the pdftk library [15]. Pdftk is an effective free tool for processing PDF files, including their splitting and merging, decryption and encryption, and bursting into single pages. The first of two possible solutions was employed for ISTC – certificate generation from the previously prepared PDF template.

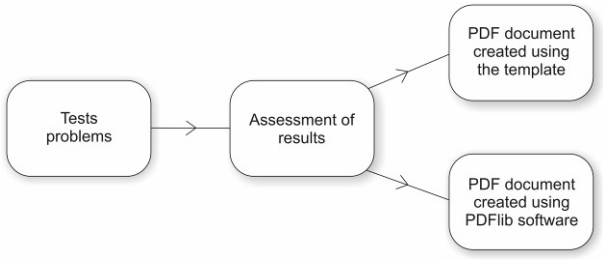

Fig. 1. Certification system in ISTC

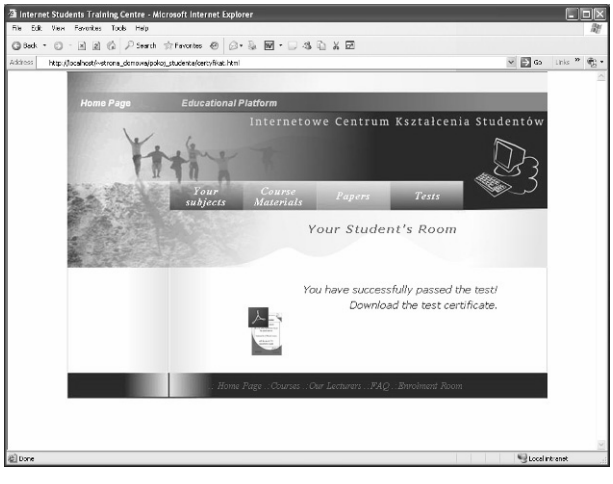

Fig. 2. *Student's Room* window after passing the exam from the subject: Fundamentals of Materials Science

The certificate generation application system consists of the following parts:

- HTML form with test problems generated using the Hot Potatoes software [16-19],
- PHP scripts determining test result,
- script creating the certificate using the empty PDF template,
- bitmap images with the ISTC logo and signature of the authorised person – inserted into the certificate,
- PDF certificate template developer in Adobe Acrobat program.

The successful exam result is show in Figure 2. In case the student does not obtain the minimum score he or she will be advised about the failed exam only.

The certificate's structure, style, and most of the text are static, and only the data pertaining to the particular person are substituted (name and surname, test score as percentage, mark, and date); therefore, development of the document template consists in entering the substitute symbols in places where the dynamic information will appear, e.g., <<NAME>>, <<score>>, <<mark>>, etc. The substitute symbols were used with the formatting codes, like dashes, digits and brackets, during development of the PDF template file with Adobe Acrobat. Therefore, one had to find and replace them. The `replace_pdf()` function was developer which generates automatically the relevant regular expression for the substitute symbol and replaces that symbol for the appropriate text. A fragment of the substitute symbol with the formatting code may be as shown below [9, 14, 15]:

```
[(text)5(b)-1.7(eg_stu)5(o)-1.7(dent_ID)]TJ
```

which after processing becomes the legible expression:

```
[(textbeg_student_ID)]TJ
```

```php
<?php
    set_time_limit( 180 );
    .
    .
    .

//generation of headers that will help the
//browser to select the appropriate application
header( 'Content-Disposition: filename=cert.pdf');
header( 'Content-type: application/pdf' );
$data = date( 'F d, Y' );

//open the template file
$file_name = 'CertificatePHP.pdf';
$wp = fopen ( $file_name, 'r' );

//read the template into the variable
$display = fread( $wp, filesize( $file_name ) );

fclose ( $wp );

//replace with data the substitute symbols in template
$display = pdf_replace( '<<NAME>>', strtoupper( $name ), $display );
$display = pdf_replace( '<<Score>>', $score, $display );
$display = pdf_replace( '<<Mark>>', $mark, $display );
$display = pdf_replace( '<<mm/dd/rrrr>>', $date, $display );

//send the generated document to the browser
echo $display;
}
?>
```

Fig. 3. Script generating the ISTC certificate using the template

A fragment of the script generating the certificate for the ISTC student is shown in Figure 3, and its final document (when the student obtained test approval) is presented in Figure 4.

Documents created this way may be freely formatted on the fly, as they are generated and contain the most up-to-date information acquired from the ISTC database. Personalisation of course materials makes the ISTC *Student's Room* more user friendly and makes it possible to reduce significantly the number of direct enquiries to the system Administrator.

As mentioned before, this approach – presented here on a certificate generation example – may be used for customising the teaching materials made available to the student on-line. This – in fact – boils down, after a while, to development of the individual course of studies for each student.

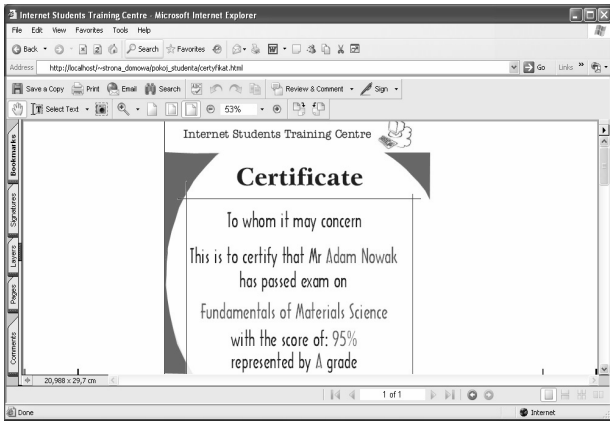

Fig. 4. The certificate generated using the PDF template

4. Conclusions

- PDF format is versatile and widely known by Internet users. PDF file viewers are available for all computer platforms and the format was designed for printed documents, which makes it the best solution for generating the personalised documents.
- Dynamic document generation makes it possible to preserve the confidential information and makes it possible to deliver the document customised for the particular person.
- Presented solution may be the base for development of programmed materials, i.e., those that after assessing student's knowledge and determining in what subject area – course material section – his knowledge is inadequate, will be generated automatically for him and made ready to download on the e-learning platform. These documents will cover exactly that knowledge that still has to be acquired.

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