CHALLENGES OF E-LEARNING MANAGEMENT WITHIN THE CROATIAN HIGHER EDUCATION SYSTEM

Darko Dukić[1]

[1]Senior Assistant,Josip Juraj Strossmayer University of Osijek, Department of Physics, Croatia

Abstract

For the past few years, e-learning has become synonymous with different learning and teaching techniques based on information and communication technologies. Generally speaking, e-learning has been increasingly present in the Croatian higher education system, gradually changing its traditional character. However, this modern learning and teaching concept has not been equally accepted throughout student population. There are numerous reasons for this state of affairs, one of the most important ones being disproportion, i.e. unequal pace of its introduction at different university and vocational studies in Croatia. These discrepancies cannot be eliminated without active support by all the actors participating in the education process. The greatest responsibility, nevertheless, lies with the people directly in charge of the e-learning process. To fulfil its task more efficiently, e-learning management requires relevant information on different aspects of its usage, as well as its acceptance among students. With this aim in mind, we conducted a survey of student attitudes at Josip Juraj Strossmayer University of Osijek. This paper presents the results of this research, which are based on application of various statistical methods, primarily cluster analysis.

JEL classification: I21

Keywords: e-learning management, attitudes of students, relevant information, cluster analysis

1. Introduction

In developed countries of the world, information and communication technologies (ICT) have had a major impact on education, becoming eventually its integral part. In the early stages, different technical and technological devices and tools were limited in scope and were thus used as nothing more than support to traditional teaching methods. This situation has changed dramatically in the past fifteen years or so. Intensive development of information and communication technologies, especially of the Internet, has allowed the implementation of a number of new methods and teaching tools, thus creating a very different learning and teaching environment. The result of these processes is that the education system has adapted and become increasingly learner-oriented, putting students, i.e. learners at the centre, providing them with all the necessary resources, which have been virtually tailor-made in terms of time, place and manner of learning.

There are numerous terms in use that describe technology-supported education (Anohina; 2005, pp. 91-102), such as online learning, virtual learning, virtual classroom, electronic classroom, network learning, web-based learning, web-based training and internet-based training. We could make a certain distinction between each of these terms, although these are usually no more than formal differences. It seems that the term e-learning has managed to come to the fore as a kind of paradigm for everything that has been researched and developed over the past fifty years in the field of education supported by information and communication technologies.
Numerous definitions of the concept of e-learning can be found in available sources, however, due to space limitations, we have chosen to quote only three of those:

- E-learning is the continuous assimilation of knowledge and skills by adults stimulated by synchronous and asynchronous learning events - and sometimes Knowledge Management outputs - which are authored, delivered, engaged with, supported, and administered using Internet technologies (Morrison; 2003, p. 4). It should be noted that the cited author focused on adults who have finished their formal education. He believes that e-learning is almost always for the benefit of such kind of learners.
- E-learning is the use of Internet technologies to create and deliver a rich learning environment that includes a broad array of instruction and information resources and solutions, the goal of which is to enhance individual and organizational performance (Rosenberg; 2006, p. 72).
- E-learning can be defined broadly as any use of Web and Internet technologies to create learning experiences (Horton & Horton; 2003, p. 13).

All the above definitions mention the concept of Internet technologies, which is quite understandable, given the influence the Internet has had on the education system trends.

In accordance with the changes under way in Croatian higher education, e-learning management has been gaining in importance. People engaged in managing e-learning at Croatian universities and polytechnics need to establish and maintain a system that will effectively meet the needs and requirements of its users. To be able to do this successfully, they first have to collect relevant information on different aspects regarding the use and acceptance of e-learning among student population. Conducting such surveys will allow researchers to gain an insight into the current situation, which is the first step in an effort to eliminate the registered differences in the level of e-learning achieved at particular university and vocational studies.

2. Methods

The data were collected by polling the students at Josip Juraj Strossmayer University of Osijek, and then analyzed using different statistical methods. In order to gain an adequate insight into the respondent sample, in its description we determined absolute and relative frequencies for each of the determined groups, and then grouped the data according to the modalities of chosen features, thus forming two-way tables. Basic descriptive statistics were calculated for the research variables, and 95% confidence intervals for the mean were determined.
A particular place in the research of these issues was given to cluster analysis. Cluster analysis is a set of methods for constructing a sensible and informative classification of an initially unclassified set of data, using the variable values observed on each individual (Everitt; 2006, p. 81). Cluster analysis can also be defined as a set of techniques for sorting variables, individuals, and the like, into groups on the basis of their similarity to each other (Cramer & Howitt, 2004, p. 24). In statistics, these groupings are known as clusters. In our research, cluster analysis was used for classifying respondents according to the level of e-learning acceptance on their part.

3. Previous research

There have been different approaches to the research of various aspects of e-learning implementation in the learning and teaching process. In this paper we will note only three research papers that also used cluster analysis for this purpose.
Stoyanov and Kirschner (2004, pp. 41-56) carried out a hierarchical cluster analysis of the raw data to identify how experts classified statements into groups. In addition, they attached means to each statement and group of statements. Their analysis distinguished 17 clusters of items. Tao (2008, pp. 1495–1508) identified in the cluster analysis using four higher-level issue constructs emerging from a factor analysis of 30 variables two totally distinct groups of students, namely the skeptics and the optimists. Zakrzewska (2008, pp. 209-214) divided students into groups by unsupervised classification. In the article, she described application of two-phase hierarchical clustering algorithm which enables tutors to determine such parameters as maximal number of groups, clustering threshold and weights for different learning style dimensions.

4. Sample and research variables

The sample was comprised of 215 students of the Josip Juraj Strossmayer University in Osijek. The distribution of the surveyed students according to gender is given in Table 1.

GENDER	NUMBER OF STUDENTS	PERCENT
Male	72	33.49
Female	143	66.51
TOTAL	215	100.00

Table 1. Distribution of the surveyed students according to gender

Table 2 shows the student distribution according to the year of study. Students of senior years were more strongly represented in the sample, since it was assumed that they would have had more opportunities to encounter various forms of e-learning during their studies.

YEAR OF STUDY	NUMBER OF STUDENTS	PERCENT
I	33	15.35
II	24	11.16
III	69	32.09
IV	89	41.40
TOTAL	215	100.00

Table 2. Distribution of the surveyed students according to the year of study

The following table was the result of grouping the data according to gender and the year of study.

GENDER	YEAR OF STUDY				TOTAL
	I	II	III	IV	
Male	8 (3.72%)	13 (6.05%)	16 (7.44%)	35 (16.28%)	72 (33.49%)
Female	25 (11.63%)	11 (5.12%)	53 (24.65%)	54 (25.12%)	143 (66.51%)
TOTAL	33 (15.35%)	24 (11.16%)	69 (32.09%)	89 (41.40%)	215 (100.00%)

Table 3. Distribution of the surveyed students according to gender and the year of study

Table 4 lists the distribution of students according to the scientific field of the faculty, i.e. department, in which they are matriculated.

SCIENTIFIC FIELD	NUMBER OF STUDENTS	PERCENT
Natural sciences	77	35.81
Technical sciences	24	11.16
Biotechnical sciences	35	16.28
Social sciences	61	28.37
Humanities	18	8.37
TOTAL	215	100.00

Table 4. Distribution of the surveyed students according to the scientific field of the faculty, i.e. department, in which they are matriculated

By simultaneous grouping of the data according to the modalities of features representing the respondent gender and the scientific field of the faculty, i.e. department, in which they are matriculated we obtained Table 5.

GENDER	SCIENTIFIC FIELD					TOTAL
	Natural sciences	Technical sciences	Biotechnical sciences	Social sciences	Humanities	
Male	23 (10.70%)	15 (6.98%)	15 (6.98%)	13 (6.05%)	6 (2.79%)	72 (33.49%)
Female	54 (25.12%)	9 (4.19%)	20 (9.30%)	48 (22.33%)	12 (5.58%)	143 (66.51%)
TOTAL	77 (35.81%)	24 (11.16%)	35 (16.28%)	61 (28.37%)	18 (8.37%)	215 (100.00%)

Table 5. Distribution of the surveyed students according to gender and the scientific field of the faculty, i.e. department, in which they are matriculated

In Table 6, year of study is connected with the variable defined as the scientific field of the university faculty, i.e. department, in which a respondent is matriculated.

YEAR OF STUDY	SCIENTIFIC FIELD					TOTAL
	Natural sciences	Technical sciences	Biotechnical sciences	Social sciences	Humanities	
I	17 (7.91%)	1 (0.47%)	8 (3.72%)	3 (1.40%)	4 (1.86%)	33 15.35%)
II	9	0	9	4	2	24

	(4.19%)	(0.00%)	(4.19%)	(1.86%)	(0.93%)	11.16%)
III	35 (16.28%)	1 (0.47%)	5 (2.33%)	21 (9.77%)	7 (3.26%)	69 32.09%)
IV	16 (7.44%)	22 (10.23%)	13 (6.05%)	33 (15.35%)	5 (2.33%)	89 41.40%)
TOTAL	77 (35.81%)	24 (11.16%)	35 (16.28%)	61 (28.37%)	18 (8.37%)	215 (100.00%)

Table 6. Distribution of the surveyed students according to the year of study and the scientific field of the faculty, i.e. department, in which they are matriculated

For this research, we defined 18 variables by which we examined students' attitudes on various aspects of e-learning:

- Estimate of knowing about the possibilities of using e-learning in education (V1);
- Estimate of the level of e-learning development at the respondent's faculty, i.e. department (V2);
- Estimate of the e-learning concept as such (V3);
- Estimate of the possibility to study and graduate by means of e-learning alone (V4);
- Estimate of the need for the traditional teaching to be supported by e-learning (V5);
- Estimate of the capability of e-learning to simplify the education process (V6);
- Estimate of the impact of e-learning on student creativity (V7);
- Estimate of the impact of motivation on e-learning efficiency (V8);
- Estimate of grading objectivity when taking computer tests and exams (V9);
- Estimate of the possibility for e-learning to provide flexibility in choosing teaching times (V10);
- Estimate of possibilities for "out-of-classroom" education offered by e-learning (V11);
- Estimate of the possibility to reduce the costs of higher education through e-learning (V12);
- Estimate of the usefulness of e-learning for people with limited mobility (V13);
- Estimate the capacity of e-learning to promote the acquisition of knowledge and skills in ICT (V14);
- Estimate of lack of direct student-teacher contact as a drawback of e-learning (V15);
- Estimate of lack of contact with fellow students as a drawback of e-learning (V16);

- Estimate the inadequacy of e-learning for students with low computer literacy (V17);
- Estimate the possibility for e-learning to encourage a user's computer and Internet addiction (V18).

For assessing students' attitudes a 5-level scale was used, in which 1 denoted the lowest and 5 the highest degree of agreement with a particular claim.

5. Analysis Results

In order to gain a better insight into the basic features of student responses, Table 7 lists basic descriptive statistics (mean, median, mode, standard deviation and variation coefficient) calculated for the 18 analyzed variables. The table also contains 95% confidence intervals for the mean.

VARIABLE	DESCRIPTIVE STATISTICS					95% CONFIDENCE INTERVAL FOR THE MEAN	
	Mean	Median	Mode	Standard deviation	Variation coefficient	Lower bound	Upper bound
V1	3.144	3.000	3.000	1.103	35.092	2.996	3.293
V2	2.828	3.000	3.000	1.137	40.205	2.675	2.981
V3	3.553	4.000	4.000	0.984	27.686	3.421	3.686
V4	2.744	3.000	3.000	1.170	42.635	2.587	2.901
V5	4.060	4.000	5.000	1.064	26.201	3.917	4.203
V6	3.874	4.000	4.000	0.971	25.052	3.744	4.005
V7	3.740	4.000	4.000	1.026	27.445	3.602	3.878
V8	3.633	4.000	4.000	1.046	28.785	3.492	3.773
V9	2.884	3.000	2.000	1.144	39.673	2.730	3.038
V10	3.540	4.000	3.000	1.008	28.477	3.404	3.675
V11	3.572	4.000	3.000	1.052	29.438	3.431	3.713
V12	3.623	4.000	3.000	0.996	27.502	3.489	3.757
V13	3.995	5.000	5.000	1.202	30.076	3.834	4.157
V14	4.107	4.000	5.000	0.903	21.990	3.986	4.228
V15	3.233	3.000	3.000	0.991	30.672	3.099	3.366
V16	3.274	3.000	3.000	1.125	34.355	3.123	3.426
V17	3.019	3.000	3.000	1.152	38.158	2.864	3.173
V18	3.205	3.000	3.000	1.182	36.885	3.046	3.364

Table 7. Basic descriptive statistics and 95% confidence intervals for the mean

The highest average grade was obtained for the variable defined as estimate of the capacity of e-learning to promote the acquisition of knowledge and skills in ICT (V14). The only other variable that received the average grade higher than 4 was the need for the traditional teaching to be supported by e-learning (V5). The lowest average grade was calculated for the variable defined as estimate of the possibility to study and graduate by means of e-learning alone (V4). Thus, students approve of using e-learning within the teaching process; however, they would not embrace the idea of education based on e-learning alone. The average grade lower than 3 was calculated for another two variables: estimate of the level of e-learning development at the respondent's faculty, i.e. department (V2), and estimate of grading objectivity when taking computer tests and exams (V9). Taking exams on a computer is definitely more objective than some other forms of examination, however, the results for the variable V9 lead to the conclusion that students do not prefer this way of taking tests and exams. Their negative attitude, as a reflection of subjective perception, must have had an effect on the stated assessment.

It was only in the case of the variable defined as estimate of the usefulness of e-learning for people with limited mobility (V13) that the median had the value of 5. There were three such variable in the case of mode. In addition to the already mentioned variable V13, the largest number of respondents gave the grade 5 also to variables: estimate of the need for the traditional teaching to be supported by e-learning (V5), and estimate the capacity of e-learning to promote the acquisition of knowledge and skills in ICT (V14). The lowest mode value was calculated for the variable defined as estimate of grading objectivity when taking computer tests and exams (V9).

The calculated variation coefficients indicate that with all the variables there is data dispersion which cannot be regarded as small. The last two columns in the table contain 95% confidence intervals for the mean. Thus it can be concluded e.g. for the variable V1 that there is 95% probability that the average grade given by students to the familiarity with possibilities of e-learning in education is higher than 2.996, and lower than 3.293.

Our sample of students was divided into two clusters by applying k-means cluster analysis. Table 8 shows the means and standard deviations of these clusters.

VARIABLE	CLUSTER			
	1		2	
	Mean	Standard deviation	Mean	Standard deviation
V1	2.559	1.098	3.590	0.879
V2	2.301	1.008	3.230	1.066
V3	2.968	1.005	4.000	0.692
V4	2.183	1.083	3.172	1.050
V5	3.280	1.067	4.656	0.557
V6	3.237	0.925	4.361	0.681
V7	3.097	0.968	4.230	0.769
V8	2.946	0.948	4.156	0.782
V9	2.484	1.069	3.189	1.108
V10	2.892	0.853	4.033	0.823
V11	2.925	0.900	4.066	0.879
V12	3.129	0.850	4.000	0.936
V13	3.247	1.176	4.566	0.862
V14	3.559	0.902	4.525	0.646
V15	3.183	1.021	3.270	0.971
V16	2.957	1.197	3.516	1.006
V17	2.817	1.063	3.172	1.197
V18	3.118	1.169	3.270	1.193

Table 8. Means and standard deviations of clusters

The first cluster is comprised of respondents who exhibit lower support for e-learning, whereas the second cluster consists of students who have a more positive outlook on this modern learning and teaching concept. In accordance with this, average grades calculated for the first cluster are lower than those determined for the second cluster. In the first cluster 93 students (43.26%) were allotted and 122 students (56.74%) in the second.

Figure 1 shows the values of means for the two clusters.

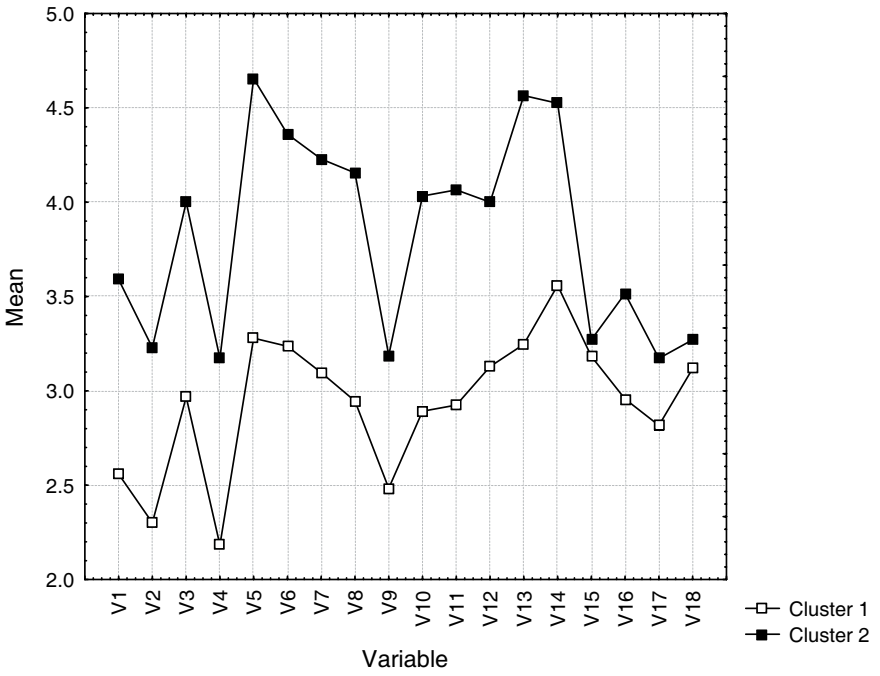

Figure 1. Plot of means for each cluster

Below is the analysis of variance (ANOVA) table. This table helps us to identify the variables that are most important for cluster separation.

VARIABLE	Between cluster sum of squares	df	Within cluster sum of squares	df	*F*-ratio	*p*-level
V1	56.097	1	204.433	213	58.448	0.000
V2	45.489	1	231.144	213	41.918	0.000
V3	56.232	1	150.903	213	79.371	0.000
V4	51.653	1	241.278	213	45.599	0.000
V5	99.942	1	142.272	213	149.626	0.000
V6	66.682	1	134.927	213	105.267	0.000
V7	67.711	1	157.703	213	91.454	0.000
V8	77.200	1	156.772	213	104.888	0.000
V9	26.203	1	253.890	213	21.983	0.000
V10	68.620	1	148.794	213	98.231	0.000
V11	68.684	1	167.949	213	87.108	0.000
V12	40.032	1	172.452	213	49.445	0.000

V13	91.708	1	217.287	213	89.899	0.000
V14	49.189	1	125.351	213	83.583	0.000
V15	0.406	1	209.966	213	0.412	0.522
V16	16.514	1	254.295	213	13.832	0.000
V17	6.648	1	277.278	213	5.107	0.025
V18	1.223	1	297.773	213	0.875	0.351

Table 9. ANOVA table

On the basis of calculated *F*-ratios it can be concluded that variables defined as estimate of the need for the traditional teaching to be supported by e-learning (V5), estimate of the capability of e-learning to simplify the education process (V6), and estimate of the impact of motivation on e-learning efficiency (V8), have the most important role in assigning students to one or the other cluster. The variables with the weakest role in classifying students into clusters are estimate of lack of direct student-teacher contact as a drawback of e-learning (V15), and estimate the possibility for e-learning to encourage a user's computer and Internet addiction (V18). It should be noted that in the case of cluster analysis, *F* statistics cannot be interpreted as in a traditional ANOVA, i.e. that the significance values are not a reliable estimate of the probability.

6. Conclusion

Management of e-learning cannot be improved unless we gather adequate information regarding its acceptance among the users. There are numerous aspects of e-learning implementation that need to be taken into account here. Such surveys need to be conducted continuously, as this creates the conditions for making optimal decisions.

E-learning is increasingly present in the Croatian higher education system; however, the pace of its introduction has been rather uneven or even erratic. In some institutions different forms of e-learning are already deeply ingrained in the teaching process, whereas other higher education institutions have only begun to use some of its simpler forms. Given that, differences in students' perceptions come as no surprise, which was confirmed in our research. By using cluster analysis, our sample was divided into two groups. The first consisted of students who give lower support to e-learning, and the second group encompassed students with a more positive outlook on e-learning. Apart from defining the possible clusters, the paper also analyzed the basic features of student attitudes regarding certain aspects of e-learning implementation.

Surveying the opinions of e-learning users has not received sufficient attention in the Croatian education system. In this context, the research whose results are presented in this paper can be viewed as an effort to change this state of affairs. If we accept that the growth and development of our higher education depends

directly on the success in introducing and implementing information and communication technologies, it becomes more than clear what adverse effects can occur if users' perceptions are disregarded.

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