

University doctoral (PhD) dissertation abstract

**IMPLEMETING AND ANALYSING THE COLLABORATIVE E-
LEARNING MANAGEMENT SYSTEMS IN THE AGRARIAN
TRAININGS AND THEIR RULE IN HUMAN RESOURCE
DEVELOPMENT**

Peter Lengyel

Supervisor:
Assoc. Prof. Dr. habil. Miklós Herdon



**UNIVERSITY OF DEBRECEN
Károly Ihrig Doctoral School of Management
and Business Administration**

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1. AIMS OF THE RESEARCH

Due to the extremely wide spectrum of the topic and also because of the research conditions, I drew up such aims in my research which can also have useful results not only in theory but also in practice. The number of educational institutions, companies and other users applying e-Learning systems has grown significantly in the last decade, therefore they have become as important means and resources as other informational systems of the institutions. However, there are several conditions and components of successfully using these systems in the educational institutions – for example what kind of system is chosen, how it is implemented and introduced. The operation of the system and the services available for the users (teachers, students) are also important. Above all, probably the most significant question is what teachers and students can profit from the system. What is the advantage of using it? How does it help the process of teaching and learning to become more effective and transparent? Does it support the management of institutional education? If it does so, to what extent? Naturally, the organizational and economical aspects of the use of e-Learning systems are also important. The application of the e-Learning systems is gradually becoming more essential for those institutions, organizations and companies which have distant teaching and trainings and also for the improvement of human resources. My research has the following aims based on the above mentioned questions and presumptions:

1. The research topic is based on the e-Learning guidelines, standards and systems that essentially define the processing of these, so the first objective is to group, and structure these and learn about the various e-Learning solutions and models. Primarily the European and Hungarian distance learning and e-Learning policies were regarded as a dominant base of my research aims.
2. Nowadays the educational institutions can choose from many open sources, free framework, which may correspond to the demands placed on the framework by the institution, such as the commercially available systems. **My objective is to choose a system to meet the needs of UD CAAES. Accordingly I defined the task of the LMS characteristics, knowledge of the functions, as well as the comparative LMS applications using a development of criteria, which is comparable to the system.**

3. **My next objective is an institutional implementation of an LMS as a result of which I have developed an integrated e-Learning portal at UD CAAES.** After the introduction of the LMS more integration can be realized, all of which appear as the added values of the successful education. Continuous development, e-Learning methods, curriculum making are needed to ensure that the institution-wide e-Learning application be successful. **For the proceeding of the application of e-Learning it is necessary to make a model of the application of e-Learning, which is the basic element of the institutional e-Learning strategy. A further objective is creating a model, which will contribute to enhancing the effectiveness of quality assurance system.** My hypothesis related to this objective is the following:
4. **My research objectives include the quality of e-Learning Establishment and the support of our institution. Accordingly, tasks were set for the examination of e-Learning opportunities for quality improvement in education, improvements in this regard, proposals and recommendations for application development. The course structure recommended for the application of e-Learning for institutional quality improvement together with other functions reachable as a modul of the system, can ensure an integrated and comprehensive e-Learning quality service. The strategy and implementation of quality improvement is only possible by providing qualified human resources.** The basic objective of the introduced LMS is to improve the quality of education, which is one way where the students and instructors receive ongoing feedback about their experiences with the system. **Corresponding objective is to compile a questionnaire, which was a result of useful information about the students and staff e-Learning system and application views.**
5. **I try to find out what are the costs of the institutional introduction of an e-Learning system and what advanages it has. I would also like to examine the economical aspects of the e-Learning.** The economical analysis of an e-Learning project which includes the business and economical factors is really complicated. Therefore, the most important part is probably to study the economical factors influencing the educatinal process and also the interactions, environment and conditions relatig to them. I suppose that the application of the e-Learning decreases the expenses significantly.

6. **E-Learning systems are suitable for developing human resources outside the institutions (distant teaching, self learning). One of the aims of my research is to examine the spread of e-Learning in the training of agricultural specialists especially regarding the evolution of human resources of agricultural management specialists and consultants.**
7. **My aim is to make a further research of the spreading of the e-Learning application and the examination of the institutions in non-agricultural training. In this respect, I aimed the domestic and international agri e-Learning initiatives, projects and examination of the current e-Learning application of agro-economic potential and needs to be assessed.** By the proliferation of digital objects and the lack of powerful search options it is increasingly difficult to navigate between them. The repositories will allow the different types of content (text, image, video, audio, etc.), storage and publication of re-use. They are capable of organizing information stored in the developing categories, meta-tags and use them to ensure efficient retrieval. **My goal is to make a research on the function of existing "good practice" repositories and develop a prototype of agribusiness repository.**

In line with the objectives the following hypotheses can be defined:

- **H1: E-Learning can be effective training tool for full time training, even if the currently existing traditional classroom teaching is used in addition to increasing the knowledge content of education provided and the quality.**
- **H2: An integrated e-Learning system contributes greatly to the easing and successfulness of the learning and teaching process to a high extent.**
- **H3: The quality development of e-Learning should be ensured under organized circumstances.**
- **H4: The application of e-Learning requires a lot of inputs in the short run. The introduction takes a long time and expenses but following the professional introduction it decreases the costs in the long run.**
- **H5: The open source systems and the freely available curriculum have a more important role in the cooperation based developments and applications.**

2. PRELIMINARIES, APPLIED METHODOLOGY

2.1. Preliminaries

The international and domestic institutions of higher education is facing challenges and tasks among the first in what strategy to employ in addition to the rapid development of information communication technologies. There are number of international and domestic research provides important and useful experience for market development of e-Learning technologies.

Institutional development strategies, the leaders of higher education institutions must take account of changes in reporting procedures and the potential of e-learning benefits of technology. The integration of the domestic institutions of higher education in the European research area will speed up the e-Learning technologies, knowledge of the results, the recovery experience.

The topic choice was the reason that it is primarily agricultural and economic education courses I attend training system at the University of Debrecen Centre for Agricultural and Applied Economic Sciences (UD CAAES). Primarily we can apply the e-Learning solutions for my objectives set out in these courses. There is a European project which is the basis for my research, with one of the exercise part of an e-Learning system was the introduction of the selection and training of project-defined target group. Accordingly, I have researched the e-Learning applications of UD CAAES. The primary objective was to improve the efficiency and quality of education formulated by introducing e-Learning technologies.

2.2. Applied methodologies

Literature research

I began the analysis of e-Learning systems and development of methods in agribusiness professionals with use research literature. It follows that my research was primarily secondary type of examination from the issues in the research literature. During secondary analysis I reviewed the publications and studies. I filtered out elaborated from them the knowledge and results for my research.

Selection methodology

The UD CAAES is implemented in the European NODES project involving one of the tasks of e-Learning systems were studied, which may be used under the project. Primarily to search for and study of systems that are available under GNU/GPL license.

Among the tools of comparative EduTools and the criteria of using the Matrix CMS and the NODES project, taking into account the needs of two LMS system remains a possible choice of systems. Both systems have nearly the same parameters, and both the usability of the built-in means, in respect of functions.

After all, we have chosen Moodle, because the support is broader than the ATutor's and Hungary also has been used in more than one institution in 2006.

Like many other higher education institution, we also introduced the Moodle LMS system at the UD CAAES in 2007, The faculty leaders recognize the fact that modern technologies in education should be entered, which was realized in the Moodle system.

Methodologies of application, implementation

Based on opportunities of e-Learning and Moodle I have created a 4-level e-Learning model. This model shows and expresses the plenitude of the application of e-Learning, has become an integer, and use all the benefits of this process for the recovery of UD CAAES Moodle education system.

A. Gilfus model was applied to the UD CAAES e-Learning system development process. The model of e-Learning applications for all users involved in training the percentage changes in relation to the number illustrated.

The instructors for the courses to my colleagues to present the potential of the system, which describe the operation of the system, usability. The course is designed to work with our support to other departments of the Centre is also used in the educational process is the Moodle, which can make a colorful and effective arm training.

Many higher education institutions use the information obtained to solve it. In-depth interviews during the application of methodological aspects of e-Learning solutions for continued dialogue with institutions of higher education employing teachers. They have provided invaluable background information to understand an issue. Thus, the importance of quantitative research in addition to the primary type of information, qualitative research section also provided.

Questionnaire survey

Questionnaire survey was carried out at the UD CAAES among of the Economic and agricultural engineering and technical management of information technology students. The primary way of getting information (primary), as new, unknown and unpublished, original, primary data acquisition occurred during the survey.

There was an on-line way of response, which is a quantitative online CAWI (Computer Assisted Web Interviews) survey over the Internet. Rapid market surveys carried out by this

method. The questionnaire is available on the Internet on-line form, e-Learning portal (<http://nodes.agr.unideb.hu/eportal/>) is possible. The questionnaire made by LimeSurvey software system (Figure 1).

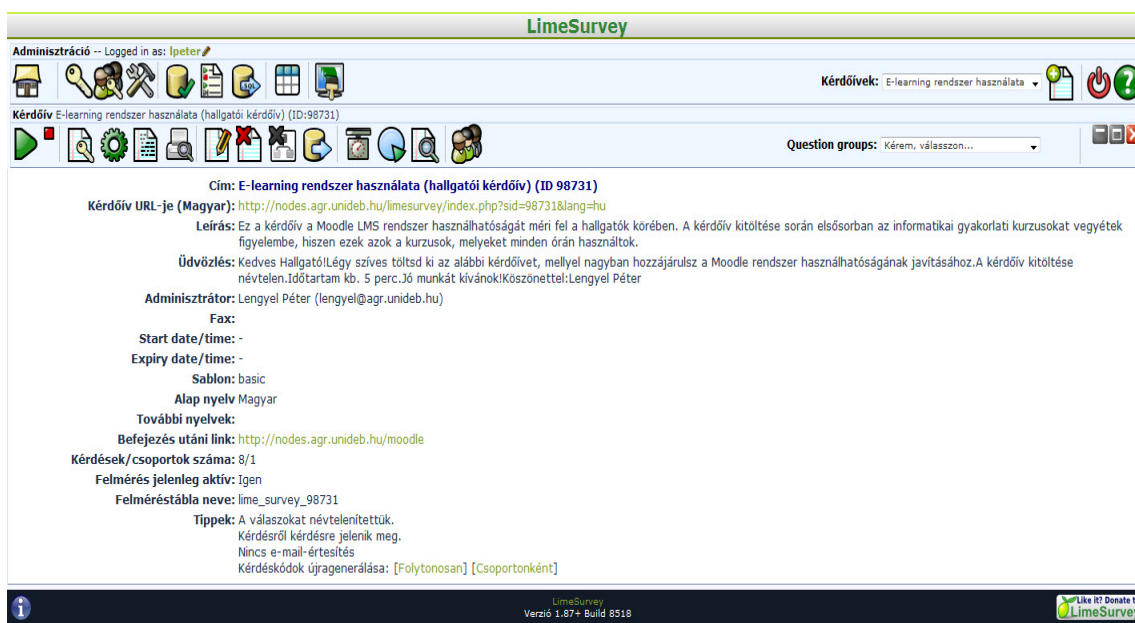


Figure 1. Administration interface of Limesurvey application

In this Thesis a research survey designed from which the predetermined group of users to get answers to important research questions. A questionnaire to evaluate the Mann-Whitney test was used. With this method we can determine significance of the averages of the two groups. as follows: the two samples are ranked together, regardless of group that is ready to make the ranks. A questionnaire to evaluate the SPSS (Statistical Package for the Social Sciences statistical package for social sciences) program version 15 was used. The application of the questionnaire responses LimeSurvey SPSS syntax and data files were exported to the files that I imported into SPSS.

The applied statistic methods

I used the **Mann-Whitney test** to evaluate the questionnaires of the students who use the e-Learning system. This method is used to compare the means of two groups in case of ordinal scales or not normally distributed variables.

I also used factor analysis and **binominal logistic regression**. I examined whether the background variables manipulating the variables are possible to be developed on the basis of the answers given. I used factor analysis to demonstrate this since it contracts the coherent factors into one common factor. **Factor analysis** is used to compress data and explore data structure. This method contracts the basic variables into so called factor variables which

cannot be directly observed. In most cases, factor analysis is used foremost in order to filter out multicollinearity.

Logistic regression quantifies the probability of occurrence of the category of a doubtful, category like dependent variable under the condition of the known outcomes of other explanatory variables. Logistic regression is a non-linear classification method that does not suppose the continuity of explanatory variables neither the normality of multivariables. The decision-maker can construct a decision-making rule relying on the hypothetical probability value in order to classify the given observation unit into a predetermined, result like category. If the number of the dependent variables' outcome is two, then the method is called a binominal logistic regression.

3. MAIN RESULTS OF THE DISSERTATION

3.1. Development and experience of integrated e-Learning portal

Like many other higher education institutions, we have introduced the Moodle system at UD CAAES in 2007. The faculty leaders recognize the fact that modern technologies in education should be entered, which was realized in the Moodle system.

The system will implement the phases of the 2nd Fig. Moodle is the beginning of the 2006/2007 School year 2 semester, 5 exams and objects used within hours of support work activity. These are the objects of the Corporate Integrated Information Systems, Management Information Systems, Mathematics and Computing, Software and Training Office knowledge. In the 2007/2008 School year 1 half have increased to 17 the number of active courses in the Information Technology category, this meant that the Economic and Agricultural Informatics Department of the subjects taught by 80% has been applied in the context of Moodle.

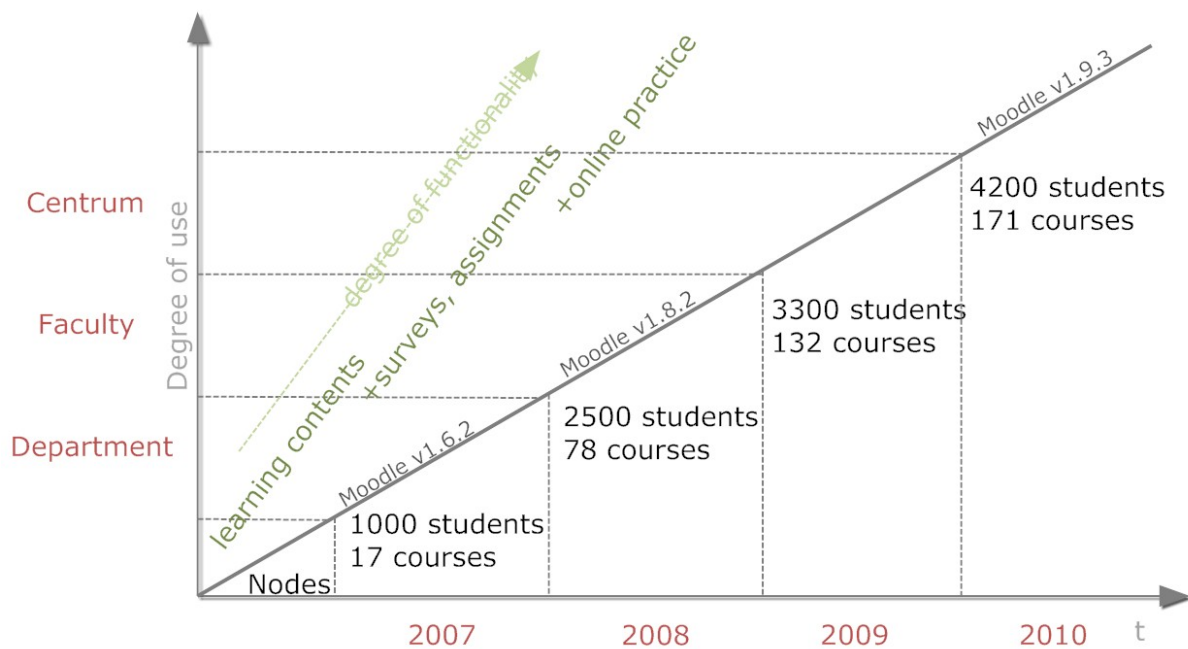


Figure 2. E-Learning System Implementation phases at the UD CAAES

Departmental use and testing of one year after the scheme began in January 2008 with the introduction of the Faculty of Business and Rural Development. Prior to the introduction of the system used in Moodle version has also been updated. The system used a large number of courses has grown rapidly, and with it of course, the users (teachers and students) numbers. Began in 2009, the Agri-Business Administration and site of introduction, which has continued to grow thanks to the courses and the number of users as well. Implementation of the phases during the system upgrade has happened several times in order to become available

as soon as the newer features. To implementation have found that although all the features of Moodle to provide online learning and teaching process, but it does not help the media, the creation of interactive resources, which are important elements of e-Learning. The Moodle LMS and e-Learning was created based on the possibilities of a 4-level e-Learning model (Figure 3). This model shows and expresses the plenitude of the application of e-Learning, has become an integer, and use all the benefits of this process for the recovery of UD CAAES Moodle education system. This model shows that the institutional e-learning application, which is ongoing and at levels which have yet to be fulfilled in order to complete each level, together with supporting model, run the UD CAAES e-learning activities.

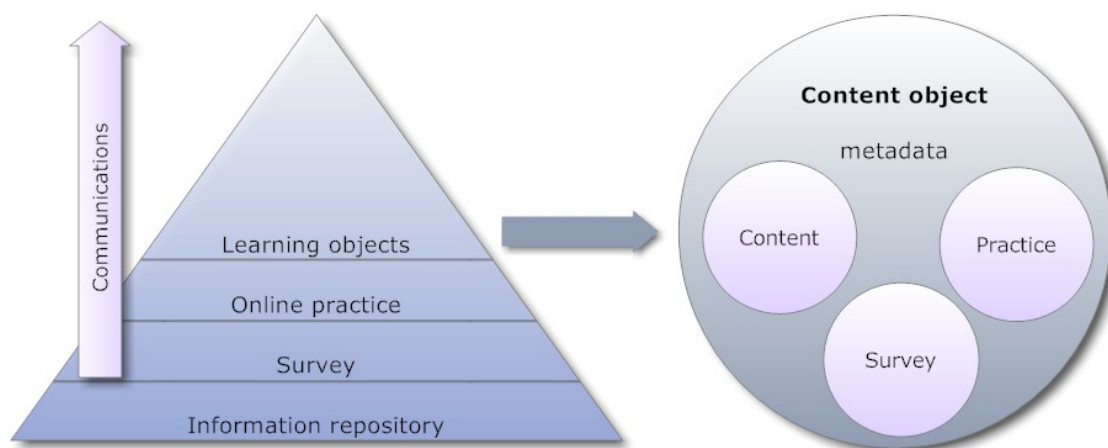


Figure 3. The 4-level e-Learning model

The 4-level e-Learning model:

- Level 1: **Information repository** - this is a Moodle system, which includes only those electronic documents, as documents of the courses, teaching materials, PowerPoint presentation. This entry-level functionality of the system is Moodle of UD CAAES.
- Level 2: **Survey** - to assess the knowledge and performance activities, such as. the use of tests and tasks.
- Level 3: **Online practice** - - multiple choice, true / false, matching, short answer and other types of questions they answer and create, evaluate and support of Moodle in the question bank and activity of the test beds.
- Level 4: **Learning Objects** - Elements of the curriculum (LOs) are in the final points of the use of e-Learning. An e-Learning content can be built from these elements. The interactive, multimedia learning objects Moodle is not suitable for the establishment, so this should be used for external application.

My goal for the initial introduction of Moodle LMS was to achieve level 1. Supported by a tutor training, which is designed for trainers to create a tutoring team, who are their level 1 of

use of e-learning. It quickly met. To do this, it should be noted that not all teachers see the potential of Moodle system, so they're not actively using the system, but the active systemic tutors observing their activities for entry-level functionality of the Moodle UD CAAES met over a year.

The levels can not be sharply distinguished scholars in the different activity does not allow it - so Level 2 is already considered. The level 3 of model occur, which greatly contributes to the fulfilment of e-Learning application to succeed. Communication is a basic feature of the e-learning, without which learning can not be successful. Sending tutor has also used the system, but the group communication platforms such as the forum has not yet received a prestigious role. This is because, first, the traditional form of education lies in its purpose, and they have not developed the habits that the e-Learning tools are used effectively.

The real challenge for the 4th level has been reached. Over the next few years, the curriculum will be supported by elements of the course structure. The elements of great material progress, as shared and reused. This is a repository eligible.

3.2. The effectiveness of the application, impact assesment of the quality

The success and the efficiency of e-Learning should be measured by a reliable method in order to use it effectively. Although, there are several studies about the success of e-Learning systems, only a few of them is about the measurement of this success within the institutions. It is the study of DeLone and McLean (2003) which examines the success of the introduction of the e-Learning system with the help of ELSS model (e-Learning System Success).

I made two questionnaires to evaluate the application of e-Learning - one of them was for the students and the other one asked the lecturers and the operators. The aim of the questionnaires was to compare the opinions of the students and the teachers and also to evaluate the Agricultural and Economical Center of the University of Debrecen (UD CAAES) and the Corvinus University of Budapest (CUB) regarding the application of e-Learning. The role of the questionnaire for quality development is to give guidance for the UD CAAES in the application of e-Learning. E-Learnig in the CUB is applied under certain organized institutional circumstances. This can be a good example for the UD CAAES if spreaded over other faculties as well.

The questionnaires were finalized in cooperation with the associates of the CUB eLESC (e-Learning Educational- and Service Center). The questions were developed together, on the basis of self experiences. The aim was to develop such questionnaires which are suitable both for the evaluation of the e-Learning's quality and its economical benefits.

The basis of the e-Learning's quality questions was WANG's article (2007), in which he measured the success of the e-Learning systems, therefore the questions of the students' and the lecturers' questionnaires were the same.

There were 273 students and 50 lecturers from the CUB and 288 students and 46 lecturers from the UD CAAES who properly filled out the questionnaires in may and june in 2011. I examine the answers about the e-Learning's quality in this research on the basis of two criterion (student-lecturer, UD CAAES - CUB).

The basis of the answers' comparability was that both institutions applied the Moodle frame system. I tried to find out to what extent they exploit the facilities of the system.

The groups of questions are the following:

- Quality of the system (1-7)
- Quality of the information (8-12)
- Quality of the service (13-17)
- Benefit of the e-Learning system (18-24)
- Conclusions (25-27)

The 27 questions could be answered in a scale of 10.

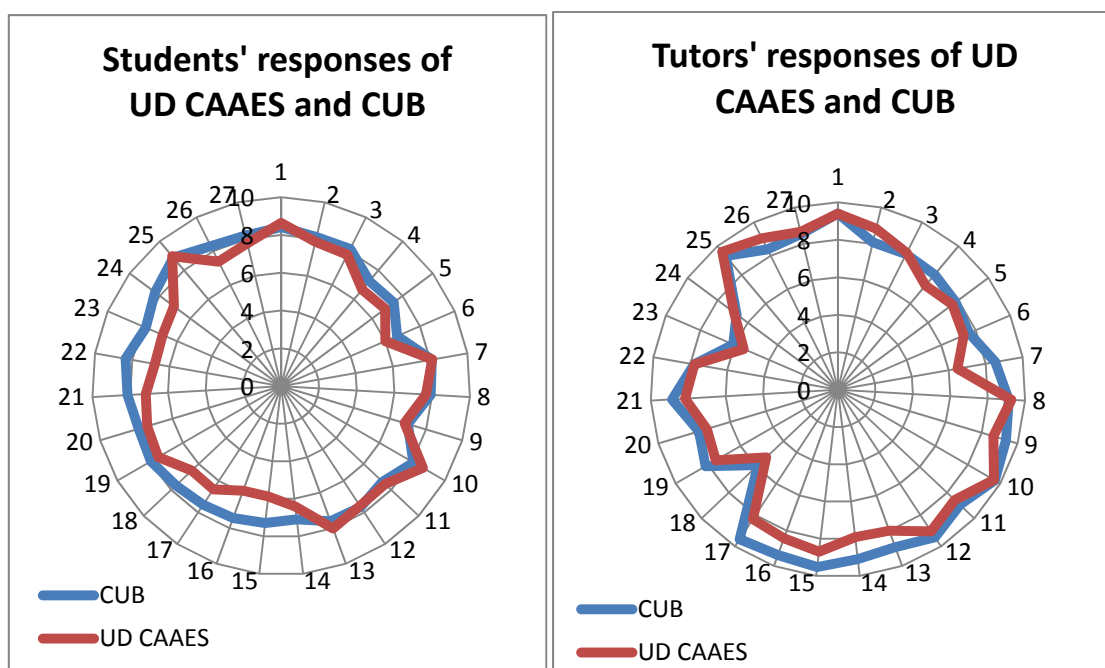


Figure 1. Comparison of UD CAAES and CUB users' responses

Figure 4 represents a diagram that indicates the means of the answers of the two institutions' students and lecturers.

It is visible on figure 4 that generally, according to the e-Learning users of the CUB the quality of the e-Learning application is better. I have chosen the answers demonstrating

significant differences based on the results of t-tests, therefore I found significant differences in the answers.

The significant differences of the lecturers' answers is illustrated by the table 1, except for the 26. question all results were higher at the CUB.

Table 1: Significant differences in evaluations of teaching issues

2. Easy to use.
7. The system is fast (speed of information access).
9. The necessary information is always at the right time published.
13. The e-Learning system an appropriate level of on-line help for.
14. The system is in constant contact developer(s) to users.
15. The operator (s) available (s) to solve problems.
16. The operators of the future development of cooperative relation.
17. The operator(s) provide appropriate assistance (they) use the system.
26. The e-Learning system is successful.

Regarding the result, it can be said that the e-Learning application of the CUB is more successful than that of the UD CAAES according to the students' and the lecturers' evaluation. It is also obvious that the quality of the system's operation of the CUB is higher than the UD CAAES. This result supports my H3 hypothesis according to which the UD CAAES can evolve in the quality of e-Learning application by ensuring the institutional frames for the system:

H3: It is expedient to ensure the quality development of the e-Learning's application by establishing organized e-Learning groups.

Hereafter, I examined whether background variables influencing the variables are possible to be formed. I used factor analysis to demonstrate this which contracts the coherent factors into one common factor. I examined the variables on the basis of the *Kaiser-Meyer-Olkin (KMO) criteria* to determine whether they are suitable for factor analysis. The value of the KMO is 0,886 (table 2), which means that the variables are suitable for factor analysis.

The table also indicates the null hypothesis of the Bartlett test, which means that there is no correlation between the basic variables since the levels of significance (Sig.) is smaller than 0,05. Consequently, the basic condition of the factor analysis, according to which the variables must correlate, is fulfilled.

Table 2. The results of KMO and Bartlett test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0,886
Bartlett's Test of Sphericity	Approx. Chi-Square	17 114,773
	df	351
	Sig.	0,000

I used two methods to determine the number of the factors. One of them is the percentage of variance, which determines the number of the factors on the basis of the cumulated percentage of the variance, which means that it is necessary to establish such number of the factors which makes it possible to reach a cumulated minimal level of variance. The table 3 indicates the variance explained by the factors.

Table 3. Choice factors in the method variance

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11,526	42,690	42,690	11,192	41,452	41,452	6,140	22,740	22,740
2	3,621	13,410	56,100	3,317	12,285	53,737	5,893	21,825	44,565
3	1,944	7,201	63,301	1,566	5,800	59,538	3,105	11,501	56,066
4	1,500	5,554	68,855	1,264	4,681	64,219	2,201	8,153	64,219
5	1,090	4,037	72,892						
6	0,953	3,530	76,423						

The Cumulative % column's 4. row shows the cumulated variance of the four factors (64,219%) which were developed by the Kaiser-criteria. It is above the necessary 60%.

A 5 factor solution would have been reasonable regarding the methods but relying on the fulfilled factor analysis there would only be one variable in the 5. factor. Therefore, I have chosen a 4 factor solution which means that I replaced 27 variables which explains in 100% with 4 factors which explains in 64,22%.

I rotated the factors during their selection to filter the correlated factors without relation and also in order to get a more simple and understandable solution. I used the *Varimax* rotational method during which the orthogonal rotation results in correlating factors.

I reached a 4-factor solution as a result of the analysis, where the $KMO = 0,886$ and the explained variance is 64,22%. The names of the factors are the following:

FACTOR1: Quality of the service

FACTOR2: Efficiency of the system

FACTOR3: Quality of the online material

FACTOR4: Usability of the system

Binominal logistic regression

I used logistic regression for the results of the factor analysis. My aim was to determine the importance of a given factor for the users of the CUB compared to those of the UD CAAES.

Tables 4 and 5 represent the first phase of the analysis. Table 4 shows the constant Wald-statistic in the preanalysis phase, which is the square of the beta (B) and the standard error. It is demonstrated that it is not significant.

Table 4. Parameter estimation based on the Wald-statistic

	B	S.E.	Wald	df	Sig.	Exp(B)
Step 0 Constant	-,043	,078	,300	1	,584	,958

Table 5. Significance of individual effects of variables

	Score	df	Sig.
Step 0 Variables			
FACTOR1	49,687	1	,000
FACTOR2	20,899	1	,000
FACTOR3	22,418	1	,000
FACTOR4	,401	1	,526
Overall Statistics	97,189	4	,000

Table 5 represents the individual effect of the independent variables yet not used in the analysis, according to which FACTOR1, FACTOR2 and FACTOR3 are also significant on their own, while the forth variable is not.

The second part of the analysis demonstrates the final result. I used the „Enter” method, which means that I used the four independent variables in the analysis at the same time.

Table 6. Wald-statistic

	B	S.E.	Wald	df	Sig.	Exp(B)	95,0% C.I. for EXP(B)	
							Lower	Upper
Step 1(a) FACTOR1	,759	,105	52,118	1	,000	2,135	1,738	2,624
FACTOR2	,521	,102	26,021	1	,000	1,683	1,378	2,056
FACTOR3	-,596	,104	32,805	1	,000	,551	,449	,676
FACTOR4	-,115	,087	1,748	1	,186	,891	,751	1,057
Constant	-,108	,087	1,549	1	,213	,898		

Table 6 also applies the Wald-statistic. If the given variable is significant, then it supports the model. It is obvious that FACTOR1, FACTOR2 and FACTOR3 contributes to the model, while FACTOR4 does not. The Exp(B) indicates how each variables correct the estimation. Regarding this, it is FACTOR1 that corrects the estimation the most (Exp(B)=2,135) with 113,5%, while FACTOR2 corrects it with 68,3%. FACTOR3 worsens the estimation with 44,9%, which means that according to the CUB users the first factor is twice, while the second factor is 1,683 times more important than according to the UD CAAES users.

3.3. Analysing the costs of e-Learning application

E-Learning project is a very complex analysis of economic activity, which includes business and economic factors. For this reason, perhaps the most important economic factors

affecting the training process and their specific interactions, environments, knowledge of conditions. After they concluded that analysis of the combination of factors which best fits the specific training needs. I listed the cost items to 3 groups, which are assessed in Table 1.

The first Cost includes the cost of technology. The development of digital content, or to obtain the total cost of the training process is one of the largest part. The Digital content is much better quality, better quality figures should be prepared as conventional printed education curricula. More videos and other learning elements can be colorful and assist in the learning process in which the creation, development, acquisition greatly increases the cost. The cost is not dependent on the number of employees nor the student nor the number of training programs, nor the duration of a course.

Table 1. Type of cost items

	Cost	Number of students	Course duration	Value
Technological costs	Content development	Fix	Fix	High
	Hosting content	Fix	Variable	Low
	Maintance content	Fix	Variable	High
	Distribution content	Variable	Fix	Low
	LMS licenoe	Fix	Fix/Variable	High
	LMS installation	Fix	Fix	High
	LMS customization	Fix/Variable	Fix/Variable	High
	LMS hosting	Fix	Variable	High
	Infrastructure	Fix/Variable	Fix	High
Cost of e-Learning staff	Technical tutoring	Variable	Variable	High
	ETM training cost	Fix	Fix	High
	Administration e-managemet	Variable	Fix/Variable	High
	External consultancy	Fix	Fix	High
	Synchroneis teaching	Variable	Variable	High
General costs	Promotion	Fix	Fix	High
	e-Learning support	Variable	Variable	High

At the costing plan the future content changes be taken into account, which is a result of the learning materials should be updated. That expense, however, the rate depends on the duration of training, ie, in this regard, variable costs will be displayed.

The storage of materials using a hosting service or your own server to solve the operation, which involves cost for both cases, but only for the duration depends on the number of students in training programs do not. However, it should be noted that the total cost of this cost is low. The cost of the distribution of content from anywhere, at any time ensure that broadband internet access provided. This is a cost, both service providers (educational institutions) and the service recipient (student) side is shown, but not the total costs.

E-Learning project is undoubtedly one of the biggest costs of purchasing LMS. Opportunity cost of ignoring this, in case if we choose an open-source framework. These frameworks may be used freely and can be downloaded free of charge, may be obtained. This significantly reduces the introduction of an e-Learning system costs, helping the educational institutions to make a minimal cost elindíthassanak an e-Learning project. However, this does not mean that it costs nothing to be allocated for the introduction of LMS, because in this case it is true that the system is available free of charge, but the installation, customization, parameterization, and system maintenance, high operating costs. The Hungarian higher education institutions to reduce costs significantly by internal humánerőforrásból to ensure implementation of these activities. Compared to the traditional training they all represent additional costs, which are also an important part of a project's total cost of e-Learning. Both the installation, maintenance and hosting costs are not dependent on the student number of participants, but the LMS as a service to ensure the time-dependent, ie, variable cost. In the event that the institution does not choose to open-source system, you need to buy the system, that license fees can be calculated that the cost can vary the length of use.

The system will allow you to use and operation of infrastructure (hardware and software) the cost must be considered in calculating the total cost. It should be designed, what server, servers are required, or in conformity with the current network implementations, student and faculty computers. The costs vary by number of participants in the student as necessary to ensure the conditions for e-Learning service. The cost can vary the distance such as wiring costs. The hardware costs, software costs can be counted as such. server, study material, software and other multimédiaszerkesztő replacement value. The traditional training costs are too high compared to costs on. As the information technology applications has reduced the cost of web-based education support systems for the cost of a downward trend is expected. Accordingly, the same cost more "powerful" systems can be obtained, or the same system at lower cost to operate, but they are optimistic about the prospects for any of the attractiveness of e-Learning application. This means that the e-Learning investment return on the total cost will be faster.

The costs of the teaching staff costs, variable costs and the number of students considered the period of training, because some sections of the courses require the presence of personal trainers. The training provided to teachers in all respects fixed charge will appear, since in this case, a professional group of instructors prepares you for the e-Learning system and methods of use. E-Learning system administration and management of high costs for which the student depends on the number of participants and the duration of a course may depend on.

The overall costs to be reckoned with, and advertising support (support) costs. E-Learning program to ensure the effectiveness, for example, students should have the basic IT training to allow them to participate in e-Learning training. Personnel costs and overheads to be high value against the cost of traditional education.

The ROI (Return on Investment) is one of the indicators of profitability which demonstrates the efficiency of the investments.

The calculation of the ROI is the following:

$$ROI = \frac{\text{benefit} - \text{cost}}{\text{cost}}$$

If the ROI is negative or there is an investment with a bigger value, then it is not recommended to choose the given investment.

The ROI values of the traditional education and the E-Learning can be compared with the following *e-Learning yield index* (I_{eH}):

$$I_{eH} = \frac{ROI_e}{ROI_h}$$

where ROI_e is the efficiency of the e-Learning investment while ROI_h is the efficiency if the traditional education's investment.

The calculation of the e-Learning yield index is a complex task which requires the familiarity both with the traditional and the electronic educations' costs and benefits. The calculation can only be relevant if we are precisely familiar with the benefits of both cases, part of which is not only financial benefit. Since I do not have such data because these can only be quantified with great difficulty if it is possible at all, therefore I calculate the rate of return of the e-Learning as an investment, in which case the incomes of the investment are the savings of the e-Learning compared to the traditional education. Therefore, the result of the ROI calculation shows the rate of return of the e-Learning's introduction including the benefits (advantages) compared to traditional education.

Hereafter, I calculate the ROI indicators of the system in the UD CAAES in the following 3 years of the introduction. I relied on the results of the lecturers' questionnaires which presented that to what extent the system facilitated the lecturers' job in the first 3 years of the application.

Costs

The basis of the cost of the e-Learning's introduction and operation is the time expended by the operators. In case of the UD CAAES, this is 120 hours monthly according to my estimations. This includes administration and management, lecturers' training, the operation,

the maintenance and the continuous development of the LMS system and the server. I calculate the personal costs of the operation for an adjunct professor, since this task is carried out by the staff of the UD CAAES. Therefore, the annual expense is the following:

$$C_{ib} = 12 \cdot \frac{281.030HUF}{168} \cdot 120 = 2.408.832HUF$$

The cost of the content's development is a further expense which I merged into the lecturers' time expanded. Naturally, there are several projects supporting the development of e-Learning contents, the costs of which I do not take into consideration.

Since the UD CAAES has an open source e-Learning system, there is no license cost, therefore it does not need to be considered, so $C_{lms} = 0HUF$

The infrastructure at the university is given, consequently in the year of the introduction, there is only the cost of the server operating the system which is $C_{h_1} = 684.300HUF$. The cost of the software is 0 because the server is included in the university license. Since this is a hardware investment, the amortization is quick and development is necessary in every year, in addition it needs to be replaced in every 3 or 4 years. I count 50 000 Huf for the yearly maintenance of the server, which covers the unexpected replacement of failed parts, so $C_{h_2} = C_{h_3} = 50.000HUF$ in the 2. and the 3. years.

Benefits

Figure 5 indicates the time expanded on the preparation of the education, the testing of the students, the evaluation and the related administration in the first 3 years of the e-Learning's application according to the lecturers' opinion of the UD CAAES. The means of the lecturers' answers indicates that in the first year, the amount of the time necessary to be expanded was higher with 32% compared to the pre e-Learning period. More time was required to acquire the system, to properly develop the courses and to fill them with content, the development of the electronic materials and the preparation of the tests questions' data base. The investment of the first year returns in the following years since the contents of the already developed courses only need freshening and enlargement. This is indicated by the value of 83%. In the following year, this data is 65% which means that e-Learning results in significant savings in the long run.

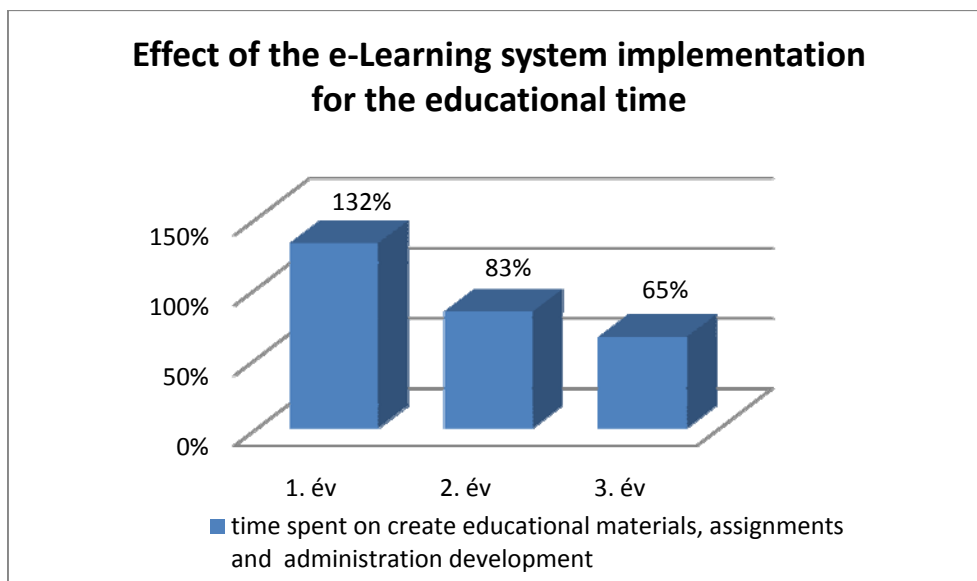


Figure 2. Effect of the e-Learning system implementation for the educational time

I relied on the regulation of the University of Debrecen when calculating the weekly compulsory hours of an adjunct professor and the monthly salary. As for the weekly compulsory hours, according to the regulation there are 14 hours, 50% of which are contact hours. The remaining 26 hours is organized optionally by the lecturer for the preparation of the education and to carry out research. All lecturers's forum mentions that the time expanded to do research is quite a few, therefore I take 15 hours from the remaining amount to prepare education, administration and tests. Since the introduction of e-Learning in our institution did not aim to replace traditional education but rather to complete and support it – this is the so called blended learning – it does not have an effect regarding the compulsory 14 hours.

The salary of an adjunct professor from the 1 January, 2011. is 218 700 Huf on the basis of the lecturer-researcher scale. This means 281 030 Huf salary cost for the employer. The saving regarding the time can be calculated on the basis of 15 hours. The cost of this 3-hour-work for one person in case of traditional education is:

$$C_{ob} = 12 \cdot \frac{21.3}{168} \cdot 281.300 \text{ HUF} = 1.265.850 \text{ HUF}$$

This expense is the relative base of the lecturers' salaries' savings. Naturally, the reduction of the time expanded on education not automatically results in the reduction of the salaries. However, the extra time can be used to do research, which is an investment in the long run, therefore it can be deducted from the budget spent on education and it can become a research expense. 46 lecturers filled in the questionnaires in our institution and as far as I know, there is no significant difference in the number of the active users of the system. Consequently, I

thing that it corresponds to the reality if I count with the reduction of the salaries for 46 people.

Regarding the previous statements, the savings of the reductions of the lecturers' salaries for the first three year are the following:

$$B_{ob_1} = \frac{1-1,32}{1} \cdot 1.265.850 HUF \cdot 46 = -18.633.312 HUF$$

$$B_{ob_2} = \frac{1-0,83}{1} \cdot 1.265.850 HUF \cdot 46 = 9.898.970 HUF$$

$$B_{ob_3} = \frac{1-0,65}{1} \cdot 1.265.850 HUF \cdot 46 = 20.380.208 HUF$$

Another saving results from the decrease of the educational materials' expenses, which means that it is not necessary for the students to print the electronic notes, not to mention that they do not need to purchase them. There are no expenses for the tests since the students have their electronic exams. It is difficult to quantify this saving, therefore I can only estimate it (for simplicity I do not consider the student side in the calculation).

The number of the active courses is 75, there are 32 students per course (own data). I take 3 tests per course, 3 printed pages per test, 9 Huf per paper as the cost of printing the papers. I could also count the costs of additional materials which is given to the student in one or two copies to spread them but the savings from these are not significant, therefore it is hard to estimate. The saving resulting from the printed materials is the following:

$$B_{oa} = 75 \cdot 32 \cdot 3 \cdot 3 \cdot 9 HUF = 194.400 HUF$$

I calculate the rate of return for the first 3 years in the followings:

$$ROI_1 = \frac{-18.633.312 + 194.400 - (2.408.832 + 684.300)}{2.408.832 + 684.300} = -6,96$$

$$ROI_2 = \frac{-8.734.342 + 2 \cdot 194.400 - (2 \cdot 2.408.832 + 684.300 + 50.000)}{2 \cdot 2.408.832 + 684.300 + 50.000} = -0,50$$

$$ROI_3 = \frac{11.645.865 + 3 \cdot 194.400 - (3 \cdot 2.408.832 + 684.300 + 2 \cdot 50.000)}{3 \cdot 2.408.832 + 684.300 + 2 \cdot 50.000} = 0,53$$

The ROI indicators of the first and the second years are obviously negative since the savings resulting from the lecturers's salaries was -8 734 342, so there were no savings. The ROI indicator in the 3. year is positive, so the investment has returned.

I did not take into consideration several costs which I could not estimate during the calculation but according to my opinion these would not significantly influence the results. I also abandoned those data which are not included in the e-Learning investment of the UD CAAES or their value is 0. These case is the same for those data, which cannot be quantified.

My calculations support my H4 hypothesis:

H4: The application of the e-Learning requires a lot of inputs in the short run and its introduction takes a long time. However, following the professional introduction it has an expense reducing effect in the long run.

3.4. E-Learning in the development of human resource management of agricultural trade

Many organisation that is active in the agricultural sector, such as the Agricultural Administration Office (MgSzH) and the Rural Development, the Training and the Consultant Institution of the Ministry of Rural Development (VKSZI) realized the opportunities of e-Learning.

The e-Learning training of the MgSzH's professionals began on the 27 december, 2009. The goal of this training was to test the usability and the possibility of integrating the e-Learning user surface in the actual education system. Although, this was a pilot testing, the curriculum and the tests were real.

Due to the growth of the volume of internet users and the reduction of the amount of money spent on education, it was necessary to develop a cheaper and more efficient way of education. This resulted in the development and the launch of the e-Learning system of VKSZI in 2010. All consultants can access the curriculum of all the trainings via the e-Learning system.

There has never been any surveys about the application of the e-Learning system among the professional consultants which enforced my aim to carry out a research among them.

My questionnaire was accessible through Limesurvey. According to the consultant register, 450 of the 600 registered consultants with valid email addresses received the questionnaire. accessibility and the request to fill the questionnaire electronically. 88 questionnaires were filled out, which is 19,6% of the total amount. Basic IT skills and computer usage are the minimal criteria for the consultants to be able to participate in the electronic exams. The respondents could rate themselves about their computer skills by a scale of five, from 1 to 5. Figure 6 shows that 37% rated themselves into the category of three, 34% to four, 22% to five and only 7% rated themselves to a two. This means that the consultants have enough IT knowledge to do exams via electronic distance learning. This statement is also supported by figure 6, which indicates that 56% of the consultants rated the role of the Internet regarding the acquisition of new knowledge by a 5.

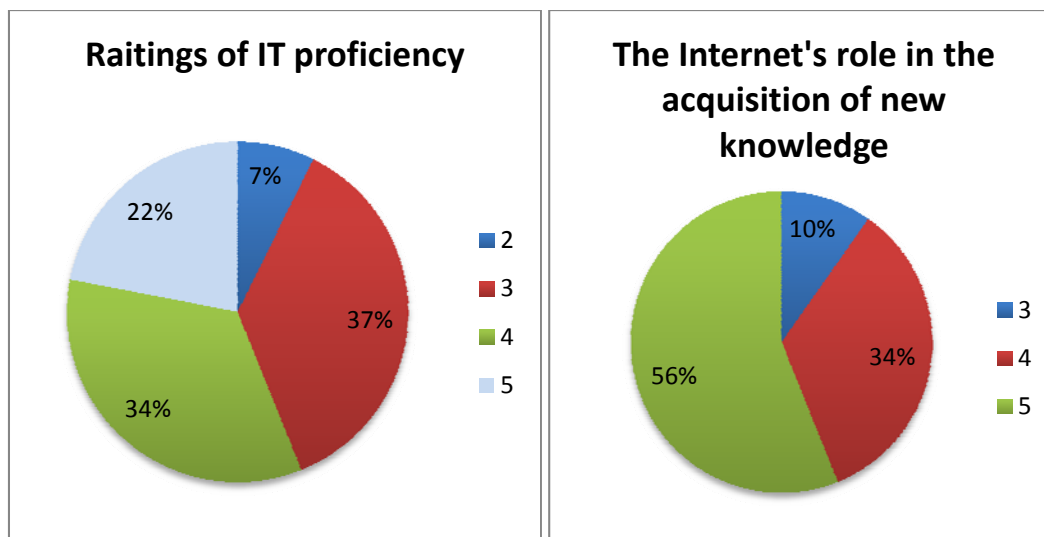


Figure 3. ábra. Evaluation of IT skills and role of the Internet

Figure 7 represents my sources of information. 64 out of the 88 respondents use database from the MVH and 52 use database from the MgSzH during their daily work. Consultants have wide variety of information sources and they greatly exploit the online databases.

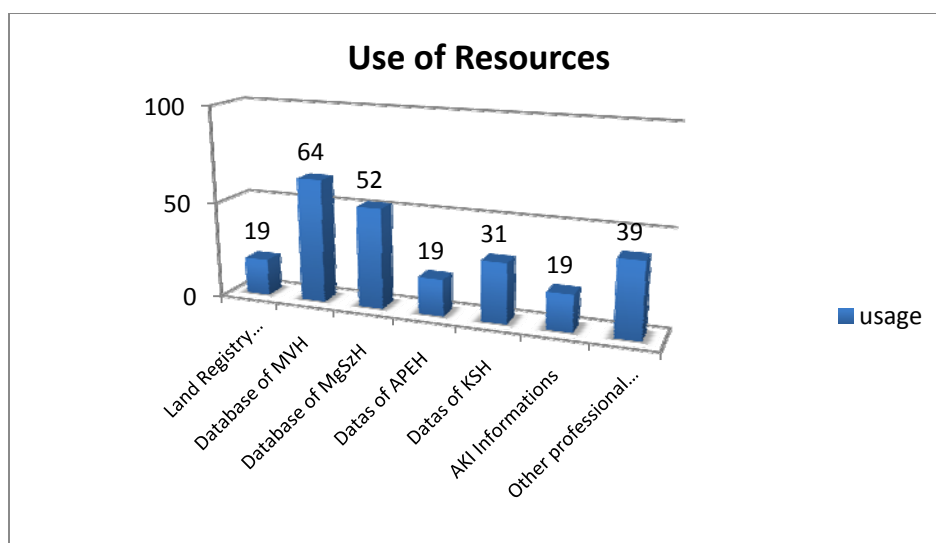


Figure 4. Sources of information among the consultants to use

I can also say that emails have the same role in everyday communication as phones (figure 8). The benefits of skype and other online communication services are not yet exploited completely. Statistics also indicate that mainly the age of 35 and younger generations use these type of information technologies.

The research also shows that the consultants use the introduced e-Learning systems because it is compulsory, therefore most of them (51% of the respondents) use the system only every 2-3 months including the download of the curriculums and the compulsory testing (figure 8).

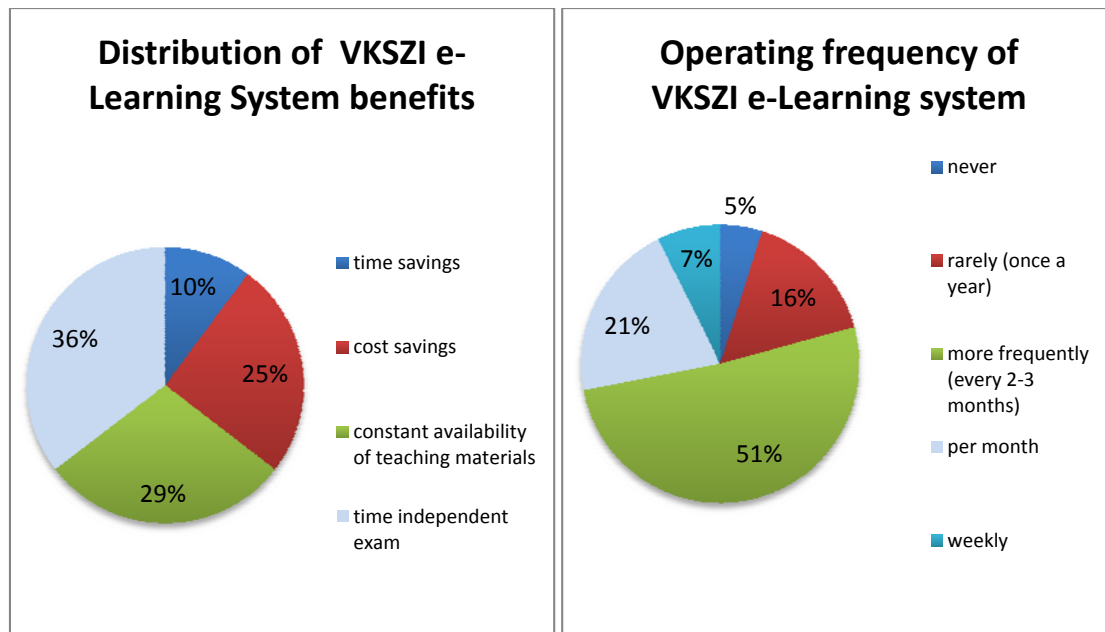


Figure 8. The evaluation of e-Learning System benefits and the use of frequency

According to 36% of the consultants, the most important advantage of the system is the independent testing regarding the exam appointments. It is interesting to see that only 10% of them think that the most important advantage is the time saving. My conclusion is that the most difficult part is the time management and not that they have to have time for examinations.

The research clearly demonstrates that the introduction of the e-Learning system was welcomed positively by the consultants and they recognized its benefits and advantages.

Regarding the two researches, I can say that e-Learning gradually has a more important role in the training of the agricultural professionals and the development of human resources. E-learning supports the distant education in both cases. As a result, by ensuring frequent consults, most of the the professionals pass the exams.

3.5. Collaborative systems and knowledge bases

The proliferation of digital objects increasingly difficult to navigate between them, the lack of powerful search options. The full-text search engine no matter how sophisticated, will never be able to absorb so many aspects and the accuracy of search results lists, such as those familiar with computerized library catalogue. The latter case are flexible and refined over the centuries, the search for precise and consistently applied standards for describing bibliographic permit. The documents published on paper documents stored as data in a computer is required to accompany metadata only began in the nineties more widely

recognized. Since then, many different detailed recommendations and standards have been different document types and applications.

The repositories will allow the different types of contents (text, image, video, audio, etc), storage and publication of re-use. Capable of organizing information stored in the (developing categories, meta-tags) and use them to ensure efficient retrieval.

A repository of universities and research institutes working document server, and archiving of scientific material to be accessible worldwide for free. Distinguish between institutional and disciplinary repositories. Institutional repositories document server they are called, are financial institutions (especially university libraries and research organizations) are operated, and their members to enable the digital publishing and archiving.

Nodes of the EU project have developed an Index of Knowledge, which are a Dublin Core-based meta. The Dublin Core is not intended to displace any other metadata standard. Rather, the role is to be used in parallel, often with the same resource, a metadata standard, which is based on different semantics. The simplicity of both reduces costs and facilitates the preparation of metadata for operational cooperation. On the other hand the simplicity does not accommodate the semantic and functional richness supported by complex metadata formats.

I created a collaborative model to illustrate the papers presented and analyzed in e-Learning systems, knowledge base and learning repositories and the functional, informational and cooperative relations of them (Figure 9).

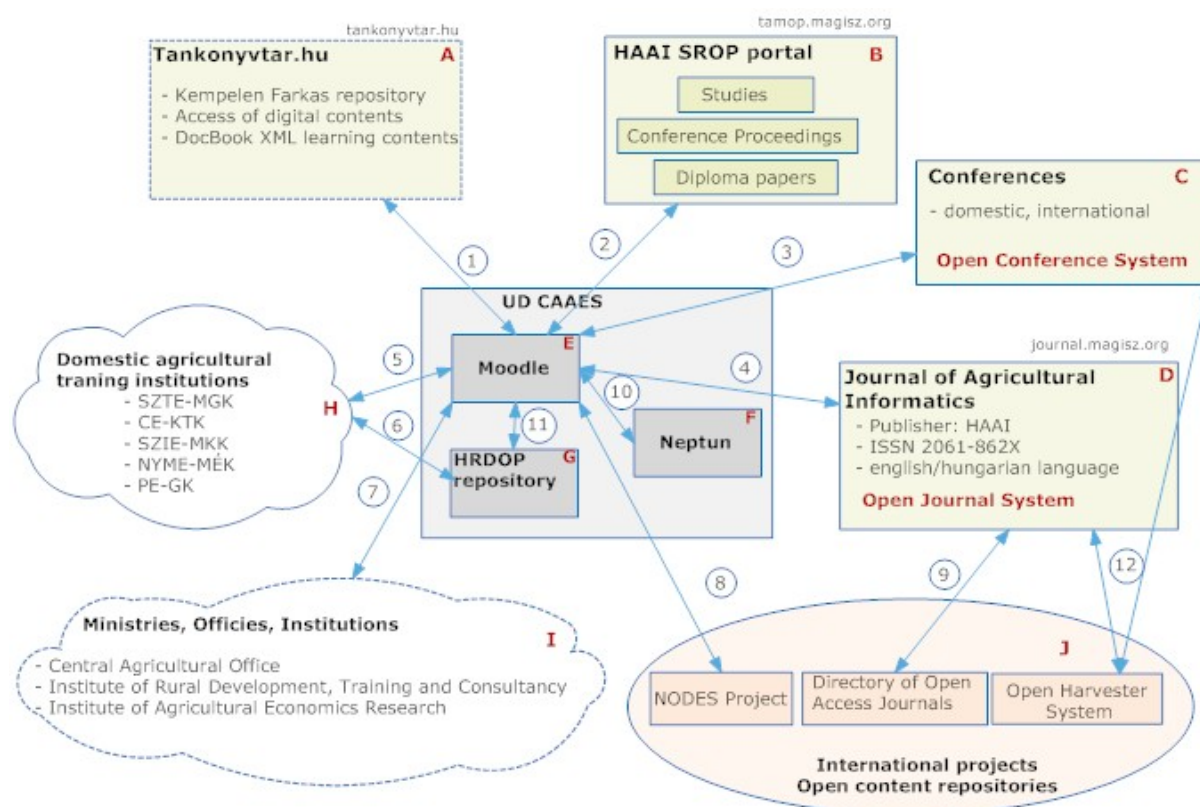


Figure 9. Collaborative model of e-Learning research development and application

The model plays a central role in the UD CAAES e-learning system consists of a number of knowledge base (Journal of Agricultural Informatics, conferences, HAAI academic portal) repository (Kempelen Farkas repository) institutional database and linked to international projects. The creation of the model, my aim was that I developed, implemented in open source systems and apply the knowledge base to realize the relationship, helping students with faculty, collaborations among researchers, learning contents interactive knowledge bases and the use of their own, domestic partner institutions and foreign partners.

4. NEW AND NOVEL RESULTS

Accordingly from my research results consistent with the objectives I would like to underline:

1. **I have created a 4-level e-Learning model which is based on opportunities of the Moodle and e-Learning methods.** This model shows and expresses the plenitude of the application of e-Learning, has become an integer, and use all the benefits of this process in the recovery of the UD CAAES e-learning education system.
2. **I created a survey among the students for evaluating the use of LMS.** After evaluating the results, I can find the following conclusions:
 - a. Students are grouped according to computer literacy. It can be said that those students that identify themselves as proficient in computer use, are more easily able to use the Moodle system. This finding out is supported by the result of the Mann-Whitney test used for students' answers.
 - b. According to the students' feedback, the use of Moodle e-Learning system contributes greatly to a successful outcome of the educational process, which is confirmed by students' responses with the average value of 7.47.
3. **I used stastistic methods to examine the evaluation of the e-Learning among the students and the lecturers of the UD CAAES and the CUB. I found significant differences between the CUB's and the UD CAAES's application as well as between the students' and the lecturers' evaluation by performing a t-test. I determined that relying on the result, that it is more effective and better in quality to operate the e-Learning system under organized circumstances. This supports my H3 hypothesis.** I have created 4 factors from the 27 variables by factor analysis and I performed logistic regression on them. My result was that according to the CUB users the quality of the service is more than twice as good, while the efficiency of the system is 1,683 times as more important than according to the UD CAAES users.
4. **I used the ROI indicator to performs economical calculations about the return of the e-Learning's application as an investment.** The first two years of an examined 3-year-period had negative results, which means that the expenses of the introduction did not return withing 2 years. However, in the third year the indicator was positive, which means that accoeding to my calculations, the introduction of the e-Learning in the UD CAAES returns in 3 years. This supports my H4 hypothesis according to which the application of the e-Learning has an expense reductive effect in the long run.

5. **I was the first to examine the advantages of the e-Learning system and the use informational technology between the professional consultants. 56% of them think that the Internet's role in the acquisition of the new knowledge is significant. 36% of them think that the most important benefit of the system is the independent testing regarding the exam appointments.** The research obviously demonstrates that the consultants welcomed the introduction of the e-Learning positively and the recognized its benefits and advantages.
6. I have examined the domestic and international agri e-Learning initiatives and projects. I have analyzed the structure and functions of existing agribusiness, and summarizing the results **I created an e-Learning model of collaborative research, development and application that aims to realize the relationship the systems developed by me, the implemented open source systems and applied knowledge bases to helping collaborations among researchers, and interactive use of learning contents and knowledge bases between the domestic institutions and foreign partners.**

5. PRACTICAL USABILITY OF THE RESULTS

In my research I formed a number of practice-oriented questions, namely, the implementation of the presented thesis. The integrated e-Learning Portal is being continuously developed and used since 2007. It is now an integral part of the educational process. The Moodle system is used more and more and functions of the education system and developed training room booking system are using an increasing number of computer rooms in online teaching employment exams, for exams. Several ways of student evaluation are also used by instructors, over which the student evaluation system is available as we need to develop multi-function use. The study material of different devices using standard materials and construction of eligible education quality and efficiency. The proposed course syllabus and assuming builds online courses and e-learning materials using or storing materials, registration of the proposed agribusiness with learning material repository application materials to ensure the quality of education. The proposed and presented with quality e-Learning and e-Learning for 4-level model realized with the "quality e-Learning" at UD-CAAES.

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