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Assuring quality of an e-learning project through the PDCA approach

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ABSTRACT

Purpose: The aim of the paper is to present the methodology used to manage an extensive e-learning project at the Czestochowa University of Technology. Systematic and generic methodology was used to assure quality and homogeneity of the implemented on-line courses.

Design/methodology/approach: The PDCA based model for managing the e-learning project has been presented. The model was successfully used to plan, describe, create, implement and evaluate 28 on-line courses. Documents designed in accordance with the Deming's cycle were used to ensure that the courses are of high quality and fulfil the criteria of the University standards.

Findings: The discussed model proved highly effective in obtaining the quality project aims. The model was created, tested and evaluated during the two-year-long project and resulted in the implementation of 28 e-learning courses in three faculties: Mechanics and Machine Building, Environmental Engineering and Computer Sciences.

Research limitations/implications: Having been tested and used on a small scale, the model is currently being incorporated into the whole University. Teachers report that the process of creating the documents is highly time-consuming. Attempts are being made to make the process less demanding by, for example, creating user-friendly forms in both: Word Macros (Visual Basic) and Web Based interactive tools.

Practical implications: One of the most difficult issues observed was quality assurance. It is usually obtained by review and evaluation processes carried out at least twice. The proposed methodology proved highly efficient. Although the courses are unique and individual, they are also very homogeneous and methodically uniform.

Originality/value: The methodology described in the paper is based on the Crosby's philosophy (right first time) and uses the PDCA cycle as the tool. It can be used by e-learning project managers either at educational or business enterprises.

Keywords: E-learning; Computer aided teaching; Project management; B-learning; Moodle

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1. Introduction

The expansion of the internet and a growing presence of electronic media in our life make education as we know it a thing of the past. Audio and video lectures delivered online, videoconferences, webinars, discussions on forums and chats, flexible study hours, Internet consultations, multimedia teaching materials accessible from anywhere and at any time are all not a futuristic vision of education, but reality in many foreign and domestic schools and universities [4-7].

Distance learning is becoming a new way of gaining knowledge, alternative to traditional education and the existing educational structures. Thus, higher education institutions face the task of preparing a new model of education, which will incorporate the e-learning solutions. Certainly, it is a time-consuming process, where both hopes and fears are voiced by students as well as academic staff. That is why the adopted solutions should serve the purpose of integrating various forms of education; they should support the traditional system instead of replacing it.

The latest Sloan C report published in 2010 [8] claims that in the USA alone over 4.6 mln students participated at least once in an online course offered in the previous semester. Interestingly, the figure increased by 17% in comparison to the previous year and it is estimated that the process is ongoing. The research reports that over 25% of all the USA students took part in at least one online course. Unfortunately, there are no similar data available for Poland. The findings of a survey conducted at Czestochowa University of Technology show that 14% of the polled students (464 persons) have experience in distance learning, while 45% students do not know what e-learning means in practice. It seems encouraging that nearly 80% of respondents voiced their readiness to enrol in an online course, which leads to the belief that there is a huge demand for such education. The university should be urged to implement elements of distance learning, which ought to be preceded by a publicity campaign and a series of trainings.

According to the definition accepted at the University, distance learning is not just a set of electronic presentations made available for students nor is it providing a pdf file or a link to a website. For the project's needs it was agreed that e-learning/e-teaching or e-education means an interactive method of education which comprises delivering teaching materials, managing the didactic process, monitoring and assessing progress and ensuring student-teacher as well as student-student communication and interaction by means of information technologies, particularly Internet communication tools. The authors are aware that such a definition is neither complete nor perfect as e-learning is a complex and difficult idea to define. 'Difficult' mainly due to the fact that every individual understands it in a different way. 'Complex' because it undergoes constant changes and improvements. A few years ago, when first attempts to define e-learning were made, e-education was, in fact, believed to be a partially or fully Internet-based training (see Wikipedia). Today, however, e-learning comprised a huge range of tools used not only for teaching, but also learning, co-learning, collaborating and communicating or, to put it in other words, building the so called Personal Learning Environment (PLE) or Personal Learning Network (PLN). E-teacher very often becomes a student or course participant by learning new things together with his students. Not only is the role of a teacher changing, but that of a student too. He has stopped being just a passive recipient of knowledge, which is later verified in tests and examinations, and has become an active co-developer of the course who makes critical comments on the delivered knowledge and searches for additional or supplementary information. Abramowicz [9] writes about a crisis and 'twilight of academy', predicting a birth of e-Academy – a geographically unlimited university where didactic teams will be set in the network and will be able to deliver their message to any place in the world. Observing both students and tutors in the process of e-education, it was decided that a model e-course should be developed and enforced. Such a model would require teacher-student, teacher-group, and student-student interaction at every stage of work in the course.

Being aware of the expectations and possible difficulties a team of employees of the Faculty of Mechanical Engineering and Computer Science and the Faculty of Engineering and Environmental Protection started a project financed by the European Social Fund with the aim of laying foundations for the development of the University e-education and a gradual introduction of e-learning to the programmes of study on offer.

The team working on the project, based on the experience gained by the Institute of Metal Working, Quality Engineering and Bioengineering, established its primary goal to be acquainting academic teachers and students with e-learning, its pros and cons, and preparing them for this new form of education, while building basic technical infrastructure and setting the standards for distance learning at the same time. It was agreed that the target educational model should be blended learning, where the content delivered electronically will supplement the traditional classes.

Blended learning is free from many flaws of 'pure' e-learning and, at the same time, it is relatively easy to implement in the traditional student-oriented university [10]. The quality of the didactic process was the priority for all the people involved in the project. Therefore a systematic PDCA approach was considered, adopted and further incorporated. A model planned according to the PDCA methodology was based on four main documents/stages: ECTS form, course syllabus, knowledge and interaction cards and scenario. Below, all the four stages have been described in detail.

2. Learning Content Management System

Dedicated computer systems called virtual learning environments (VLE), learning management systems (LMS) or learning content management systems (LCMS) are used to organize and manage e-learning. These systems allow the user to create dynamic WWW services, either public or for a particular group of students. They offer a wide variety of tools supporting and facilitating the publication of the service content, either in a text or graphic form or as ready-made documents or usable applications. The systems make it possible to manage groups of users (students, teachers) as well as resources created for them. They help to organize the work of teams and individuals by offering tools which enable monitoring of the learning process. An attempt to incorporate e-learning into the traditional system of education at the Faculty of Mechanical Engineering and

Computer Science was made as early as in 2001 at the Institute of Metal Forming, Quality Engineering and Bioengineering, when an e-learning platform was installed on the Institute's server. With time the scope of the tool application was extended to cover new areas, e.g. to enhance student mobility [1, 2]. When the decision was taken to support traditional classes with online teaching, an analysis was performed to compare the software available on the market. All the necessary requirements were defined and after studying the existing solutions, the Moodle platform was selected. Now, having used the platform for 10 years, it seems that the decision was right and it proves to be no worse than the existing commercial products while definitely surpassing other Open Source platforms. It is also worth noting that one of the world's largest and oldest online universities, Open University in Great Britain, likewise has chosen Moodle as its LCMS platform. Drawing on the literature review, the platform appears popular in Poland too [13-18].

The Moodle platform is also widely used as a workspace in European projects to exchange experience and know-how as well as to supplement various forms of education [1, 2].

3. Project description

The project in question was launched on 1st September 2008 and lasted till 30th of September 2010. It was divided into four stages.

3.1. Stage I - Gaining knowledge

The aim of this stage was to obtain knowledge concerning the existing technical and organizational solutions in the field of e-learning applied by other universities, their implementation experiences as well as the direction of changes. Simultaneously, a survey study was conducted to diagnose the needs and the extent of knowledge regarding e-learning among both teachers and students of the faculties in question. The idea of incorporating the new model of teaching was supported by 65% to 80% of the students (depending on the faculty) and 89% of the teachers. This implies a very positive attitude toward distance learning. At this stage teachers who volunteered to take part in developing and executing the electronic teaching materials were recruited. They faced only one condition, namely running classes in one of the chosen faculties. As a result, 10 courses ready for blended learning were developed at each faculty. This facilitated a smooth implementation of the new way of teaching at the Faculty of Computer Science first, then at Mechanics and Machine Construction and, finally, at the Faculty of Engineering and Environmental Protection. Later e-learning was offered at other faculties as well.

3.2. Stage II – Organizing knowledge

During this stage workshops, training and seminars on e-learning were carried out (mainly dealing with e-methodology but also with technology). The server and the Moodle platform were set up and requirements and guidelines relating to the preparation of electronic teaching materials as well as pedagogical recommendations for the staff were established. The participating teachers were trained by specialists from the foremost domestic and foreign e-learning centres. They had an opportunity to 'go over to the other camp' and become e-students as part of the training took place in the virtual environment.

3.3. Stage III – Applying knowledge

Stage III involved the preparation of course scenarios and developing the e-content. The teachers were encouraged to follow pedagogical guidelines when conducting e-classes and make use of the incorporated technical tools. This stage is described in detail below. At the same time, an instruction manual on how to use the platform was prepared for students.

3.4. Stage IV – Spreading knowledge

The last stage involved launching selected courses in order to test the adopted solutions and update the courses accordingly. Simultaneously, on the basis of experience gained during the project, attempts were made to prepare another project in the field of e-learning which would encompass all the University faculties and result in adoption of a strategy aiming to implement e-learning together with all appropriate organizational solutions.

4. PDCA cycle and documentation

While preparing and realizing the project, great attention was paid to ensuring high quality of all courses and the whole project. Following the Total Quality Management rules, the work on the project was based on team-work and modelled on the PDCA cycle, also called the Deming cycle. PDCA (Plan – Do - Check – Act) is an iterative process aiming at systematic and constant quality improvement. The PDCA Cycle, developed by W. Shewhart in the Bell Laboratories, USA in the 1930's, was promoted by W.E. Deming twenty years later and is currently widely known as the Deming Wheel or Deming Cycle. The main idea behind it is to divide the project (process) into four steps. Although in each case the range of activities assigned to a given step may differ, the list below presents a number of general examples:

- Plan – defining the concept, aims and objectives; identifying problems and critical points; training; developing templates, models, methodology, etc.
- Do – solving a problem on a small scale; preparing documents and procedures; describing the process; piloting, etc.
- Check – measuring the results; evaluating the solution/model; comparing the results with the established goals; preparing standards, quality assurance procedures, and the review process, etc.
- Act – full scale implementation; implementation as a standard; introduction to the company culture, etc.

In the discussed project, each course was blended, which meant that a third of the classes were to be conducted face-to-face at the University premises, and two thirds online. It was assumed that such a course would run in stages and it would require preparing teaching materials according to the established model. The model had been based on the PDCA cycle (Fig. 1). Below, the documents required to prepare the teaching materials have been enumerated:

- the course card (ECTS form) – a template obligatory for the whole University in traditional classes (Plan),
- the course syllabus also indicating topics to be realized online (Plan),
- the KNOWLEDGE card (Do-Check),
- the INTERACTION card (Do-Check),
- the course scenario (Act).

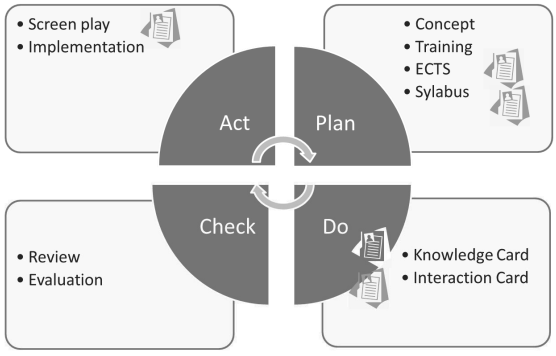

Fig. 1. PDCA methodology used to manage the documentation of the project

Before the course scenario was to be written, the syllabus, and both knowledge and interaction cards for each teaching unit had to obtain a favourable review (Check). The review was done by University senior researchers, who were selected by the heads of chosen majors.

5. Documents

5.1. Plan – Course syllabus

Course syllabus, approved by the proper Faculty Board, is the starting point for designing electronic teaching materials. In each University major, the course syllabus has a form of the ECTS form. Although it provides a lot of information, the way in which the information is provided and detailed has not been standardized. This often leads to significant differences in course syllabuses depending on who (teacher) and where (faculty) they were written. For instance, the lack of fundamental information such as the type of classes (lectures, tutorials, etc), number of teaching hours assigned to a given teaching unit or detailed division to topics was observed.

As 'course description' ought to present the whole area of knowledge and skills which are to be gained by the student in a particular course and ought to comply with curriculum standards for a given major, it was decided that the ECTS form should only be a prelude to designing electronic teaching materials.

On the basis of the ECTS form, the teachers prepared their course syllabuses in a standardized and universal way. There were two types of classes as stated in the curriculum: lectures and tutorials (seminars/projects). For instance, if in a course there was one lecture (1L) and one tutorial (1T) per week and both types of classes were to be conducted online, the syllabus should include the content for both. If, however, only one type of classes was to be conducted online, e.g. the tutorial, the syllabus should include the content of the tutorial alone. For each type of classes, the teacher divided the content into teaching units corresponding to the number of teaching hours per semester for a given type of classes, complying with the curriculum. Thus, the course syllabus (1L, 1T) included 15 teaching units for lectures and 15 teaching units for tutorials. The course syllabus (1L, 2T) included 15 teaching units for lectures and/or 30 teaching units for tutorials. The syllabus should also include such information as the aim of the classes, entry requirements, and details of the course and its place in the curriculum:

- Course title,
- Major,
- Specialization,
- Type of study,
- Year and semester,
- Type of classes,
- Number of hours per week,
- Number of ECTS points,
- Name of the tutor,
- Content of lectures divided into teaching hours,
- Content of tutorials divided into teaching hours,
- Obligatory and optional literature,
- Methods of evaluation/Course requirements/Grading criteria,
- Means of contacting the tutor,
- Statement concerning originality of the work.

In the project, it was assumed that blended learning, which combines face-to-face teaching with computer-mediated instruction, would be the target model of classes applied in the University. Following this premise as well as taking into consideration the financial limits in the project budget and the binding directives of the Ministry of Science and Higher Education, it was decided that, for a given course, the electronic teaching materials would not be designed for the whole course, but only for the part equalling to 2/3 of the total number of teaching hours (at maximum) per semester. For this reason the teacher had to indicate the teaching units, selected from the course content, for which he would prepare the electronic teaching materials.

5.2. Do – Knowledge and Interaction Cards

The KNOWLEDGE and INTERACTION cards were then prepared for each of the selected teaching units. The 'teaching unit' was understood as part of the course content which would be conveyed to the student within one teaching hour. At the same time, it was assumed that such a teaching unit will constitute one, self-contained, thematic module of the e-course. A module on the

Moodle platform builds on two categories: RESOURCES and ACTIVITIES. The RESOURCES are used for setting and publishing the teaching materials. The ACTIVITIES not only enable the teacher to monitor the students' progress or test the acquired knowledge, but also make it possible to incorporate student-student, student-group, student-teacher, or teacher-group interaction into the course. Drawing on the abovementioned assumptions, it was agreed that, at this stage, the electronic teaching materials the teacher would be required to prepare two sets of information for each teaching unit. These would be recorded in two cards:

- the KNOWLEDGE card – provides a detailed description of the knowledge (content) to be acquired by the student, together with a list of all available resources (e.g. pdf, swf, ppt files);
- the INTERACTION card – provides above all a detailed description of: skills and competences which the student will gain; forms of interaction supported with examples; the way in which the student's progress will be monitored and assessed; description of interactive activities which are going to facilitate learning. The card also gives information about the grading system and grading criteria for each teaching unit.

While designing interaction for their courses, the teachers had an opportunity to consult practitioners of e-learning and specialists in e-methodology. The methodologists worked with the teachers individually giving advice on how to adapt and convert traditional teaching materials into electronic ones.

5.3. Check – Review process

All documents, i.e. the course syllabus as well as knowledge and interaction cards were subjected to a review process. The reviewers included senior researchers, mainly chair and institute heads who were in charge of the didactic process in their units.

5.4. Act – Scenario

As most, if not all, our tutors had no previous experience with the Moodle platform, it was assumed that the easiest way to describe their course would be by means of a scenario. A template was prepared and it was consulted with domestic and foreign online methodologists and practitioners. Then the tutors were asked to fill in the templates with appropriate content. This stage was also monitored by methodologists who individually consulted ideas, made comments and gave advice. Below are listed the scenario key points for each teaching unit (module):

- Didactic aim – providing detail description of the aims of a given teaching unit;
- Instructions - providing detail description of how the work in each unit should be organized. If necessary, it should be made clear that a given unit draws on some previous knowledge, gained either in online or face-to-face classes;
- Content (KNOWLEDGE) – providing complete and exhaustive description of a given teaching unit by means of, e.g. a PowerPoint presentation, PDF file or any other electronic teaching material. This could also be a text converted to the Moodle Book or Lesson. In such a case, the tutor should divide the text into appropriate pages, add monitoring questions, and support the material with drawings, pictures, diagrams etc. The e-content should reflect what was described in the KONWLEDGE card. Any changes to the e-content should be demonstrated in the KONWLEDGE card too;
- Tools (INTERACTION) – providing complete and exhaustive description of all activities or interactions intended for a given teaching unit. By means of a clear instruction the student should be thoroughly informed of what is required of him in a given activity. A script and, if needed, graphics should be prepared for each interaction. The e-content should reflect what was described in the INTERACTION card. Any changes to the e-content should be demonstrated in the INTERACTION card too;
- Method of evaluation/Grading system - providing clear and precise requirements and grading criteria for both each activity and the whole teaching unit;
- Additional teaching materials – providing a complete text or links to web pages or other resources;
- Organization of work (teacher) - providing details of how the teacher intends to work in the teaching unit, including time frame for each activity:
  - when the teacher opens a given teaching unit;
  - when he opens a given activity;
  - order of activities and a deadline for each of them;
- Organization of work (student) - providing details of how the student is expected to work with the activities, including the time required to complete them (e.g. participation in a forum – 20 minutes);
- Every single e-course (even the most advanced one) should be up to the standard which comprises:
  - information about the subject of the course, its range and entry requirements;
  - time of the course, i.e. when it starts and ends;
  - schedule of individual teaching units (also called modules), including deadlines for tasks and tests;
  - participation rules such as: requirements for students, methods and techniques of work used in the course, principles of communication with the tutor and other course participants, rules concerning group work, information about possible absences and how to make up for them, and last but not least grading criteria.

For the abovementioned reasons, during the preparatory stage, module zero with a half-filled in template was developed and offered to the tutors (the module should be present in every single course). The idea proved excellent and is definitely worth recommendation.

6. Conclusions

Although the project is completed, the implementation of e-learning at Czestochowa University of Technology has only begun. In 2010/2011 there are plans to educate and train over 200 teachers to be able to develop Electronic Teaching Materials. The trainings are being conducted by both persons participating in the project and specialists in distance learning from the leading

distance teaching centres based in Poland and abroad. Part of the training will be delivered with the use of distance learning tools. The courses will be developed under the guidance of experienced distance education methodologists from the foremost domestic centres. A recording studio equipped with suitable hardware and up-to-date software was designed and set up especially for this purpose and has been made available for the teachers. With the support of a computer specialist, the studio allows the teachers to create audio/video materials to use in their e-teaching practice.

As Czestochowa University of Technology has not much experience in e-education, the University authorities are facing a difficult decision relating to the choice of technology and the way such education should be organized. It will be necessary to develop certain standards applicable to e-learning. All the decisions will depend on the development strategy adopted for online education. With accordance to Czestochowa University of Technology Senate Resolution made last year, it is allowed to deliver 60 online teaching hours per major per academic year. On one hand, it is a very important resolution as for the first time it legitimizes e-learning at the University. On the other hand, the possibility to practise this way of education has been limited to a great extent.

The methodology relating to the implementation of e-learning elements, which was presented in the paper, is a complex and systemic issue which aims to ensure high and constant quality of the teaching process. The authors' of the paper share the view that the differences in the methodology of traditional and distance education provoke introduction of new supplementary elements of preparing, implementing and conducting online classes. The discussed solutions proved successful although required a lot of work and time. The outcomes, however, let us believe that distance learning at our University will result in a wider and more appealing educational offer as well as better quality of education. The application of modern teaching methods should also have a positive impact on the University's image – of a modern and developing University which follows the trends and the needs of students and the Polish educational market.

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