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VALIDATION OF THEORETICAL MODEL FOR DECISION MAKING ABOUT E-LEARNING IMPLEMENTATION

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Abstract: *In the paper the possibility to use mathematical models and statistical techniques in strategic planning and decision making about e-learning is presented. Strategic planning and decision making has been covered as consisting of four phases: (1) intelligence, (2) design, (3) choice and (4) implementation. Each of the phases will be described in this paper, but the accent will be put on the statistical evaluation of the results of the questionnaire which was based on the developed theoretical model for decision making about e-learning implementation in the higher education sector.*

In general, the main objectives of this paper are: (1) validation of the first theoretical model for decision making about e-learning implementation in the higher education sector, by means of factor analysis and (2) reduction of a large number of variables to a smaller number of factors, i.e. designing the improved theoretical model, for modelling purposes (developing AHP & ANP models).

Keywords: *e-learning, decision making, strategic decisions, mathematical modelling, factor analysis.*

1. INTRODUCTION

E-learning is usually defined as a type of learning supported by information and communication technology (ICT) that improves quality of teaching and learning. Implementation of e-learning contributes to the advancement of higher education. E-learning system is a powerful tool for achieving strategic objectives of the university (teaching, research and serving the society) and it contributes to the progress on the institutional level as well as the personal level, including both teaching staff and students [6].

Moreover, e-learning is more fun and interesting [23], it enables better visualization and simulation, encourages innovation and multimedia capabilities [1, 21], allows dynamic interaction [19], adapts to the learner's style and implies numerous benefits, including "just in time – any time" approach [25], lifelong learning and possibility of parallel working and studying [18, 19, 20].

E-learning supports collecting, analyzing and applying information appropriately and comprises different teaching methods, for example information management, creative thinking, critical thinking, problem solving and collaborative learning.

There are different options for implementing e-learning in the teaching process. E-learning can be used as a means of support to the already established systems of education i.e. blended-learning model, it can also be partially introduced (for single subject or a group of subjects), or can be implemented as an independent form of teaching, in other words as a separate teaching programme.

Generally speaking, universities in Croatia are currently at the stage of strategic planning and bringing decisions about the implementation of e-learning in the existing academic activities. Strategic planning and decision making about the e-learning implementation is one of the aims of Tempus EQIBELT project [28] coordinated by the University of Zagreb, which provides useful platform for our research.

In our paper we will present possibility to use mathematical models and statistical techniques in strategic planning and decision making about e-learning.

2. OBJECTIVES AND RESEARCH METHODOLOGY

The overall objectives of the study are:

- to provide basis for decision making for members of EQIBELT project team and university strategy teams in the process of creation of e-learning vision and strategic documents
- to develop the theoretical model for decision making about e-learning implementation in the higher education (HE)
- to prioritize the criteria/subcriteria for decision making about e-learning implementation in HE taking into consideration the results of the questionnaire
- to complete the factor analysis, validate the theoretical model and reduce a large number of variables to a smaller number of factors, i.e. designing the improved theoretical model for modelling purposes
- to develop the AHP and ANP model for decision making about e-learning implementation in HE

The specific objectives of this paper are:

- validation of the theoretical model for decision making about e-learning implementation in the higher education sector, by means of factor analysis and
- reduction of a large number of variables to a smaller number of factors, i.e. designing the improved theoretical model, for modelling purposes (developing AHP & ANP models).

We have treated decision making as consisting of four phases: (1) intelligence, (2) design, (3) choice and (4) implementation (*Table 1,* [7]). Each of the phases will be described in this paper, but the accent will be put on the statistical evaluation of the results of the questionnaire about criteria and subcriteria essential for decision making about the e-learning implementation.

In the Design phase we have developed a theoretical model for decision making about e-learning implementation and created the questionnaire which was based on this theoretical model (criteria/subcriteria)..

In the statistical evaluation of the results we have used factor analysis to validate the theoretical model for decision making about e-learning implementation. The factor analysis reveals the latent structure (dimensions) of a set of variables (criteria and subcriteria) and

reduces a large number of variables to a smaller number of factors for modelling purposes (developing AHP & ANP models in the Choice phase).

3. PROGRESS REVIEW OF THE SURVEY - FOUR PHASES OF DECISION MAKING ABOUT E-LEARNING IMPLEMENTATION

As we stated before, we have treated decision making about the e-learning implementation in Croatian universities and faculties in four phases: (1) intelligence, (2) design, (3) choice and (4) implementation (Table 1, [7]).

In the Intelligence phase we have identified our central decision making problem: decision making about the e-learning implementation in Croatian universities and faculties. We have conducted situation analysis which has included a review and presentation of key facts and major trends concerning the problem. All of these factors influence the problem definition and alternative specification components. We have also conducted search and scanning procedures and presented a problem statement. The tools that we have used were: Data Acquisition, Storage and Retrieval and Data analysis (*Table 1,* [7]).

Based on the results of the Intelligence phase, in the Design phase we have established alternatives, criteria and subcriteria and developed a theoretical model for decision making about e-learning implementation. The tools that we have used were Data analysis, Data Acquisition, and Storage and Retrieval (*Table 1*, [7]). We have analyzed a lot of sources, but the most important for the theoretical model development were strategic documents related to e-learning originating from leading EU universities [8, 9, 10, 11, 12, 13, 14, 15, 16, 22, 27].

We have considered and compared the mentioned documents and extracted the alternatives and most important criteria/subcriteria for decision making process about e-learning implementation, considering the main characteristics of the universities where a particular e-learning strategy is implemented.

The alternatives in decision making process about e-learning implementation on different levels are:

- ICT supported face-to-face learning,
- Blended learning and
- Learning that is entirely online.

The developed theoretical model (criteria/subcriteria) is presented in *Table 4* and details are given in the paper "Imaginative acquisition of knowledge-strategic planning of e-learning" to be included in the ITI 2006 Conference programme [6].

3.1. QUESTIONNAIRE DESCRIPTION AND RESPONSE

After we had developed the theoretical model for decision making about e-learning implementation, we have created a questionnaire about the importance of the advantages and goals of e-learning implementation and about criteria and subcriteria essential for decision making about the e-learning implementation (theoretical model). The alternatives were not included in the questionnaire, but explanation of each criteria/subcriteria was attached to the questionnaire.

The pilot survey had been conducted at the 1st Policy Workshop on Creating University E-Learning Vision and Strategy, held in March 2006 in Dubrovnik [28], where 33 questionnaires were collected. The participants were: vice-rectors for teaching, development or quality improvement, vice-deans for teaching, development or quality improvement coming from different faculties, schools and departments, members of university bodies responsible for teaching, quality improvement or university development,

student representatives in university and faculty decision making bodies, members of government bodies responsible for implementation of e-learning methodology and technology, members of EQIBELT project team and university strategy teams, as well as university teachers involved or interested in e-learning. In other words, a representative sample of e-learning experts in Croatia was surveyed. We have published the results of that pilot survey in [6].

After the pilot survey, we have carried out the complete survey. We have collected a total of 90 questionnaires (including 33 questionnaires collected in Dubrovnik). The participants were experts on e-learning and university teaching in Croatia. Therefore, besides the experts mentioned above, we have additionally questioned vice-deans for teaching, development or quality improvement of faculties, schools and departments, members of EQIBELT project team and university strategy teams, the university teachers (professors, assistants), coordinators of CARNet reference centres for e-learning, members of the project team for standardization of e-learning material established by CARNet, project managers of e-learning projects in CARNet [27], tutors in ELA (E-Learning Academy, CARNet) [27] and e-learning specialists in SRCE [29]. The criteria for the selection were expertise in e-learning and the familiarity with the HE environment. We have published the results of the complete survey in the paper "Development of AHP based model for decision making on e-learning implementation" to be included in IIS 2006 Conference [2] programme.

3.2. MATHEMATICAL MULTICRITERIA MODEL FOR DECISION MAKING ABOUT E-LEARNING IMPLEMENTATION

As we have already mentioned, the third aim of the survey was prioritizing of the criteria/subcriteria. The most important criteria/subcriteria serve as input in the multicriteria decision model that we have developed in the third phase – the Choice phase (*Table 1,* [7]). We have developed mathematical multicriteria model - Analytic hierarchy process (AHP) that supports decision making process on the most suitable alternative, that is, form of implementing e-learning, on different levels [2]. We also intend to develop the ANP (Analytic Network Process) model. The AHP and ANP methods are powerful and flexible methods for decision making, which are helpful in setting priorities and making the best decision when both qualitative and quantitative aspects of a decision need to be considered [7]. These methods have previously been applied in management, governance, allocation and distribution of resources for making strategic decisions of major importance and responsibility. AHP is one of the most widely exploited decision making methods. The complete AHP model is presented in the paper [2].

The fourth phase of the decision making is the implementation of e-learning. The action plan and control system must be included in it.

Table 1: DSS for the Decision making and Implementation Process [7]

DECISION MAKING	TOOLS
1. Intelligence phase (Identify the central decision problem) ▪ Perform a situation analysis ▪ Conduct search & scanning procedures ▪ Problem identification ▪ Determine problem ownership ▪ Present a problem statement	**Data Acquisition, Storage and Retrieval** Data base management systems, Interactive query, Data bases **Data analysis** Spreadsheets, Graphics, Statistical analysis MS/management science/operations research models
2. Design phase Develop alternatives & establish criteria **Search for alternatives** ▪ Initial list ▪ Revised list **Set criteria for choice** ▪ Must criteria ▪ Want criteria **Predict and measure outcomes**	**Data analysis** **Data Acquisition, Storage and Retrieval**
3. Choice phase (Evaluate alternatives) ▪ Develop multicriteria decision model ▪ Solution to the model ▪ Sensitivity analysis ▪ Selection of alternatives	**Decision analysis:** expert systems (designed to replace decision maker), expert support systems (AHP, ANP..) **Data analysis** **Data Acquisition, Storage and Retrieval**
4. IMPLEMENTATION **(Action plan and control system)**	**Data Acquisition, Storage and Retrieval** **Data analysis, Decision analysis**

4. VALIDATION OF THEORETICAL MODEL FOR DECISION MAKING ABOUT E-LEARNING IMPLEMENTATION USING FACTOR ANALYSIS

4.1. FACTOR ANALYSIS

Factor analysis is a generic term for a family of mathematical and statistical techniques concerned with the reduction of a set of related variables in terms of a small number of latent factors that can be used to represent relationships among interrelated variables [17]. The primary purpose of factor analysis is data reduction and summarization, but there are many other uses [26]. The main applications of factor analytic techniques are: (1) to reduce

the number of variables and (2) to detect structure in the relationships between variables. Factor analysis has been widely used, especially in the behavioural sciences, to assess the construct validity of a test or a scale.

There are two types of factor analysis: exploratory and confirmatory. Exploratory factor analysis attempts to discover the nature of the constructs influencing a set of responses. Confirmatory factor analysis tests whether a specified set of constructs is influencing responses in a predicted way [5].

We have used exploratory factor analysis to validate a theoretical model, to reduce a large number of variables to a smaller number of factors for modelling purposes, to specify the strength of the relationship between each factor and each variable and to determine which sets of items should be grouped together in a theoretical model.

Following DeCoster [5], we have performed factor analysis in six basic steps:

1. *Collect measurements.* We have measured 27 variables; discrete scale for validation of importance was from 1 to 5. We have collected 90 questionnaires from experts and all questionnaires were filled in correctly.

2. *Obtain the correlation matrix.* We have obtained the correlations between the variables.

3. *Select the number of factors.* There are four criteria for choosing *m*, the number of factors: (1) choose *m* equal to the number of factors necessary for the variance accounted for to achieve a predetermined percentage of the total variance, (2) choose *m* equal to the number of eigenvalues greater than the average, (3) scree test and (4) test the hypothesis that *m* is the correct number of factors [24].

   We have chosen the criteria of testing the hypothesis that *m* is the correct number of factors. The reason for that was the structure of the theoretical model (5 factors were recognized in the theoretical model, *m*=5): Organizational readiness of environment, Legal and formal readiness of environment, Availability of basic ICT infrastructure, Availability of specific ICT infrastructure and Human resources (the criteria Development of human resources and Availability of human resources can be considered as one factor under the joint title Human resources) (*Table 4*). The results of the factor analysis have confirmed the hypothesis.

4. *Extract the initial set of factors.* There are a number of different extraction methods; the most frequently used are maximum likelihood, principal component and principal axis extraction. We have used principal component method supported with statistical program SPSS [3].

5. *Rotate the factors to a final solution.* There are two major categories of rotations, orthogonal rotations, which produce uncorrelated factors, and oblique rotations, which produce correlated factors. We have used the Varimax rotation since it is generally believed that the Varimax is the best orthogonal rotation.

6. *Interpret the factor structure*. Each of the variables is linearly related to some of the factors. The strength of this relationship is contained in the respective factor loading, produced by rotation.

4.2. INTERPRETATION OF THE RESULTS

The extraction method which was used in the factor analysis was Principal Component Analysis [17] and the rotation method was the orthogonal Varimax rotation [17] with

Kaiser normalization. The factor analysis was performed with the support of the statistical program SPSS [3].

We have specified the number of factors, *m*=5 (5 factors were recognized in the theoretical model). Let us mention that the factor analysis was also conducted for number of factors *m*=3, 4 and 6, but based on qualitative analysis performed in the first phase of the survey, it turned out that the structure for *m*=5 is the most informative and logical one and it is at the same time in accordance with the set theoretical model. Results of the factor analysis for *m*=5 are very close to the structure of the set theoretical model in the questionnaire for decision making about e-learning implementation (*Table 4*). In that way the set theoretical model is justified.

In order to establish the reliability of the theoretical model for criteria for decision making about e-learning implementation, we calculated *Cronbach alpha-coefficient* for estimation of inner consistency of results. For the initial model with 27 variables the Cronbach alpha-coefficient is 0.8927.

We set the lower boundary for projection of variable variance on the factor on 0.519 and noticed that 6 variables did not correlate above 0.519 with the principal components of the original correlation matrix and therefore we excluded them from the model. Moreover, 5 out of the above mentioned 6 variables relate almost equally to two or three factors. Finally, the new theoretical model was reduced to 21 variables (*Table 4*). Variables that are excluded were: VAR 031 Standardization of digital educational materials, VAR 050 Training of students for use of e-learning, VAR 028 Protecting intellectual property rights on state and academic level, VAR 035 Integral information system of universities/faculties, VAR 037 Virtual learning environment (CMS, LMS, LCMS…) and VAR 026 Organizational readiness of universities/faculties for e-learning implementation.

Experts did not recognize the importance of intellectual property rights and standardization of digital educational materials and in our opinion it shows that in general the state of the art in e-learning in HE in Croatia is at a rather early stage. Furthermore, the variables Training of students for use of e-learning, Integral information system of universities/faculties, Virtual learning environment and Organizational readiness of universities/faculties for e-learning implementation were excluded because of the redundancy with other variables in the theoretical model.

Moreover, the factor analysis was carried out on the new reduced model. The extraction method performed was Principal Component Analysis with the orthogonal Varimax rotation. The results were 5 extracted factors identical to those from the first factor analysis with 27 variables (*Table 3*).

Table 2 shows the total variance of results obtained by factor analysis of the reduced model. Note that five factors account for 63.143% of the variance among the intercorrelations of the 21 variables, where the first factor accounts for 18.961 % of the variance, the second for17.425 % the third factor for 10.582 %, the fourth for 8.952 % and the fifth factor accounts for 7.224 % of the total variance.

Kaiser-Meyer-Olkin index (CMO index) is K=0.769 and it confirms the adequacy of the sampling. It should be stated that the CMO measures the sampling adequacy which should be greater than 0.5 for a satisfactory factor analysis to proceed with.

The Cronbach alpha-coefficient for estimation of inner consistency of results for the reduced model equals 0.8686 (N=90). For each factor the results are as follows: FACTOR 1: $\alpha = 0.8701$, FACTOR 2: $\alpha = 0.8559$, FACTOR 3: $\alpha = 0.7048$, FACTOR 4: $\alpha = 0.5468$, FACTOR 5: $\alpha = 0.3767$. In spite of relatively low alpha for the last factor, it is kept in the model. The relatively low measure is the consequence of the fact that there are only two variables in the factor.

Table 2: Total Variance for the reduced theoretical model

Factors	Total	% of Variance	Cumulative %
F 1 Human resources	3,982	18,961	18,961
F 2 Specific ICT infrastructure for e-learning	3,659	17,425	36,386
F 3 Basic ICT infrastructure for e-learning	2,222	10,582	46,968
F 4 Strategic readiness for e-learning implementation	1,880	8,952	55,919
F 5 Legal and formal readiness for e-learning implementation	1,517	7,224	63,143

Table 3 shows a rotated component matrix of the reduced model with 21 variables which have a high correlation (above 0.512) with the principal components of the original correlation matrix. All 21 variables have a high correlation (above 0.512), so we can conclude that the reduced model is justified.
On the basis of the factor analysis results, we can confirm 5 factors of the model for decision making about e-learning implementation:

- F 1 – Human resources
- F 2 – Specific ICT infrastructure for e-learning
- F 3 – Basic ICT infrastructure for e-learning
- F 4 – Strategic readiness for e-learning implementation
- F 5 – Legal and formal readiness for e-learning implementation

Table 4 compares the set theoretical model for decision making about e-learning implementation (in the questionnaire encompassing 27 variables) and the structure encompassing 21 variables which are linearly related to one of the 5 factors, resulting from the factor analysis. It should be noted that we restructured the factors from the first model. First we merged the categories Availability of human resources and Development of human resources into one factor entitled Human resources. Then subcriteria Managed learning environment was transferred to the factor Basic ICT infrastructure, which seems to be more appropriate.

The factor analysis performed does not only confirm the major findings of prior data acquisition and analysis, but it also refines and better restructures our first theoretical model. We assume that there are two reasons for correspondence between the two models. Firstly, the fact that the qualitative analysis in the first part of research was thoroughly made on a considerable sample of strategic documents on e-learning implementation and, secondly, the use of experts in the survey. The latter was essential for this highly specific

area which requires both familiarity with e-learning and expertise in the higher education environment.

Table 3: Rotated Component Matrix for the reduced theoretical model

	F 1	F 2	F 3	F 4	F 5
F1 - HUMAN RESOURCES					
VAR 046 Availability of support staff for methodology of e-learning	**,883**	3,415E-02	5,202E-02	-1,120E-02	-4,832E-02
VAR 045 Availability of technical support staff for e-learning	**,835**	6,881E-02	,119	2,543E-02	,103
VAR 047 Availability of support staff for graphical design, animation and video	**,761**	,118	9,200E-02	,105	1,353E-02
VAR 049 Continuous training of support staff	**,709**	,146	,164	,196	,106
Centar VAR 044 Specialized e-learning centres at univer universities	**,652**	-1,242E-03	,176	,206	4,064E-02
VAR 048 Continuous training of academic staff	**,610**	,175	,139	,238	,156
F 2 - SPECIFIC ICT INFRASTRUCTURE FOR E-LEARNING					
VAR 041 Video and audio streaming	-,196	**,840**	9,800E-02	-1,927E-03	,108
VAR 040 Network videoconferencing system	-5,610E-02	**,806**	,176	,204	,154
VAR 043 Systems for simulation and virtual environment	,265	**,784**	-9,944E-02	9,253E-02	,153
VAR 042 Production of video and audio materials	,214	**,769**	9,195E-02	-9,597E-03	-4,100E-02
VAR 039 Exam management system	,160	**,609**	,254	,136	-,101

VAR 038 Library management system	,242	**,603**	,179	9,750E-02	-,276
F 3 - BASIC ICT INFRASTRUCTURE FOR E-LEARNING					
VAR 032 Network infrastructure	,163	,193	**,778**	,107	3,312E-02
VAR 033 Teachers and students equipped with computers	,266	,105	**,720**	-6,693E-02	-1,287E-02
VAR 034 Classrooms equipped for e-learning	-3,167E-02	,183	**,625**	2,887E-02	,564
VAR 036 Managed learning environment	,268	,233	**,528**	,417	-,240
F 4 - STRATEGIC READINESS FOR E-LEARNING IMPLEMENTATION					
VAR 025 Faculty strategy for development	,191	3,302E-02	5,800E-02	**,792**	,154
VAR 024 University framework for development	9,796E-02	,282	-,100	**,662**	-3,168E-02
VAR 027 Financial readiness of universities/faculties for e-learning implementation	,194	-3,291E-02	,397	**,558**	7,218E-02
F 5 - LEGAL AND FORMAL READINESS FOR E-LEARNING IMPLEMENTATION					
VAR 029 System and criteria for academic staff promotion	,123	-9,182E-02	-4,377E-03	2,484E-02	**,807**
VAR 030 Evaluation and quality control at universities/faculties	,340	,251	6,778E-03	,289	**,512**

Table 4: The comparison of the theoretical model in the questionnaire and the reduced model resulting from the factor analysis

THEORETICAL MODEL IN QUESTIONNARE	REDUCED MODEL - RESULT OF FACTOR ANALYSIS
AVAILABILITY OF HUMAN RESOURCES	**F 1– HUMAN RESOURCES**
Specialized e-learning centres at universities	Specialized e-learning centres at universities
Availability of technical support staff for e-learning	Availability of technical support staff for e-learning
Availability of support staff for methodology of e-learning	Availability of support staff for methodology of e-learning
Availability of support staff for graphical design, animation and video	Availability of support staff for graphical design, animation and video
DEVELOPMENT OF HUMAN RESOURCES	
Continuous training of academic staff	Continuous training of academic staff
Training of students for use of e-learning	
Continuous training of support staff	Continuous training of support staff
AVAILABILITY OF SPECIFIC ICT INFRASTRUCTURE	**F 2 – SPECIFIC ICT INFRASTRUC - TURE FOR E-LEARNING**
Managed learning environments	
Virtual Learning Environment	
Library management system	Library management system
Exam management system	Exam management system
Network videoconferencing system	Network videoconferencing system
Video and audio streaming	Video and audio streaming
Production of video and audio materials	Production of video and audio materials
Systems for simulation and virtual environment	Systems for simulation and virtual environment
AVAILABILITY OF BASIC ICT INFRASTRUCTURE	**F 3 - BASIC ICT INFRASTRUCTURE FOR E-LEARNING**
Network infrastructure	Network infrastructure
Teachers and students equipped with computers	Teachers and students equipped with computers
Classrooms equipped for e-learning	Managed learning environments
Integral information system of universities/faculties	Classrooms equipped for e-learning

ORGANIZATIONAL READINESS OF ENVIRONMENT	F 4 - STRATEGIC READINESS FOR E-LEARNING IMPLEMENTATION
University framework for development	Faculty strategy for development
Faculty strategy for development	University framework for development
Financial readiness of universities/faculties for e-learning implementation	Financial readiness of universities/faculties for e-learning implementation
Organizational readiness of universities/faculties for e-learning implementation	
LEGAL AND FORMAL READINESS OF ENVIRONMENT	**F 5 - LEGAL AND FORMAL READINESS FOR E-LEARNING IMPLEMENTATION**
Protecting intellectual property rights on state and academic level	
System and criteria for academic staff promotion	System and criteria for academic staff promotion
Evaluation and quality control at universities/faculties	Evaluation and quality control at universities/faculties
Standardization of digital educational materials	

5. FURTHER RESEARCH

Next step is quantitative and qualitative evaluation of AHP model. In process of quantitative evaluation, the results of evaluation, i.e. objective's relative significance, will be compared with the results of the ratings of criteria and subcriteria, obtained from the questionnaire.

Then, we intend to develop the ANP (Analytic Network Process) model for decision making about e-learning implementation in higher education. The ANP method is an upgrade of AHP method and it is the most comprehensive framework for the analysis of societal, governmental and corporate decisions that is available today to decision-makers. ANP allows both interaction and feedback within clusters of elements (inner dependence) and between clusters (outer dependence).

The above mentioned research will be covered in other papers in the future.
Additionally, comparing decision models for e-learning implementation in higher education based on some other research methods or built on questionnaires including experts from other countries might be of scientific and practical relevance.

6. CONCLUSION

Until today, the factor analysis has been used in many areas. This paper shows the results of factor analysis of a questionnaire on e-learning implementation in higher education. To our knowledge, the use of factor analysis in the mentioned field is a novel concept.

The whole research has been conducted as a mixed research consisting of qualitative and quantitative part. It has shown that factor analysis (quantitative method) does not only

confirm the major findings of prior data acquisition and analysis, but it also refines and better restructures our first theoretical model.

None of the Croatian universities has strategically implemented e-learning in their teaching and learning process and therefore this survey, besides the scientific, has its highly pragmatic justification.

Let us summarize the most important outcomes of the analysis we made in this paper. Five important factors for e-learning implementation in higher education in Croatia (and its implementation in HE in general) have been identified: Human resources, Specific ICT infrastructure for e-learning, Basic ICT infrastructure for e-learning, Strategic readiness for e-learning implementation and Legal and formal readiness for e-learning implementation. Experts involved in the survey did not recognize the importance of intellectual property rights and standardization of digital educational materials and in our opinion it shows that the current state of e-learning in HE in Croatia is in general at a rather early stage of implementation.

We hope that these findings will help decision-makers at universities in the region to make feasible and sustainable decisions on e-learning implementation.

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