THE EUROPEAN STUDENTS' PERSPECITVE OF DIGITAL TEACHING AND LEARNING IN HIGHER EDUCATION

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ABSTRACT

The increase in the use of online training connected to the pandemic emergency has highlighted, as never before, that Higher Education Institutions have to deal with the digital revolution, promoted by the European Community since 1998 from the so-called Bologna Process. This work illustrates the results of the students' survey of the "Empower Competences for Onlife Learning in Higher Education" (ECOLHE) project. the project aimed to investigate the transformation processes and of developing practices of higher education's digital teaching and learning in several European countries. The research project was based on the hypothesis that the availability of technological infrastructures does not grant an efficient and effective use of ICTs by professors, students, and researchers.

ECOLHE means "empower competences for online learning in higher education". The project started the first of September 2020. The aim of ECOLHE is examine the way in which the idea of e-learning European higher education area has been translated into practice at national level by academic bodies. Our purpose is to identify the way in which the digital challenges to promote Lifelong learning **LLL through ICT in HE** is shaped in specific contexts.

The project is going on by a consortium of five partner countries that are Italy, Spain, Ireland, Grease and Finland. Universities involved in the project are E-Campus University, Roma Tre University, University Oberta de Catalunya, University College Cork, University of Patrón and Laurea University.

ECOLHE is an action research project that aims to create the best conditions of exchange best practices in: Teaching digital skills in higher education; Training course for teachers and tutors for improving online teaching in higher education in the logic of Lifelong learning, inclusion and innovation recalled by high-level Group of the Modernization HE; Recognition and validation of teaching competencies in higher education for teachers' Professional development; Recommendations for academic bodies.

The main activities are developed following a stepwise approach. In the first step the project produces the Comparative Research Report on Digital Technologies in higher education: from the European vision to the University. This report represents the first intellectual output where each partner country realizes its Case Study. We mixed together both qualitative tools, such as focus group and interviews, and quantitative tool, i.e. a questionnaire for the students survey online. Aims and scope of the

questionnaire was to investigate students' perception about the ability of integrating digital Technologies into organizational and training processes supporting teaching/learning activities. The questionnaire wasvalidated and explored the following sections: teaching innovation, students' achievement and students' experience. By means of Survey Monkey system, we collected 1148 of students from the countries partners. Despite the distribution of gender was sometime unbalance, the analysis was not affected, since gender distribution is statistically independent by the country. Data have been analysed country by country and compared, which is the focus of this paper.

The comparative study was carried out with the aim of addressing 3 research questions that are:

RQ1: Which is the University partner having the best digital practices?

This RQ is addressed with the aim at Comparing Universities in terms of digital maturity. To address this RQ the Principal component analysis has been chosen as the statistical method for the analysis. Principal component analysis is a technique useful for summarizing latent concepts underlying a group of variables. Throughout the technique the dimension of data can be reduced with an insignificant loss of information.

RQ2: Which are the latent factors characterizing student's digital maturity?

This RQ is addressed with the aim at exploring latent dimensions in the questionnaire. To address this RQ the Explorative Factor analysis has been chosen as the statistical method for the analysis. Explorative factor analysis helps in exploring how many different latent dimensions underly variables through responses.

RQ3. How involved students can be classified?

This RQ is addressed with the aim at profiling students according to latent aspects. To address this RQ the Cluster analysis has been chosen as the statistical method for the analysis. Cluster analysis helps in highlighting groups of units that are meant to be similar to each other with respect to some criteria.

RQ4. Are latent factors of digital maturity, in average, really different among Universities?

This RQ is addressed with the aim at understanding if average values of latent components of digital maturity are different across Universities. To address this question, we proceeded into two steps. Firstly, we checked if latent dimensions average values are statistically different and then, if this may be due to Universities. To address the first step the analysis of variance.

THE DIGITAL MATURITY OF THE UNIVERSITY

To address RQ1 a first selection of items has been done. The items in the questionnaire able to express the concept of digital maturity are displayed in table 1 with the related factor loadings.

Table 1: items and PC1

Explained variance by PC1	**63%**
	Loadings
The faculty organization/structure is clear to me	0.788
Announcements from the administrative staff are clear	0.754
Teachers provide me the support that I need	0.842
Teachers are engaged in the teaching process	0.822
Teachers are digitally competent	0.782
Technology and learning portals	0.764
ICT Tools and platforms are intuitively used	0.766

The principal component underlying them can replicate the 63% of variability. Factor leadings play the role of weights by means of item take part in defining the digital maturity and, thus, help us in defining *digital maturity* more precisely.

Statistically speaking, averages have been simultaneously compared by each other's by the HSC Tukey test that can be used to find means that are significantly different from each other. Results can be briefly summarized as follows: E-campus, Laurea University and Roma Tre University have an average value of digital maturity similar to each other and to other universities, but UOC and Patras University; Patras University has an average value of digital maturity different from all the others; and UOC average value of digital maturity is different from all the other values but UCC.

Concluding, we can say that UOC has the highest level of digital maturity considering only the item selected and Patras University the lowest whilst the UCC college University of Cork is going closer to the best performance of Spain.

STUDENT'S DIGITAL MATURITY FACTORS

However, the level of digital maturity assessed selecting only some items does not seem satisfactory to us, both due to the limitations connected with the selection bias, and the exclusion of some items. All the items of the survey reveal the level of digital maturity, that is composed by different dimention. Then, we choose to adopt a principal component analysis procedure to identify the latent dimensions that constitute the digital maturity.

For this reason and to address RQ2, all items have been used. Explorative factor analysis with the principal components' method was carried out. The right n° of factors to extract is usually chosen based on the % of cumulative variance replicated by factors or up to the first eigenvalue less than 1As shown in table 2, the number of factors having an eigenvalue less than 1 is five. That is, there are five components constituting student's digital maturity.

Table 2: variance explained by factors

Latent factors	***Initial eigenvalues***	***% variance***	***% cumulative***
1	14.436	40.1	40.1
2	2.996	8.322	48.423
3	1.956	5.434	53.856
4	1.398	3.884	57.741
5	1.063	2.953	60.694

Once factors have been extracted, varimax rotation with Kaiser normalization has been applied with the aim of catching the meaning of each factor on the basis of factor loadings.

The first factor explains the 40% of the variance, then this is the most important component of student's digital maturity. As it is shown in table 4, this digital maturity component is made of 10 variables, and it describes the perceived benightment of students about their higher educational experience (teaching and more). For this reason, the factor has been called *Digital Tuning*. This component account for the student's tuning with digital training processes, which improves their learning activities making their experiences more efficient and effective.

Although the other four components explain overall half of the first component variance, then are less relevant than digital tuning for digital maturity, they account for relevant aspect in term of its quality. The second factor explains the 8% of the entire variability of data, than it is less relevant than digital tuning in explaining digital maturity although it highlights a different element involved in it: *Teaching innovativeness*. In fact, it is made of 10 variables (Tab. 4), which account mostly for tools and methods of the training process. The third factor explains 5% of variance and is made of 7 variables (Tab. 4), highlighting the relevance of soft skills for the digital maturity, and for this reason it is called *Soft skills*, Then, it catches the capacity of the University to teach soft skills to the students. The fourth factor explains the 4% of total variability and is made of 7 variables. It describes the perception of students to be enrolled in the job market after their studies, so it has been called *Eemployability.* The last factor, namely *Positive relationships*, and it explains the 3% of total variability, since it is mad of 2 variables: students are respectful towards peers, and their being at ease with peers. Then, It catches the students' trustful positive sentiment of being in relations with others.

STUDENTS' DIGITAL LEARNING STYILES

To address RQ3 factors have been used to classify students by means of cluster analysis. Cluster analysis helps in highlighting groups of units that are meant to be similar to each other with respect to some criteria. After having explored by a dendrogram the proper number of clusters, the k-means analysis has been carried out.

Seven clusters have been selected. Their interpretation can be done by observing means of cluster centroids (Tab.5) that help in providing a name for each cluster.

Table 3: cluster centroids

Cluster number & label		Digit. Tuning	Teaching Innov.	Soft Skills	Employab.	Positive Relation.
1	Job focused	-0,9	-0,42	-0,05	1,07	0,43
2	Task Oriented	-0,1	0,28	-1,75	-0,56	0,23
3	Cosmic Pessimists	-1,05	-1,39	-1,05	-0,39	-0,91
4	Self-realizaton Focused	0,7	0,52	0,04	0,4	0,38
5	Teacher Centered	-0,6	0,94	0,32	-0,2	-0,75
6	Lone Rider	0,7	-0,71	0,17	0,23	-1,42
7	Social	0,12	-0,56	0,7	-0,92	0,64

Job focused: is a group of 162 students representing the 14.1% of the total sample. They are focused mostly on the *employability* and seems to be less interested in digital. Task-oriented: is a group of 102 students representing 8.9% of the entire sample. They are interested on average to all the digital components but the *soft skills*. They seem to be practical and effective not really caring to relational effectiveness. Cosmic Pessimists: is a small group of 56 students (4.9%) interested in none of the digital components but are the employability. Perhaps they are not favourable to digital training. Self-realization Focused: is the largest group of students (307 representing 26.7%) interested in all the aspects highlighted by latent factors, and they are definitely *digital tuned*. Teacher Cantered: is made of 179 students (15.6%). It does not care about peer's relationship but focuses mostly on *teaching innovativeness* rather than being *digitally tuned.* Lone Riders: is a group of 117 students (10.2%), and It is the reverse of teacher oriented one. Both groups don't focus on peer's relationship, but these students are highly *digitally tuned* and don't care about *teacher innovativeness*. Social: is a large group of 225 students (19.6%) mostly interested in the relational activities surrounding education. They are

cantered on *soft-skills* and *positive relationship,* and they do not really focus on employability and care less about teacher innovativeness

To address RQ4 the analysis of variance, henceforth ANOVA, has been carried out. ANOVA is an inferential method for comparing means of several groups. The test analyzes whether the difference observed among sample means is still reasonable true in the populations. ANOVA compares two types of variability of the data: the variability between groups and the variability within groups. The larger the variability between groups relative to the variability within groups the larger the value of statistic test used to carry out the conclusion. Farther distance between variabilities means data support the hypothesis the means are statistically different.

Here, we use the multivariate technique to address the difference of the average of latent components is not due to the causality but to a given reason, such as the university affiliation.

Among several assumptions to properly carry out ANOVA is that the level of variance of a given variable is constant across groups. The following table shows the value of statistic test for each latent component and the related p-value. Since p-values are not statistically significant (given a level of significance equals 0.01), then we can accept the homogeneity assumption.

Table 4: homoscedasticity test result

Components	Statistica di Levene	df1	df2	Sig.
Digital Tuning	1,568	5	1142	0,166
Teaching Innovativeness	1,792	5	1142	0,112
Soft Skills	2,81	5	1142	0,016
Employability	0,787	5	1142	0,559
Positive Relationship	2,408	5	1142	0,035

Due to the result gained in Table 4, we can proceed with the analysis. By comparing, component by component, the variability between groups and within groups, we can conclude that the average of the digital maturity is different in the latent components (test is statistically significant -Table 5).

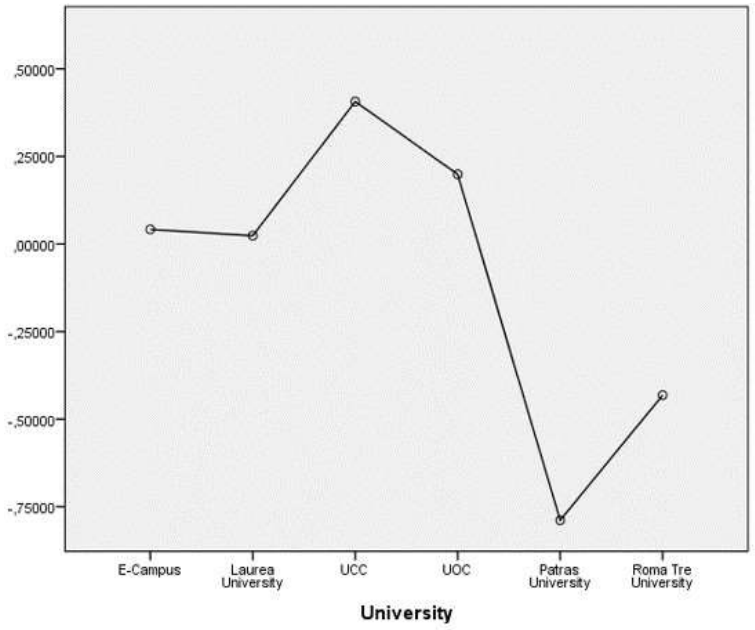
To better appreciate the difference among latent components average values across universities, the following graphs plotting means of latent components by universities. Digital Tuning seems to have a trend similar to digital maturity (Figure 1). The most tuned students are those from Spain and Ireland, two university with a long experience in digital training, followed by the Italian digital university and the Finnish one. The traditional university's Italian students are less *digitally tuned*, being however significantly more tuned than the Greeks. In fact, digital tuning seems to be related to their familiarity with the digital higher education environment.

Table 5: ANOVA result

		sum of sq.	df	Sq.average	F	Sig.
Digital Tuning	between groups	128,516	5	25,703	28,82	**0,000**
	within group	1018,484	1142	0,892		
	Total	1147	1147			
Teaching	between groups	99,251	5	19,85	21,636	**0,000**
Innovativeness	within group	1047,749	1142	0,917		

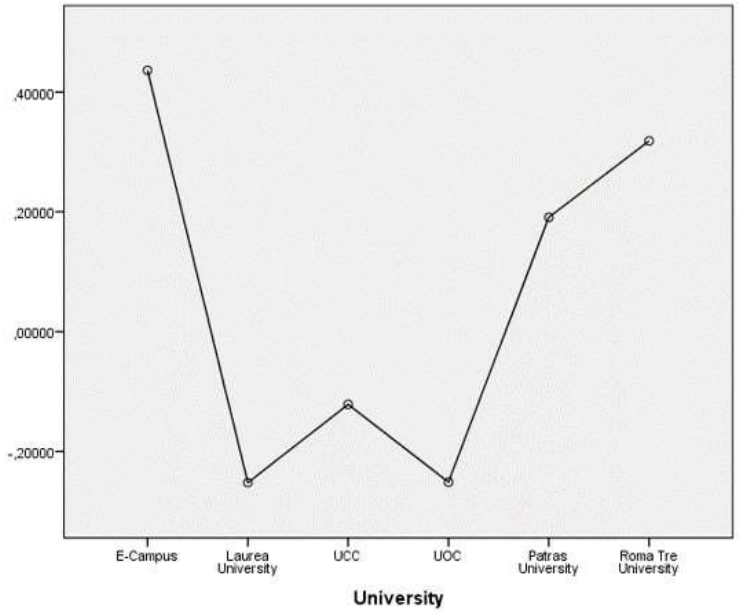
	Total	1147	1147			
Soft Skills	between groups	95,293	5	19,059	20,695	**0,000**
	within group	1051,707	1142	0,921		
	Total	1147	1147			
Employability	between groups	166,501	5	33,3	38,785	**0,000**
	within group	980,499	1142	0,859		
	Total	1147	1147			
Positive	between groups	276,672	5	55,334	72,607	**0,000**
Relationship	within group	870,328	1142	0,762		
	Total	1147	1147			

Figure 1: Digital tuning vs Universities



With regard to innovative teaching, as can be seen from the graph (Figure 2), two elements intervene: the level of digital maturity of the country and the disciplinary area of the students. Indeed, the students of the Italian and Greek universities seem to be more enthusiastic about teaching innovation than Finnish, Irish and Spanish. Probably, in digital mature countries, students are more critical on digital teaching and learning, resulting less satisfied. Conversely, students from countries still developing their digital structures and practices, students seem to be more enthusiastic. However, the Greek students are less enthusiastic than the Italians even though they are less critical than the Spanish, Finnish and Irish. It can be assumed that this is due to the type of training of these students, often coming from faculties of natural sciences such as engineering, who have greater competences and familiarity with digital processes.

Figure 2: Innovative teaching vs Universities



Finnish and Irish students consider soft skills more important than Italians (Figure 3). The Italians give them less importance as well as the Greeks who consider them less important than all. Attention to soft skills seems to be connected with the type of student interviewed. Students enrolled in faculties of natural sciences, like Greeks, seem to have less attention for this type of skills. Humanities students tend to pay more attention to this aspect.

This factor makes the difference between digital and traditional universities (Figure 4). The graph highlights how Finnish Greek and Roma Tre students are most interested in using university education to enter the world of work, while E-Campos and Finnish students seem to be interested in career opportunities. Digital universities probably do it because they already have a job, while those who choose traditional universities follow a classic path that takes people from high school to university, and subsequently enter the job market.

Between the two digital universities, the Spanish one seems to have students less interested in the possibility of entering in the job market. This is probably because Spanish students are already wormking and chose the digital university to fit their education and their working life. Wh ile E-Campus has a younger target that not necessarily is already working.

Figure 3: Soft skills vs Universities

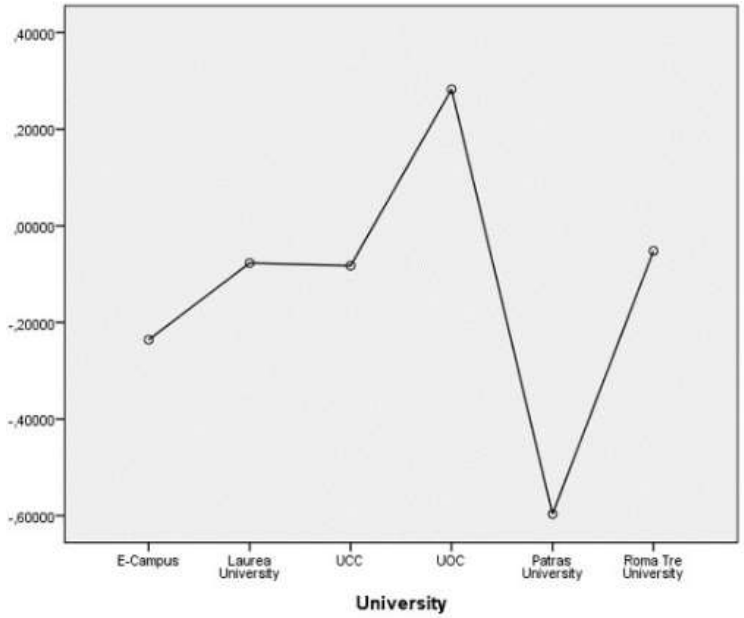
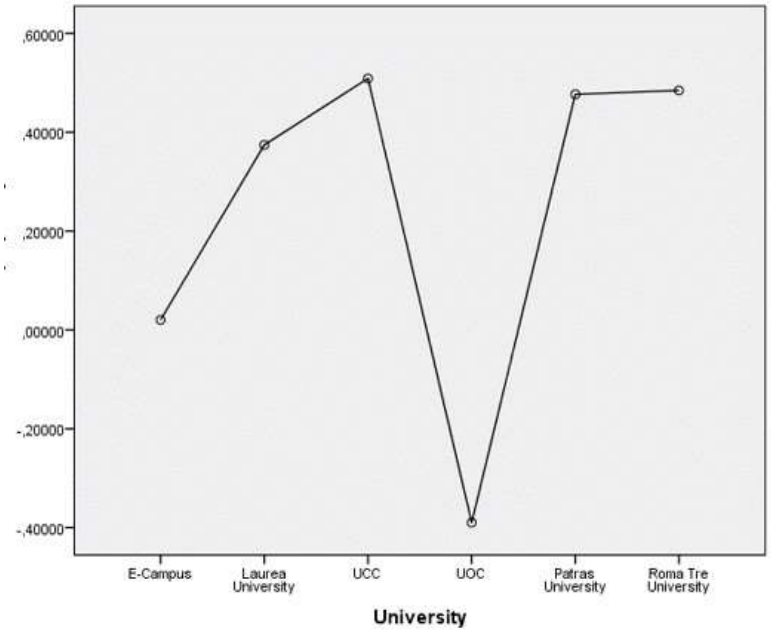
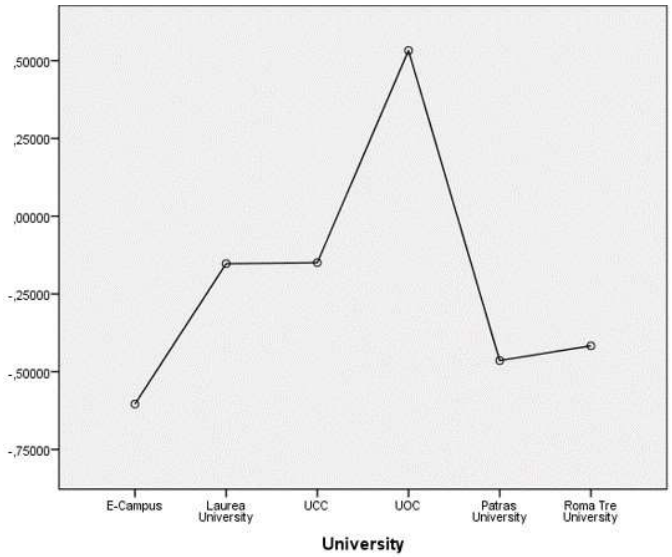


Figure 4: Employability vs Universities



Spanish, Irish, and Finnish students are the most caring to the relationship with peers, even if Spanish students stand out from all the others by showing a greater sensitivity to this aspect (Figure 5). Italians and Greeks seem to show less interest in this aspect. One possible explanation could be that these students take this for granted, just as Spanish students showed less interest in job placement in their questionnaire responses because they are probably working students.

Figure 5: Positive relations vs Universities



CONCLUSION

ECOLHE is a three-year project involving six partners from five European countries (Italy, Spain, Finland, Greece, Irelnd) characterized by a different digital development process and Digital Economy and Society Index (DESI) value. This work illustrates the results of an online survey involving 1148 students from online and traditional universities in the partner countries. The data was collected by means of a self-administered questionnaire aimed at investigating the elements deemed relevant for students' digital learning and training. The results of the multivariate analysis made it possible to identify five components characterizing digital maturity and seven digital learning styles. Finally, the comparison between the universities involved made it possible to understand the effect that teaching practices had on the perception of students in terms of effectiveness and efficiency. Some factors, such as DESI, starting time of country digital development, type of university, traditional or digital, type of faculty, natural science or human and social sciences, working student, seems to be associated with students' perception of the digital teaching and learning practices.