

# Improving Process of Teaching Students by Means of Methods and Tools of Knowledge Management and e-Learning

Lech Banachowski, Aldona Drabik, and Jerzy Paweł Nowacki

**Abstract**—The process of teaching students is of the greatest importance. It is important to study how to manage it to achieve the best advantages to the students and the university. The authors propose to apply the methods and tools of knowledge management and e-learning. The potential of knowledge management lies in the optimization of university processes, in introducing organizational learning and in helping to take well grounded decisions. The potential of e-learning lies in the improvement of the quality of education, in higher flexibility and adaptability of teaching process to the needs of individual students and in lowering the cost of education. The article shows how to apply e-portfolios and information systems to support the teaching process and knowledge management at academic institutions

**Index Terms**—E-learning, knowledge management, process of teaching students, e-portfolio, information technology in education.

## I. INTRODUCTION

In recent years we have witnessed many changes at Polish universities and schools offering higher education. First of all, they have been increasingly active in EU projects whose key objective is the development of the educational potential. Secondly, they have been adopting ICT to enhance teaching methodology. Thirdly, in 2011 the Ministry for Higher Education changed the general principles of organization of study from one based on the centrally pre-defined educational minimums (benchmarks) to one focused on effects of education defined by the teaching institution. That requires setting up a system for registering educational outcomes (accomplishments of each student). Moreover, we must make sure that the outcomes we would like to achieve are realistic, consistent and relevant to the needs of the job market, and not just easy to report by our system.

In the case of state universities there is growing pressure from decision-makers for evidence that public money is spent effectively by students and schools, and not wasted.

Non-state universities are under even bigger pressure – their revenue and expenses need to balance in order for the school to survive, not only the economic, but also the increasingly deeper demographic crisis. Pre-employment students tend to choose primarily state universities whereas students already in employment prefer paid extramural options offered both at state and non-state schools. The latter can only outbid the former by offering better preparation for

future work or more flexibility, e.g. the option of distance education.

We are witnessing a rise in lifelong learning and frequent changes of one's profession among university graduates. Hence postgraduate study programs enjoy such popularity.

All the above mentioned phenomena require a new, proactive approach to organizing university processes so the institution can meet the challenges posed by the changes and avoid traps in managing its educational offer. The two methods which seem most promising are knowledge management and e-learning.

Knowledge management is a proven method used in many commercial institutions where survival and development depended on the optimization of business processes and implementation of processes facilitating the continuous learning of the organization. E-learning is a method using ICT with the potential for both improving the quality and lowering the costs of education. It is especially true about blended learning, promoted by the Ministry as combining best practices of traditional and online education.

The main goal of teaching students is to produce graduates who are well-prepared both to meet the needs of the current job market and to face the challenge of lifelong learning. The intermediate formal aim is for the students to master the knowledge and skills defined as the expected learning outcomes. A problem arises of verifying whether, or to what extent, the key objectives are reached and how a university can prove that its graduates have mastered the required knowledge and skills.

The paper describes the starting point of actions taken at PJIIT within the framework of EFS whose objective was to identify the processes of knowledge management at the Institute and build electronic systems to support them. The project is envisaged for the period 1.10.2012-30.09.2014. We present the methods and tools which will be relevant to the situation of PJIIT, but which can also be used in similar projects at other universities. The methods involve applying knowledge management and e-learning to improve the didactic process.

## II. IMPROVING THE PROCESSES OF UNIVERSITY MANAGEMENT AND KNOWLEDGE MANAGEMENT

In a knowledge-based society higher schools are at the center. They are the key creators, keepers and suppliers of knowledge for the society. The transfer between universities and society is a continuous process.

Similarly to the operation of other complex organizations, activities of schools can be seen as sets of interconnected

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processes. In order to improve the functioning of an institution one must improve specific processes. The basic method used for the optimization of processes in an institution is knowledge management and the key process directly connected to any school's mission is teaching students. The process closely related to it is monitoring of the quality and efficiency of teaching.

Universities possess primarily the knowledge pertaining to the areas in which they offer education. The faculty learns it first, pass it on to students, check whether the students have mastered it, prepare presentations and experiments to facilitate the didactic process, develop the knowledge by writing textbooks, doing research and publishing the results. The students are clients, consumers of the knowledge. By paying the tuition fees they gain access to the relevant curricula, which gives them not only knowledge and skills but also their confirmation in the form of a certificate or a diploma.

Universities are also institutions keeping and developing knowledge regarding the organization and implementation of didactic processes and organizations processes. Faculty members gain it, use it and share with others when they develop curricula, syllabuses, choose teaching and student evaluation methods, assess the efficiency of those methods. The university prepares accreditation documents, conducts teacher evaluation, analyses the job market, runs information and promotional campaigns among potential candidates, etc.

Traditionally a curriculum was built on the basis of educational standards published by the Ministry and of a desired graduate profile defined by the school. In 2011 the ministry got rid of the minimum standards and replaced them with a requirement that universities develop their curricula basing on predefined desired educational outcomes in the three areas: knowledge, professional skills and social competencies. Each school is obliged to guarantee that its graduates have mastered the knowledge, skills and competencies declared by it. A problem arises how to prove that educational outcomes are reached.

Knowledge management is a systematic process of gathering, storing, using and sharing of data, information, documents and didactic materials in order to improve university processes, supported by tools offered by information technology. It is characterized by:

- 1) using the operations of aggregating and interpreting data
- 2) following, monitoring and assessing changes in time of selected indicators pertaining to university processes,
- 3) using graphical representations of information and changes, such as graphs, diagrams, video films, etc.

Questions asked in the process of knowledge management may relate to e.g. (more details in [1]-[3]): the ways of improving teaching results, the ways to better meet the needs and expectations of students, to adjust didactic interventions to particular circumstances, to lower the attrition rates, etc. It is advisable to identify processes which cause frustration among students and lecturers and which may hinder the attainment of key objectives. The analysis of syllabuses can point to redundancies as far as content of courses is concerned and indicate which subjects need a revision. The analysis of knowledge presented in didactic materials may help decide on the direction/s of development of a given university, also on the areas worth researching and the

possibilities of cooperation with the institutions employing the graduates. It is possible to conduct a thorough review and overhaul of the departments and curricula. Information concerning similar educational establishments can be gathered and analyzed, as well as the profiles of candidates who are interested in choosing a certain university or a certain field of study.

Knowledge management requires the development of both the technical base and the processes of collecting and using data at a university. Having the knowledge allows for the taking of more informed actions and decisions which will help the institution meet its goals.

Traditionally knowledge management has been understood [1] as an infinite iterative process of data gathering, processing and drawing conclusions. Data are descriptions of facts and measures related to university functioning. The first step of knowledge management is to ask for relevant data. Data are then converted into information in the form of reports, presentations and other documents. Knowledge is interpretation of information and making decisions best suited to the realities of the institution. The analyses and actions taken should lead to asking for further data and information, asking further questions. It should be possible, for example, to gain insight into why students routinely fail subject X and many have to retake it, even several times. To solve such problems we might need more data than we currently have at our disposal, so more data need to be gathered.

**Decisions and actions are takes on the basis of the knowledge gained by means of iterative data collection, processing and analysis.**

Changes which are going to be introduced should be suggested as part of a bottom-up process by communities of practice (CoP). In order to improve current university processes ICT tools are made available to facilitate discussions, share results, focusing efforts on the evaluation of the process of teaching students. Teachers should have access to information regarding the curriculum, number of new students, numbers of students who have dropped out, together with the semester and the reason why that happened, grades obtained by students, the number of graduates and their final grades, professional careers of graduates.

It is worth mentioning several factors which may slow down the process of the emergence of a community of practice at a university:

- 1) The fact that faculty members work in several places, hence have too big workload
- 2) Too much focus on research work at the expense of didactic work as something of lower priority
- 3) Lack of competition and motivation to introduce changes, inherent in the current model: professor and assistants
- 4) Lack of funds for the development of didactic work
- 5) Lack of support on the part of university authorities.

Among university processes it is the monitoring of a didactic process that carries most weight [4] – a process which comprises the identification of desired learning outcomes, measuring to what extent these have been attained and evaluating the didactic process itself. Its objective is to ensure that the identified desired learning outcomes are reached during the didactic process. The relevant analyses

should provide feedback which will enable the reformulation of the desired learning outcomes to adjust them to the needs of the job market and international teaching standards, as well as the improvements in the didactic process itself, to make it more effective. Measurement of the success ratio of the didactic process is a continuous endeavor whose aim is to enhance it. Planning of the evaluation of results should take place during the initial stage of course design.

In monitoring the effectiveness of the didactic process the following tools could be very useful:

- 1) systems for following and recording of academic results and for measuring the efficiency of teaching programs as functions of results attained by students – results are recorded in teaching managements systems of the LMS type;
- 2) e-portfolios which serve the purpose of documenting learners' progress;
- 3) diploma theses, reports and computer programs demonstrating the skills of problem-solving and higher-order reasoning mastered by students.

It is a great challenge for universities to develop such curricula which would draw on the professional knowledge brought in by students who are already in employment. There is a need for the emergence of an environment which would enable the two-way exchange between students and school.

Working students have a practical approach to education and tend to concentrate on those aspects which they find useful in their professional careers. A well-designed course should have a feedback mechanism for identifying the students' needs and how they use acquired knowledge to solve real-life problems. What is needed is a relevant component of a university knowledge management system.

Knowledge requires a context in which it would make sense, e.g. an article in a specialist magazine or a lecture for students. It might be difficult to ask students to write a quality wiki article for the sole purpose of passing a course. There is a difference in how a student who only wants to get the lowest passing grade works and the work of a student who wants to get the highest grade. Yet another case is a student who wants his or her wiki article to be reviewed and published in a magazine or a monograph. Students of higher years are capable of doing research which may yield results worthy of publication. The university may publish monographs including students' articles in a particular field – these articles would be subjected to a review process along the same principles as the articles of faculty members. Furthermore, students of higher years could participate in preparing didactic materials used in the teaching process. Involving students in the creation of knowledge lays the foundations for further cooperation with them after their graduation – both in the dissemination and the creation of knowledge, that is continuous study as described in [5].

### III. IMPROVING UNIVERSITY PROCESSES AND E-LEARNING

By e-education (commonly referred to as e-learning) we understand all forms of electronically supported learning and teaching, including the Internet, multimedia, distance communication, materials in the electronic form – used both off and on campus. E-education comprises the acquisition of knowledge which is distributed and made available thanks to

electronic media, as well as the assessment of students' knowledge taking into consideration the social processes in learning and teaching, cooperation and interactivity. Electronic materials combine text, graphics, animation, and streamed audio and video.

Hence both watching a live or pre-recorded lecture from one's home or participating in an online seminar from a well-equipped lab at school would be considered e-education. Similarly access to electronic libraries with books, magazines and multimedia materials.

The traditional didactic process based on lectures, tutorials and laboratories attended by groups of students at a university premises can easily be expanded to involve the elements based on ICT. Stationary tutorials will expand beyond the boundaries of a classroom and time limits imposed by a timetable. All materials and information related to the course are published online. A teacher can modify and update them with an immediate effect. Students who have missed a class can access the materials covered, which would help them avoid falling behind. Home assignments are submitted via the Internet, grades and tutors' comments are posted online. Since some part of a didactic process is moved online, the teacher can use the offline part of the course to focus on more difficult aspects of the subject and activities requiring teamwork. Using an LMS, a student can check his or her knowledge doing online tests, as well as play and replay multiple times a recorded lecture (which could, in turn, be delivered by a specialist from another academic center), watch a multimedia presentation, do exercises in an online lab (based on a simulation or a connection with a real lab, e.g. remote control of robots), use a remote terminal to access software installed at their school, including virtual machines.

We can safely conclude that the didactic process can be split into two parts. There are some elements which are better managed at a distance, and should be reserved for the online component of a course; and there are elements better managed in the face-to-face context – these should be reserved for the face-to-face or stationary part of the course.

Summing up, e-education has a significant positive impact of the teaching process because:

- 1) it widens the range of possibilities of contact and information exchange among students and between students and teachers by offering a range of tools:
  - WWW pages,
  - email, chat, forum,
  - file exchange.
- 2) It makes it possible to collect information regarding how students use the modules of the e-learning platform (frequency of access, duration of sessions).
- 3) It offers a variety of tools which enable the assessment of students: tests, quizzes, programmed lessons, wikis, home assignments, e-portfolios, etc.
- 4) It gathers all educational materials needed by students in one place.
- 5) It provides the option of modifying and updating the materials by lecturers if there is such a need.
- 6) It enables the creation of didactic materials by students, e.g. in the form of wiki articles.
- 7) It provides a working environment for team projects.
- 8) It provides access to a plethora of educational materials in the Internet.

What is worth noting here is the emergence of new tools which have not yet been all integrated with traditional LMS systems, such as blogs, wikis, social bookmarking, social networks and e-portfolios.

#### IV. RELATIONSHIPS BETWEEN KNOWLEDGE MANAGEMENT AND E-EDUCATION

Knowledge management and e-education have many common features [6]:

- 1) both are based on the idea of collecting, sharing and using knowledge;
- 2) both propose using repositories in the form of knowledge bases built with the help of such structures as wikis, e-portfolios, social bookmarking, etc.;
- 3) both have the learning process at the center;
- 4) both foster the culture of continuous learning;
- 5) both advocate the use of learning objects and the standardization of metadata to allow for the multiple use of these objects;
- 6) both use the tools and methods of information technology to facilitate learning;
- 7) both issue magazines and have associations (communities of practice) in the Internet, including the common publication "Knowledge Management and E-Learning";
- 8) both aim at modifying the behaviors of people and institutions, expanding the contents of knowledge bases and improving the effectiveness of institution management.

Knowledge management and e-education are related in many ways:

- 1) the tools of e-learning are used for the acquisition of knowledge, including the implicit knowledge, facilitation of knowledge sharing, supporting knowledge diffusion and application;
- 2) e-learning in a company can be treated as part of organizational learning, in which knowledge management is responsible for the collection, identification, sharing and deploying knowledge;
- 3) knowledge in e-education tends to be static – knowledge management makes it more dynamic, especially by bringing the learning experience closer to the workplace;
- 4) e-education is creating an ever increasing repository of knowledge, which, thanks to the processes of knowledge management, can personalize an individual's learning experience;
- 5) creating the community of knowledge using e-learning is a critical element in implementing the knowledge management policy.

One cannot, however, forget about the differences between knowledge management and e-learning (e-education). The former focuses on the sharing and transfer of knowledge while the latter on building the knowledge of a learner, his or her skills and abilities, achieved as a result of a pedagogical process carried with the use of the Internet and multimedia. Knowledge management has a more general, strategic character, while e-education more tactical, contained within the organizational unit.

#### V. USING E-PORTFOLIOS IN LEARNING AND IN KNOWLEDGE MANAGEMENT

E-portfolios (electronic portfolios) play a crucial role in both e-education and knowledge management. An e-portfolio is a set of materials in the electronic form (a set of files), collected with a specific end in mind, having its author or authors. It usually is a record of a process or its outcome and some of the materials are meant to be watched/read for assessment purposes. Materials gathered in an e-portfolio are called artifacts. An e-portfolio is a structure representing the knowledge component at a university.

An example of an e-portfolio is electronic documentation presenting the details of an academic course as an educational endeavor. Other examples are e-portfolios of departments and schools, presenting their profiles from the point of view of showing the activities of an institution, its curriculum and the accreditation process of the curriculum.

The material in point 4 is based on [7].

##### A. E-Portfolio of an Academic Course

The basic problem is how to document the pedagogical aspects of a course so as to use the information as the basis for the assessment of a lecturer, as well as to make the knowledge related to the subject available for other teachers to use. The only document required to start a course is a syllabus which comprises the information about the aims of the course, entry requirements, expected outcomes in terms of knowledge/skills/competencies mastered during the course, the contents of the course, textbooks, grading principles, additional requirements which must be fulfilled for the course to be successful (e.g. laboratory equipment, software, etc.)

Below we discuss an example of using didactic e-portfolios at Nebraska-Lincoln University [8]. Faculty members build e-portfolios for their courses. These are collections of works done by students during a particular course (home assignments, examination papers, term papers). Additionally, each teacher prepares a report on the results which his or her students attained and the suggestions for possible changes that he or she plans to implement in order to improve the teaching effectiveness. The e-portfolios are then shared amongst teachers and subjected to peer review. An example of one such e-portfolio is presented on Fig. 1. After each subsequent edition of a course the assessment cycle is repeated and the teacher can draw on the previous report to discuss whether and how the changes implemented have enhanced the learning outcomes.

The overall aim is to implement a university-wide practice of building e-portfolios and having them externally evaluated in the same way as research work. Moreover, the results of evaluation could act as the basis for decisions related to tenures and incentives. Finally, the materials related to all the courses in the curriculum could be used in the process of accreditation of universities and fields of study.

There is a worldwide initiative called Scholarship of Teaching and Learning, in short SOTL. Its aim is to collect and share the knowledge related to teaching practices, learning processes and student assessment. What is needed is deeper understanding of what students do, how they learn and what sort of experience they gain while studying, how we can determine whether they have mastered the material envisaged for them and how long they will remember what they have

learnt. Likewise there is a need to understand how academic teachers work, what problems they face and how their work could be improved.

The international organization ISSOTL, International Society for the Scholarship of Teaching and Learning holds annual conferences in the field of SOTL. There are a total of 36 magazines devoted to SOTL, beside magazines publishing the results of research regarding the didactic issues specific to particular fields. The SOTL movement advocates the development of good teaching practices leading to effective learning by students, as well as conducting research into the mechanism of effective learning and teaching. The significant feature of the SOTL movement is the idea of improving teaching by open sharing of research result.

The research methods typically used include reflection and analyses, interviews, questionnaires, analyses of didactic materials, analyses of results obtained by students, didactic experiments, case studies.

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 School: University of Nebraska - Lincoln  
 Department/Program: Art & Art History  
 Sub Area/Specialty: Drawing and Visual Literacy  
 Year: 2005

**Portfolio Objective/Abstract:**

This Course Portfolio focuses on my drawing unit- one of the four components in the Visual Literacy curriculum. (These units are Perceptual Drawing, Speculative Drawing, Color and Composition & Analysis. They make up the studio component of UNL's interdisciplinary drawing and design foundation program.) While taken by students in differing sequences, each unit can serve as an introduction to studio art and design that will be built upon by the other units. The units are designed to complement one another and to reinforce basic skills and awareness of issues in art and design. Although the Visual Literacy program has been in place since fall 1998, the current units have only been taught in this form since fall 2001. This Course Portfolio represents the current iteration of my course and reflects the evolution of my course since 2001 and the changes I have made as a result of my involvement with the Peer Review of Teaching program. I completed a Benchmark Portfolio for the course in 2002 and Inquiry Portfolios in 2003 and 2005.

Type of Portfolio: Comprehensive  
 Evidence of Student Learning in the Portfolio: Combination of Methods

Size of Class: 11 to 29  
 Type of Student: Major Only  
 Level of Course: first-year  
 Type of Course: Major/discipline

Teaching Environment:	Student Activities:	Assessment Approaches:
<ul style="list-style-type: none"> <li>• Studio</li> </ul>	<ul style="list-style-type: none"> <li>• Writing</li> <li>• Classroom Discussion</li> <li>• In-Class Group Exercises</li> </ul>	<ul style="list-style-type: none"> <li>• Homework</li> <li>• Portfolio Development</li> <li>• Individual Project</li> </ul>

Fig. 1. E-portfolio of a course.

**B. E-Portfolios of Students**

A student's e-portfolio is a set of materials prepared by him or her both in class and as part of extracurricular activities. The aim is to collect, organize and present the evidence of qualifications obtained, knowledge and skills mastered and verified in different contexts. An e-portfolio may pertain to one subject or the whole academic education and professional experience of a student.

E-portfolios might serve as a good basis for the assessment of a student at the end of a course or the whole study program. It allows for the combination of knowledge and skills acquired during different courses (different subjects). The curriculum will thus cease to be perceived as a collection of unrelated subjects, but an organic whole. E-portfolios may

also gather the experiences gained in different periods of one's life, the knowledge acquired during studies and in the process of self-study. It documents the knowledge and skills and may be used in the job search process, or a transfer of a student to another school. Finally, e-portfolios provide ample opportunities for self-reflection and planning of further academic, as well as professional development.

Greater integration of e-portfolios with the curriculum is instrumental in the success of their deployment by students, who should become more aware of the different potential viewers/readers of the portfolios. The audiences will involve other students, teachers, members of accrediting committees etc.

E-portfolio is a tool used widely in lifelong learning and continuous learning of adult professionals, as well as in the process of certification renewal in those professions where such action is required. Ideally this should be stored in one personal place in the Web, in which all crucial personal, educational, social and business data were stored. Some of the artifacts gathered there would form an educational passport of a person serving as "a cumulative, continuing appraisal of life experience and formal learning anytime and anywhere" [9].

The collection of e-portfolios of students can be the basis for the assessment of curriculum of a particular department or the whole university. It may act as a source of data for the research into the learning process. The deployment of e-portfolios in education should lead to improved documentation and evaluation of students' progress. It is crucial to link the effects of learning with the requirements put forward by the accrediting bodies. Once such data is aggregated the administrators of university systems can generate reports presenting students' achievements (or their lack) and measuring their academic progress.

To facilitate the process of managing the materials in e-portfolios special structures have been designed into which students put their materials. These can be of a matrix type. In one row students would place the materials related to one, specific competency (learning outcome), for example an IT skill of building a data model for applications. The columns would represent levels of proficiency. Placing the material in the matrix should ideally be accompanied by a reflection on the part of the student why this piece of work fits were it does and whether it could be placed in another cell of the matrix. In other words, whether the knowledge could not be transferred and used in another context.

**VI. INFORMATION SYSTEMS FOR SUPPORTING TEACHING AND KNOWLEDGE MANAGEMENT AT PJIIT**

In the final passages of the articles, let us mention the systems supporting teaching and knowledge management at Polish-Japanese Institute of Information Technology. They are at the development stage.

The Edu system (of the LMS class) supports teaching of all subjects at PJIIT and is used primarily at the Faculty of Information Technology – not only for online but also stationary courses. It is constantly upgraded. The current version has, among other features:

- 1) Course interface supporting course and teaching management,

- 2) Archive of past courses,
- 3) forms for entering end-of-course credits and exam grades,
- 4) repository of elements which can be shared between courses,
- 5) lists of students enrolled for specific courses.

A lecturer has access only to his or her courses and information pertaining to these. He or she can follow the student activity register, showing who and when used given modules. Faculty authorities can monitor all teachers.

Knowledge sharing at PJIIT is done using a hierarchical catalogue system based on Microsoft SharePoint. Each employee has the rights to access relevant catalogues in the system depending on his or her position.

## VII. CONCLUSIONS

In the article we have demonstrated the advantages of using knowledge management and e-learning to improve the process of teaching students. Unfortunately, not everything can be improved that way. Our experience shows that there are powerful psychological barriers which have resulted from educational tradition. First and foremost, we need to tackle such wrong attitudes of students as:

- 1) Studying should be easy and entertaining, like surfing the Internet or playing a computer game,
- 2) To solve a problem it is enough to use a web browser
- 3) It is enough to swot the night before an exam and forget everything one has learnt right after passing it successfully
- 4) Cheating during exams is good because it lets one get a better grade.

Similarly, we should try to change wrong attitudes of some teachers, for example:

- 1) It is enough to supply students with valuable content and those who want to learn, will do so;
- 2) If a student has not learnt it is only his or her fault;
- 3) Exams and credits are the only motivators which make students learn;
- 4) One should not be too severe and strict during exams because of a bigger workload during make-up sessions and poorer scores in end-of-term evaluation questionnaires filled by students.

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