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Moving Education to Cloud: A pilot Study in Montenegrin Higher Education

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Abstract
The paper considers challenges of moving education into Cloud under the conditions of digital divide. The content of the paper is divided into two parts. In the first one, the focus is on digital divide, since it greatly affects the issue. In the second part, a model for adapting Cloud in higher educational environment is proposed, with the emphasise on the needs of so-called developing countries, which suffer consequences of digital inequality. The statistical analyses of the survey conducted on the basis of the proposed model have been made at two universities in Montenegro (South-East Europe). Moreover, brief conclusions along with some guidelines for the future research work in the field are given.

Keywords: *education, digital divide, developing countries, model for adopting Cloud*

Introduction

Differences in the level of education of individuals are among the major causes of digital divide. This cause-and-effect relationship is multiple and can be explained by several theories. According to diffusion of innovation theory (Rogers, 2003), complexity is the main obstacle to the adoption of new technologies. Therefore, the simpler a technology is, the sooner it gets accepted. Education plays a key role here. More educated people are more willing to cope with more complex problems and effectively overcome the requirements set by new technology. In other words,

a higher level of education makes it easier to overcome the barrier to the use of new ICTs (Information and Communication Technologies). Higher education enables a better acceptance and understanding of information, which again leads to informational divide between those with higher and those with lower levels of education. This is basically the main argument on which theory of educational differences relies (Tichenor, 1970). The theory is developed in the context of mass media spread (TV, radio, etc.). Namely, Tichenor et al. (1970) claim that the infusion of mass media information into the social system is on the rise in a way that a portion of the population with a higher socio-economic status adopts information faster than the part of the population with a lower status of this type, which shows that the disparity has a growing trend rather than declining one. If this is the case with mass media, which are far less complex and demanding than the Internet, in the case of the Internet, the previously identified problem of divide will be even more emphasized.

The mass media technologies are not as demanding as ICTs, as they do not require much engagement on the part of their users. Instead of being only the recipients of what is offered to them, as is the case with unilateral mass-media content, users are required to navigate through a large amount of information by ICTs. In addition, in the case of the Internet, although availability is a prerequisite, it is not sufficient *per se* to achieve all of the advantages that this technology can bring, so the important differences can remain in the domain of the nature of its use. Vicente & Lopez (2006) note: not only does a user need access to infrastructure, but one also needs the ability to access information, i.e., the ability to find and use it properly.

The hypothesis that educated people will work in information-intensive industries, i.e., that they will use ICTs more intensively both at work and at home, makes sense. In accordance with this, Howard et al. (2001) came to a conclusion that more educated people use the Internet more productively and with a higher economic impact compared to those with a lower level of education. Peng et al. (2011) have shown that people using PCs at work and at school are more likely to adopt new ICT solutions. Tengtrakul & Peha (2013) have shown that the higher educational level of a student, the greater the possibility of accepting ICT in households (which these students belong to), etc.

It becomes clear that there is a positive correlation between the level of education, the socio-economic opportunities of individuals and the adaptation of new ICT systems. Implicitly, this hypothesis could be also extended to the use of Cloud in the generation and dissemination of knowledge.

Moving education into Cloud in developing environments

Today, when it comes to using computer infrastructure, various platforms and software solutions, Cloud computing is an ubiquitous paradigm which has introduced significant changes in the way services are provided. Simply, Cloud computing is Internet-based computing. Cloud can also be described as a set of clusters of distributed computers (with farms of servers, as enormous centres for data collection and processing), which provide resources and services via network medium, i.e., the Internet. Customers used to deploy applications installed on their own (physical) computers or company (local) servers, while today these applications are moved to Cloud. For example, when users check their g-mail account, bank account status online, or update their facebook status – they are, in fact, in Cloud.

The question is why such a large number of activities, including education, is moved into Cloud? Numerous literary sources say that this is in order to increase the flexibility and scalability of user needs, to free the users of capital investments in infrastructure and software, "pay as you go" services, as well as automatic software updates, increasing the possibilities of collaboration, the ability to access resources from any place, more efficient group work on the same projects, increasing competitiveness (SUK&IB, 2015), etc.

Apart from this, we are undoubtedly faced with an expansive and less controllable growth of technical forms of material culture, which we are often, in a certain way, forced to adopt. It is, in fact, a kind of imperative of the new digital era. On the other hand, education is more and more treated as an expense, rather than an investment (and not only in developing countries, but also in developed ones). So, this is also one of the reasons for moving education into Cloud. All the challenges of moving education into Cloud in developed parts of the world are even more emphasised in developing environments, and that is, above all, willingness to manage knowledge and (confidential) human resources data in Cloud. Therefore, by taking into account contextual factors, socio-economic and political constraints, above all, an attempt has been made to propose a model for the implementation of Cloud in the developing environments.

If we start off with the assumption that the increase in the adoption of Cloud services will be present in the field of education (especially higher and lifelong) in developed countries, indisputably, new opportunities in this domain will arise for developing countries, as well. For these countries, small capital investments and flexibility in the use of resources are of particular importance. By opening Cloud capabilities, developing countries should be able to use the same infrastructure and resources as technologically highly developed countries (Kshetri, 2010).

Methodology

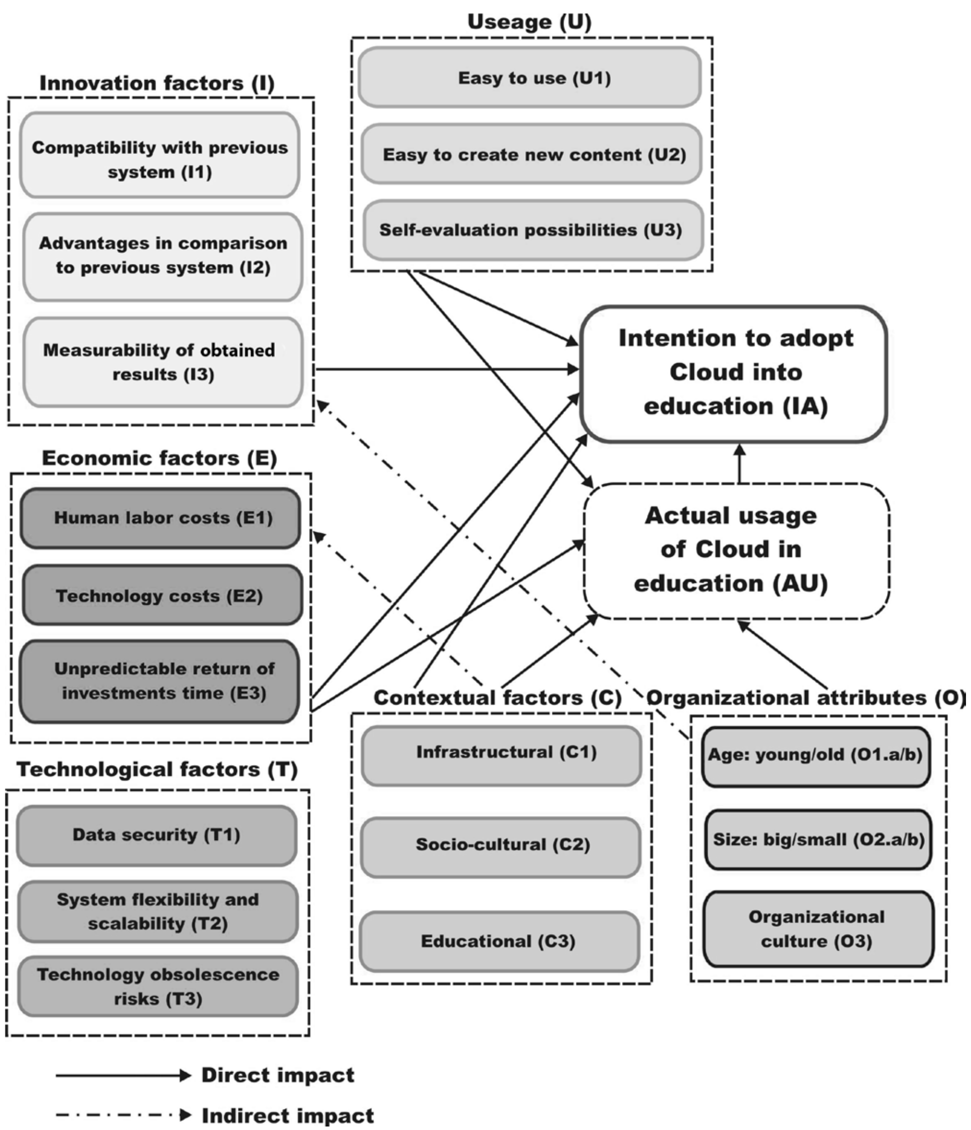
In developing countries, there is very little preliminary research on the adaptation of Cloud resources in education. The model proposed here (cf., Figure 1) is inspired by a study which was carried out in sub-Saharan Africa (Humphrey, 2016), and it was slightly modified in accordance to the conducted pilot study requirements. The model represents the basis for designing a questionnaire, by means of which the readiness of the higher education institutions in the developing country (Montenegro) to implement this type of education, could be analyzed. The model is based on triangulation (reconciliation) of two theories of adoption and expansion of ICTs: theory of diffusion of innovations (Rogers, 2003) and theory of a technologically acceptable model (Davis, 1989).

The model, which is proposed here includes one *dependent variable*: intention to adopt Cloud into education. The *independent variables* in the model are organized in several subgroups: innovative, economic, technical, contextual and organizational factors (attributes). The last, but not least, is the independent variable: actual use of Cloud in higher education. In Figure 1, direct and indirect links between dependent and independent variables are presented.

The main hypoteses on which is based the model, are as follows:

- H1: Innovation factors are positively correlated with the tendency of introducing Cloud computing into higher education;
- H2: Economic factors (costs and unpredictable return of investments) are negatively correlated with the introduction of Cloud;
- H3: Technological factors (data security, system flexibility and scalability) are positively correlated with the adaptation of Cloud computing in this domain;
- H4: The technological factor related to obsolescence risks, on the other hand, is negatively correlated with the introduction of Cloud;
- H5: Simplicity of use, easiness to create new content, and self-evaluation of possibilities are positively correlated with the adoption of Cloud;
- H6: The availability of ICT infrastructure, developed socio-cultural and educational factors are positively correlated with the introduction of this new concept into education;
- H7: The age of the user is negatively correlated with the Cloud adaptation. In other words, young people are usually for innovation, unlike the elderly generation;
- H8: The size of organization is positively correlated with the adoption, i.e., a larger higher education organization will easily adopt Cloud;

Figure 1. Relations between relevant factors for moving education into Cloud



H9: Organizational culture is positively correlated with the adoption;

H10: The level of the actual use of Cloud for educational purposes is positively correlated with its future more extensive use.

The proposed model and above-mentioned hypotheses show to what extent the considered factors influence the intent to adopt, i.e., to use Cloud computing/services in transfer of knowledge, with an emphasis on the developing environment.

The survey analysis and the obtained results

A survey based on the previously presented model was conducted with the use of creating and sending questionnaires to the professors and post-graduate students of two universities in the Western Balkan country Montenegro: the University of Montenegro (UoM), which is public, and Medditeranean University (MU), which is private. In total, 20 professors and 20 post-graduate students from both universities were interviewed. Analysis of the responses shows correlations between dependent and independent variables in the model, as well as some inter-correlations between considered items.

A preliminary version of the questionnaire was sent to the experts so that they could give their recommendations, and by doing so, improve clarity, i.e., avoid the of the questions. The respondents used a five-point Likert type scale (range: 1-strongly disagree to 5-strongly agree) in aswering the questions. The SPSS-Statistical Package for Social Science (ver.17) was used in the analysis of the responses from this pilot study (Coakes, 2013; Pallat, 2011). Table 3 presents the descriptive statistics for the model's key constructs: innovation (I), economic (E), technical (T1-data security, T2-system flexibility and scalability and T3-technology obsolescence risks); usage (U); contextual (C), organizational (O1.b-big institutions, O2.a-younger users and O3-organiational culture) and actual usage of Cloud services in education (AU) factors.

According to the statistics presented in Table 1, it is clear that there is a strong positive correlation between the dependent variable intention to adopt Cloud into higher education (IA) and independent variables: innovation (I), technical (T1-data security), usage (U), organizational (O2.a – organizational size-big and O3-organizational culture) attributes, and actual usage of Cloud (AU). Further, there is a positive correlation between IA and T2-system flexibility and scalability, and C-contextual factors. This confirms hypotheses: H1, H3, H5, H6, H8, H9 and H10. On the other hand, the dependent variable IA is in a strong negative correlation with the independent variables: economic (E3-unpredictable return

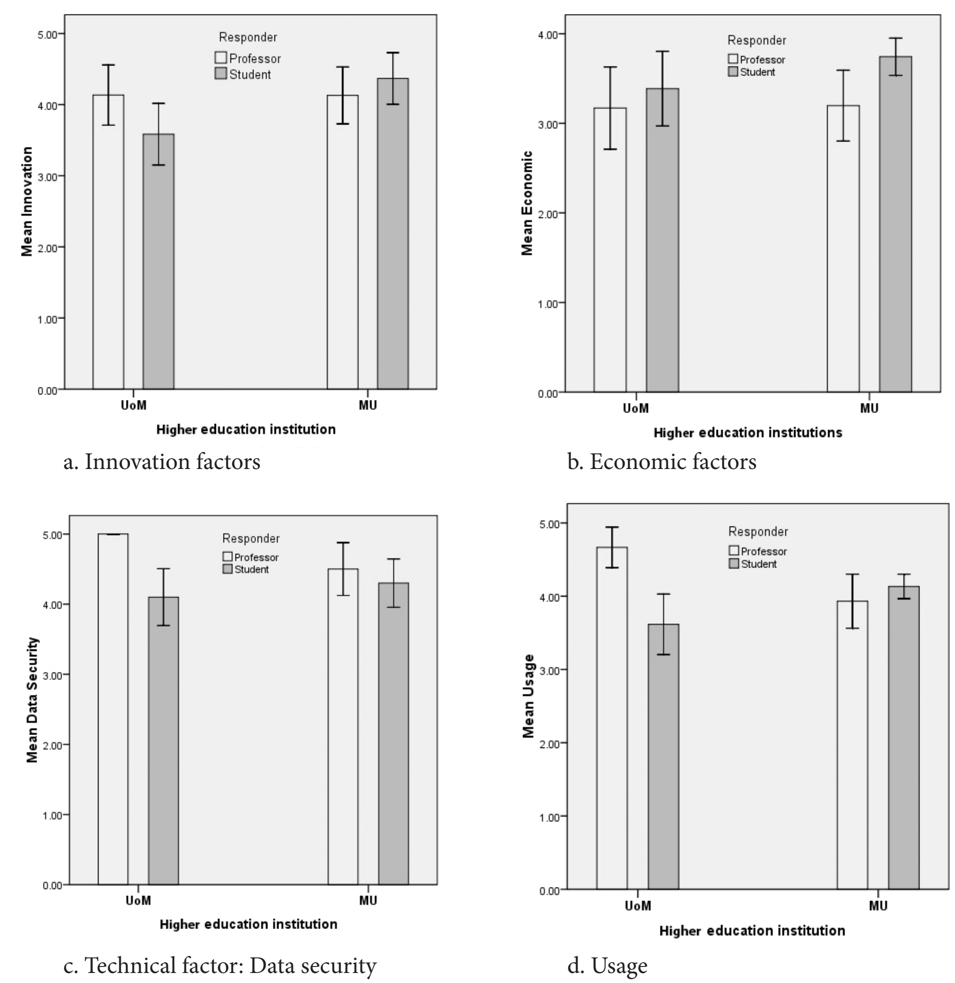
Table 1. Means, standard deviation (SD) and correlations

Const.	(N=40)		Correlations in the overall sample (N=40)											
	Mean	SD	I	E	T1	T2	T3	U	C	O1.b	O2.a	O3	AU	IA
I	4.0537	.61797	1											
E	3.3743	.56273	-.173	1										
T1	4.4750	.55412	.288	-.212	1									
T2	3.8250	.63599	.255	-.030	.242	1								
T3	2.8000	.72324	-.343*	.453**	-.333*	.145	1							
U	4.0867	.57834	-.338*	-.209	.427**	.426**	-.140	1						
C	4.0793	.35410	.259	-.246	.280	-.126	-.286	.096	1					
O1.b	2.0000	.78446	-.179*	.422**	-.413**	-.257	.542**	-.329*	-.198	1				
O2.a	4.2500	.58835	.306	-.373*	.570**	.394*	-.181	.612**	-.058	-.222	1			
O3	4.0250	.69752	.389*	-.218	.300	.126	-.477**	.523**	.198	-.281	.484**	1		
AU	2.5000	.90582	.448**	-.570**	.485**	.245	-.470**	.452**	.165	-.541**	.577**	.507**	1	
IA	4.5500	.59700	.476**	-.483**	.633**	.328*	-.570**	.648**	.313*	-.602**	.694**	.582**	.759**	1

Pearson:
*Correlation is significant at the 0.05 level
**Correlation is significant at the 0.01 level

of investments), technical (T3-technology obsolescence risks), and organizational (O1.b-older users) attributes. This is in accordance with hypotheses: H2, H4 and H7. Therefore, it can be concluded that the initial hypotheses are verified by the polls. Figure 2 presents diagrams in which there are shown: (a) innovation; (b) economic; (d) technical factor (data security), and (d) usage mean values, which are estimated by the respondents, i.e., professors and post-graduate students at the University of Montenegro (UoM) and Mediterranean University (MU). These factors are evaluated as those of quite high importance for adopting and routinizing Cloud in two analyzed higher education institutions in Montenegro.

Figure 2. UoM and UM respondents' assessments of some of the key construct in the model



a. Innovation factors
b. Economic factors
c. Technical factor: Data security
d. Usage

Statistics reliability

Due to the results of this pilot study, it is obvious that the respondents highly assessed the innovation and economics factors. Also, they highly appreciated the usage easiness and extremely appreciated data security.

In order to ensure that the questions in the survey for each construct correspond well to the attributes of the constructs, the Cronbach alpha reliability test was used. Cronbach's alpha is a statistical measurement used for determining the internal reliability of a survey instrument to ensure outputs from the measurements are consistent in producing similar results at different times (Coolican, 2014). The results of the test are shown in Table 2. They are obtained after removing the following items: E3-unpredictable return of investments, T3-technology obsolesce risks and O1.b-organizational attribute-older users, which corresponds to hypotheses H2, H4, H7, and which are in this case negatively correlated to the dependent variable in model IA.

Table 2. Reliability statistics

Constructs	Cronbach's alpha
Innovations factors (I)	0.840
Data security (T1)	0.832
System flexibility and scalability (T2)	0.856
Usage (U)	0.825
Contextual factors (C)	0.861
Size of organization – big (O2.a)	0.821
Organizational culture (O3)	0.833
Actual usage of Cloud in education (AU)	0.823
Intention to adopt Cloud into education (IA)	0.803

The Cronbach alpha value of 0.7, or higher, indicates good internal consistency of the items in the scale (Gliem & Gliem, 2003). It means that the selected instruments in the proposed model have good consistency. Additionally, factor analysis was made in SPSS, and the following constructs are identified as those of key importance: T2-system flexibility and scalability, U-usage, O2.a-organization size-big, and IA-intention to adopt Cloud. The selected factor loads (l) and error variances (e) are presented in Table 3.

Table 3. Selected factors loads (l) and error variances (e)

Constructs	Factor load (l)	Error var. (e)
System flexibility and scalability (T2)	0.752	0.434
Usage (U)	0.774	0.401
Size of organization – big (O2.a)	0.798	0.363
Intention to adopt Cloud in education (IA)	0.603	0.636

The average variance extracted (AVE) and composite reliability (CR) are calculated by Eq. (1) and Eq. (2):

$$AVE = \frac{\sum \lambda^2}{n} \quad \dots (1)$$

$$CR = \frac{\left(\sum \lambda\right)^2}{\left(\sum \lambda\right)^2 + \sum \varepsilon} \quad \dots (2)$$

Where, l is load factor, e is error variance, and n is number of load factors. The values obtained for AVE and CR are respectively: 0.541 and 0.823. Since the threshold for convergent validity is AVE>0.5 and for reliability CR>0.7 (Hair et al., 2010), it can be concluded that both conditions are satisfied for the selected items. The results obtained by the pilot study provided initial support for the model constructs, while some constructs are removed. Also, some additional checks of clarity should be done before the study survey is executed in the next turn. This might be the subject of further, more rigorous and extensive investigations in the future work.

Conclusions

In the literature, there are different answers to the question if higher education should be moved into the sphere of Cloud. Some sources advocate the transition to Cloud as the only acceptable solution today, as the imperative of the new digital age, which ensures higher efficiency in education (SUK&IB, 2015; Ellucian, 2016). Others look at this transition primarily as an attempt to reduce the cost of education, especially higher one, but not as an entirely successful attempt. Moving from well-established, traditional, routine face-to-face education to new forms of technologically supported education creates greater initial costs, alongside with uncertain outcomes (Bown, 2013).

Despite the divided opinions, it can be concluded that the decision to move education to the domain of Cloud computing/services still depends on individual preferences and numerous contextual factors, especially in the developing regions (countries), where a noticeable digital divide is still present.

Due to the conducted statistical analysis through the pilot study realized at the University of Montenegro (UoM) and Meditteranean University (MU), it can be concluded:

(a) There is a **strong positive correlation** between the dependent variable *intention to adopt Cloud services in higher education*, and the following independent variables:

- Actual use of Cloud services (0.759);
- Organizational attribute: younger users (0.694);
- Usage factors: easy to use, easy to create new content and self-evaluation possibilities (0.648);
- Technical factor: data security (0.633);
- Organizational attribute: organizational culture (0.582);
- Innovation factors: compatibility with previous systems, advantages in comparison to previous systems and measurability of obtained results (0.476).

(b) On the other hand, there is a **strong negative correlation** between the dependent variable *intention to adopt Cloud services* in higher education, and the following independent variables:

- Organizational attribute: small organization (-0.602);
- Technological factor: technology obsolescence risk (-0.570);
- Economic factor: unpredictable return of investments (-0.483).

Further research work should be done to develop efficient approaches for the assessment of real needs, when it comes to providing access, adopting and deploying new ICT solutions for generating and distributing (new) knowledge. In other words, solutions that suit the individual needs and abilities of diverse educational entities should be sought in the regions (countries) with different geo-locations. The multidimensional nature of accepting ICT innovations brings with it different levels of acceptance, which cannot be explained exclusively by economic and technological factors, but must inevitably involve socio-cultural factors, as well. In developing countries these factors are significantly different from those in (highly) developed countries.

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