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E-LEARNING AS A TOOL TO IMPROVE THE QUALITY OF EDUCATION IN QUANTITATIVE SUBJECTS

Anna Szymańska, Elżbieta Zalewska

Abstract. In recent years there has been a lot of changes in higher education. They result, among others, from the introduction of modern information technologies and communications to academic life. Providing high-quality education is one of the primary responsibilities of universities, which is why it is imperative to monitor how new methods and tools affect the quality of education. The University of Łódź, to meet the expectations of students, prepared a project of studies “E-Economics studies without barriers”. The main aim of this article is to present the project *E-Economics studies without barriers* and the evaluation of the course, including quantitative subjects, from the point of view of students and lecturers.

Keywords: e-learning, higher education, quality education.

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1. Definition and distribution of e-learning courses

The concept of e-learning is difficult to define clearly and precisely. The name of e-learning hides many terms, such as computer-based learning, learning via the Internet, e-learning, learning using mobile technology, remote learning or distance learning. The most common definition of e-learning is learning via the Internet. In the literature there is a division of e-learning due to the availability in time. There is synchronous type which defines a platform with the shared course and the ability to communicate with the instructor in real time. The main advantages of the synchronous type course include ability to work in a group, to present additional material and the possibility of the direct monitoring of students' work. The synchronous learning model is close to the traditional teaching system. The opposite type of course where communication between the leads and the student takes place asynchronously, for example by e-mail or forum, creates a type of asynchronous course. The main advantages of this solution include flexi-

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bility – the ability to access the course at any time and lower the cost of the classes. Another division of courses found in the literature applies to distribution in terms of the nature of the relationship between student and lecturer. It specifies the type of course attended by lecturers and a course attended only by students. The student uses multimedia materials and independent learning. In particular, it is based on the fact that the person involved in the training has access to prepared material and has the opportunity to talk with other course participants, exchanging knowledge and ideas. The often encountered in the literature division of courses is based on the forms of conduction of e-courses in conjunction with traditional education. It can be assumed that e-learning is a complement to traditional training methods (called blended learning), or the only way to learn, which is usually called e-learning. Blended learning is very effective, allows for a flexible way of building activities with regard to the topic and specifications of a given subject. The main advantage of blended courses it is the possibility to use remote and direct forms of activation of the learners. At university, the most commonly used is the combined model of education, which is the traditional method of learning supported by e-learning. In this article talking about e-learning we mean classes conducted only with the use of a distance learning platform. The entire course of study was conducted using blended learning.

2. Quality control of e-learning courses

The beginnings of quality testing of e-courses and the creation of their standards started in the United States in the 20th century. Currently, this theme is continued by all countries that implement e-education. Introduced in China, a system of distance learning quality testing called “Development of the *on-line* training processes accreditation system” evaluated institutions offering different forms of online learning, courses and specialties executed remotely.

In Poland, the requirements to ensure the quality of online courses are not stipulated by law, despite this, high quality materials and innovative methods of learning are required in the e-course. To maintain the high quality of teaching through the Internet, attention should be paid to the degree of implementation of the technical and methodological criteria adopted. An example of the e-learning standards are the standards of eCC (e-Learning Courseware Certification), signed by the American Society for Training & Development. The criteria relate to the practical and substantive assessment of eCC technical courses around the world. The course is assessed for compatibility standard, interface standard, quality composition and educa-

tional design standard. Detailing is evaluated through the transparency of course navigation, customizable platform for validation activities, drawing up and presentation of the text, as well as the used license programs and whether the course's operator gave sufficient information on the hardware requirements. The evaluation of the purposes of teaching and whether the objectives of the course include the practical application of knowledge in the field is methodically assessed. In addition, the use of techniques to sustain attention and the way of motivation of the course participant is evaluated, as well as whether the course has a transparent system for assessing the progress of the student.

In July 2006, the Association of Academic e-learning (SEA) leading projects for the promotion and development of e-education in higher education was created. For this purpose, criteria including four areas of evaluation e-course were prepared. The first criterion evaluates the **organization of the course**. In particular, attention is focused on the criteria for assessing whether conditions have been created for the proper and effective conducting of e-learning courses. There is the evaluation of infrastructure, recruitment process and the way of informing about principles of learning. It is important to prepare the lecturer and that teaching materials and communication tools are properly shared. Another set of criteria evaluates the course in the scope of **preparation of classes**. The course consistency with the objectives of education, the correctness and transparency of its structure and the way the organization of the content, including methodical and technical aspect are assessed. An important element of the assessment is the legitimacy of the applied technical solutions, the functionality, the reliability of the elements of the course, the selection method of testing the knowledge and the skills of students and the consistency of the assessment system. The third part presents the evaluation criteria in **conducting the course**. The evaluation shall assess the preparation of the lecturer and compliance of his/her operations with the methodology of the course. The communication and interaction between participants of the course and the lecturer is taken into account. The last stage concerns the evaluation activities of the course. These criteria shall check that the assessment process is properly planned and successfully carried out. The main purpose of the evaluation is to obtain the information needed to continue the course in the next few years and the improved exchange of defective components, so that in the next edition one can make adjustments to the courses held. These criteria are divided because of the perspective of the participant, lecturer and organizer of the course.

The criteria of the Academic e-learning Association do not apply to mixed education processes (blended learning), they serve as the basis for the evaluation of the programs and the implementation of e-learning training or studies, which consist of more than one course, while they may be used to assess individual online courses and evaluate individually each element of the component courses. They provide a valuable clue as to facilitate the proper preparation and conduct classes with the use of e-learning techniques.

Based on studies conducted in England, published by The Sunday Times University Guide in 2003, we can say that online courses are not inferior form of learning compared to traditional education. Similar results were obtained from studies commissioned by the US Department of Education, which confirmed the high efficiency of e-classes. In addition, its characteristics were compared with traditional learning and it was proved that in certain aspects it has better results than traditional learning. Confirmation of good e-course quality is the classification of the *Open University* in fifth place among British universities.

3. The course “E-Economics studies without barriers”

In 2006, the Ministry of Education announced the project “Developing the curriculum for distance learning in Economics”, which was co-financed by the European Union within the Sectoral Operational Programme of Human Resources Development 2004-2006, priority “Development of a society based on knowledge”. The University of Łódź was one of the universities which won the competition for the project. We created the e-Economics studies without barriers, which was designed for part-time first and second degree students in economics.

The assessment of a quality e-course should be based on three main elements: compliance with the principles of creating a “good” course, measured by the effectiveness of the results of the students and commented on by users of the course.

The developed learning plan and teaching materials have been prepared by the staff of the Faculty of Economics and Sociology, University of Łódź and academic teachers of the Interdisciplinary Department of New Media and Distance Learning, University of Łódź (MZNMiNO). The main objectives of the project are: developing a methodology of teaching in distance education, developing a manual for use as a distance learning platform, developing a model evaluation and diagnosing the needs of the beneficiaries of the project [Wierzbicka 2007]. The result was a learning plan for

60 faculties, multimedia packages, two volumes of a manual for lecturers and students relating to the use of XDokeos educational platform. Classes were prepared in the form of blended learning, taking into account the proportion of distance learning courses 65% to 35% of traditional learning activities. By contrast, the exams were carried out analogously to other types of studies. The training program was consistent with the standards of Economics faculty teaching. A Bachelor's degree in the e-Economics project included 1,907 hours teaching, the second cycle consisted of 635 teaching hours. Due to maintaining the appropriate ratio of classes taught using the traditional and e-learning methods, the number of modules was dependent on the number of hours in the given subject. For example, a course Statistics – a lecture of 30 hours – corresponded to a 6-module e-course. The educational platform included the entire program of classes and the lecturer can decide what to discuss in the activities conducted *face to face*, and what during remote classes. The academic teachers at MZNMiNO prepared a standard e-course. This ensured that all objects have the same interface, making it easy to move around the platform. The academic teachers of the Faculty of Economics and Sociology, University of Łódź developed teaching materials, activating and informing, which was preceded by 30-hour training for lecturers. During the training, educators became familiar with the quality criteria used in e-learning, the principles of creation and functioning of educational activating and informative materials, the rules of creating graphic resources to develop an e-course and the rules of using the educational platform. In order to improve the quality of an e-course, each lecturer was assigned remote-learning methodologists who supported technical assistance and helped in the creation of an e-course. In addition, the methodologists assembled the final evaluation of the developed e-course, based on ECC standards. The development of e-course materials was based on the preparation of the learning content, the glossary of key terms, the specification of literature and supplementary literature and also provided links to recommended websites. It was also important to develop materials activating and checking knowledge like tests, group and individual projects and the preparation of issues for discussion in the forum. In addition, information materials about the course were developed, which included the aim of the course, syllabus and rules of grading students. All participants of the classes received a DVD with a description of the course, the installation procedure and the requirements of the hardware and software assets as well as textbooks for the educational platform for users, including among others the manual for the XDokeos system [Wierzbicka 2007].

In September 2009, the Supreme Audit Office in Łódź conducted an inspection in Łódź University on the range of effects of the project “E-Economics studies without barriers”. In spite of the fact that the first degree studies did not start due to the small number of entries, the assessment was positive. Not only was the course assessed, but also information and publicity, and among others, distribution of posters and leaflets.

In practice, the course started on the second degree studies in Local Teaching Centres of the University of Łódź in Kutno, Ostrołęka and Sieradz and in the branch in Tomaszów Mazowiecki, and was studied by 275 people.

4. Evaluation of the course “E-Economics studies without barriers” – the results of own research

Evaluation of the course was conducted in two stages:

1. Assessment of learning outcomes of quantitative subjects based on the example of the subject of Statistical Inference.

2. Evaluation of the course by graduates and lecturers of quantitative subjects through an anonymous online questionnaire containing 16 questions.

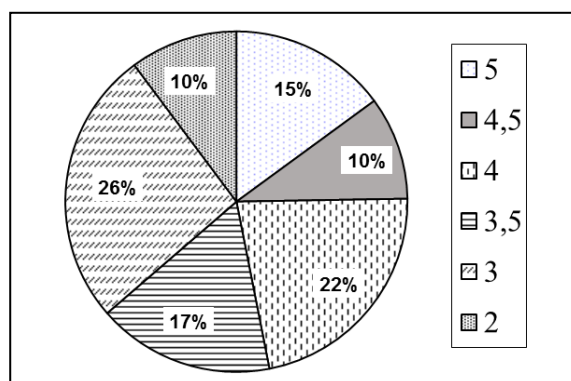


Fig. 1. Results of the first examination date of Statistical Inference students participating in the course “E-Economics studies without barriers” in the academic year 2010/2011

Source: own study based on data from USOSWEB.

1. In assessing the quality of education using e-learning methods effects measured by students’ outcomes are important. For example, we will discuss the effects of education for the academic year 2010/2011 using the subject of statistical inference. The students participating in the activities accounted for the total of 275 people who studied the part-time second degree in Economics. The results of the first examination date is shown in Figure 1.

The exam results obtained by students of the course were compared with the assessments of students learning by “traditional” method on part-time studies of second degree in Economics – the results are shown in Figure 2.

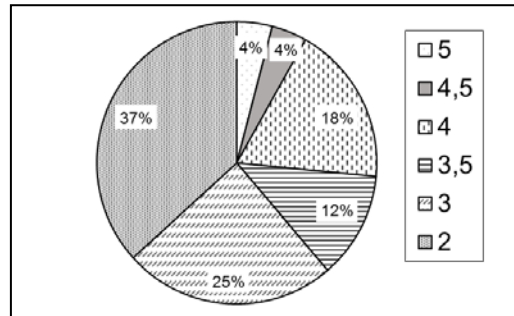


Fig. 2. Results of the first examination date of Statistical Inference students attending the “traditional” classes in Economics in the academic year 2010/2011

Source: own study based on data from USOSWEB.

Comparing the test results (Figures 1 and 2), it can be stated that the students achieved better results in the case of learning with the use of e-learning. 90% of the students studying statistical inference in the course “e-Economics studies without barriers” passed the exam on the first date, the average score was 3.65, and the prevalent grade was “sufficient”. Statistical inference was not passed only by approximately 1% of the students. The results of the examination of statistical inference obtained by students studying without the use of e-learning methods are much worse. In the first term, the exam was passed by 62% of students, where the arithmetic mean was 3.02, and the prevalent grade was “sufficient”. Finally, the subject was not passed by 20% of the students.

2. In order to obtain the opinions of the graduates and staff involved in activities based on the course “*E-economics studies without barriers*”, a statistical study was based on the questionnaires sent by e-mail. After a month, a response came from 127 graduates, that is 46% of the respondents participating in the survey, and 4 out of 8 lecturers on statistical inference. Analyzing the survey questionnaire, it is worth noting that the majority of participants were satisfied with the course. Among the academic teachers, one is definitely satisfied, two rather satisfied, and one person did not have an opinion. While the response of graduates was as follows: 41% are definitely satisfied with the course, 52% are rather satisfied, 4% rather dissatisfied, and 4% have no opinion. In addition, 52% of graduates felt the completed course of study helped them to find a job.

On the question of what form of teaching is preferred by graduates, 56% felt that these are the classes conducted using blended learning, 33% of the classes using the “traditional” learning and 11% of the classes using e-learning. Among the academic teachers, half preferred the combined classes – *blended learning* – and the other half the classes using the “traditional” method. It is worth noting that the answer to the next question, what teaching method do you think is the most effective for the student, the staff replied that it is a combination of elements of traditional teaching and e-learning. Most of the students felt that the most effective teaching is in the form of blended learning (70% of responses), only 26% preferred the “traditional” learning. Graduates assessed well the availability of materials during the e-learning classes (41% definitely good, and 48% rather good). The lecturers had a divided opinion about the students’ activity on the platform, half felt that the activity was rather good and half the activity was rather bad. Information about the structure, the substantive scope of the course and the method of assessment was exhaustive in the opinion of 96% of the graduates (19% definitely yes, 78% rather yes, 4% rather not). In addition, the suitability of e-learning materials in knowledge consolidating and preparation for exam was well assessed (41% definitely good, 56% fairly well, 4% have no opinion). According to the graduates, the e-campus platform should contain (multiple choice questions) issues supplementing the material discussed in class (94 replies), the materials discussed in traditional method classes (52 responses), new issues from the field (33 responses), and among the lecturers respectively 3 replies, 2 replies and 1 reply. In the process of improvement of the quality of education interest of academic teachers is important in suggestions and comments for the classes provided by students.

For this purpose, the study tested the opinions of students of how they evaluate the interest of the academic teachers in the suggestions, needs and changes in the form of classes proposed by the students while working together. The answers are as follows, 15% of students rated the interest of the lecturers in the listeners’ opinions as definitely good, 70% fairly well, 11% fairly badly and 4% had no opinion. Both groups of respondents acknowledged that e-learning requires from the student more work than “traditional” learning. In the group of academic teachers all the respondents agreed with this fact, while in the group of economic studies the graduates answers are as follows: 48% believe that e-learning requires more work, 37% the same amount of work as “traditional” learning and 15% less labor input than “traditional” learning. The difficulties encountered by graduates of the course, in particular for 52%, was the lack of mobilization for independent work/study, 30% lack of time, 11% trouble with Internet access, 7% trouble with computer packages. Only 15% of the respond-

ents had no problems while learning by the blended learning method. A big hurdle when working in the e-course among academic teachers was working time and constant activity on the platform. An assessment of the impact of the application of e-learning methods in studying quantitative subjects is presented in Figure 3.

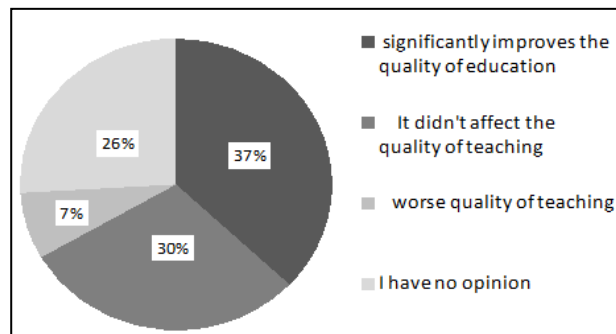


Fig. 3. Structure of the answer of graduates of course “E-Economics studies without barriers” to the question: “What do you think about the impact of e-learning on the quality of education in quantitative subjects?”

Source: own study.

The use of e-learning for education in quantitative subjects definitely improves the quality of education according to 37% of graduates, and to one lecturer. In contrast, three academic teachers and 30% of students felt that e-learning could not have improved the quality of education. Among the graduates, 26% have no opinion on the impact of the e-course on the quality of education, and 7% of the graduates felt that the quality has deteriorated through the implementation of e-classes. The last question in the questionnaire study was to summarize respondents’ opinions about the forms of learning by e-learning and “traditional” learning. It was necessary to evaluate the learning process using the “traditional” method and classes conducted in the course “e-economics studies without barriers”. The structure of the ratings given by the graduates for both forms of teaching is similar, approximately 50% of the respondents gave a good assessment for the discussed form of study, and 26% a very good grade. A negative grade was given to “traditional” studies by 4% of students, and by 7% to the form of blended learning.

5. Summary

The results of the study indicate that the use of e-learning in teaching is more effective and more beneficial for students in comparison with “traditional” forms of education, although it requires more work from them. Mate-

rials placed on the platform allow to consolidate knowledge and adapt learning time to the individual needs of students. More than one third of the graduates of the course “e-Economics studies without barriers” argued that the use of e-learning methods for quantitative subjects improved the quality of education, one third considered that it affected the quality of teaching, nearly one third did not have an opinion on this subject, while others believed that the quality of education has deteriorated. At the same time, 70% of respondents believed that quantitative subjects should be taught through a combination of “traditional” and e-learning methods. The learning outcomes support this view. Both the lecturers and students participating in the survey found that the e-learning method is laborious and time-consuming for both parties. It should also be noted that in the case of quantitative subjects, an additional barrier is the editing page. The exchange of views on the platform, both on the forum and in contact between the lecturer and individual student, requires the use of the equation editor (which requires a lot more time) or scanning/capture notes (which requires additional hardware and software). Lecturers also argue that in the case of quantitative subjects something different is to see a ready solution, and something else is solving tasks. The effects of the course “e-Economics studies without barriers” and the results of the questionnaire survey among the participants of this course, show an improvement in the quality of quantitative subjects education through the use of e-learning methods.

References

- Gregorczyk S. (2010). *E-learning a przewaga konkurencyjna szkoły wyższej*. E-mentor nr 5(37). Pp. 20-22.
- Stecyk A. (2013). *Wartość systemów e-learningowych w podmiotach edukacyjnych*. Difin SA. Warszawa.
- Wierzbicka A. (2007). *Metodyczne i technologiczne opracowanie materiałów dydaktycznych przygotowanych w projekcie realizowanym przez Uniwersytet Łódzki E-Ekonomia studia bez barier*. In: M. Dąbrowski, M. Zając (eds.). *E-edukacja.net*. Fundacja Promocji i Akredytacji Kierunków Ekonomicznych. Warszawa. Pp. 107-112.
- Wodecki A. (2006). *Why e-learning at university? Dialogue and Universalism*. No. 3-4/2006. Pp. 81-87.
- Wodecki A. (2010). *E-learning wobec trendów demograficznych w Polsce i na świecie*. In: M. Dąbrowski, M. Zając (ed.). *E-learning w szkolnictwie wyższym – potencjał i wykorzystanie*. Fundacja Promocji i Akredytacji Kierunków Ekonomicznych. Warszawa. Pp. 20-31.
- <http://www.sea.edu.pl/kryteria/> [access: 2015.08.05].
- <http://onte.wsg.byd.pl/moodle/course/category.php?id=317> [access: 2015.08.05].