Cloud Computing in Education and Student's Needs

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Abstract: Cloud computing is not just a buzz-word, it represents a strong direction of IT industry development. Speaking of cloud computing we should distinguish three different service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). The scope of this work is a model of Software as a Service. This represents the lease of computing resources on a network of remote servers where applications are executed and data is stored. The application of cloud computing is very broad and growing daily because of many advantages to the users, and is driven by the increasing use of various mobile devices (laptops, tablets and smartphones) and mobile Internet access being more available. Cloud computing is applicable in education, but it implies the acceptance of these services by all involved in the educational process. Therefore, the aim of this paper is to investigate whether there is a need between our students for applications and services in the "cloud" (SaaS), the extent to which they use them and what types of applications and services are leading. The paper analyzes and interprets the results of this study which provides indications of students' willingness to "move to the cloud".

Keywords: cloud computing, Software as a Service, education, students

I. INTRODUCTION

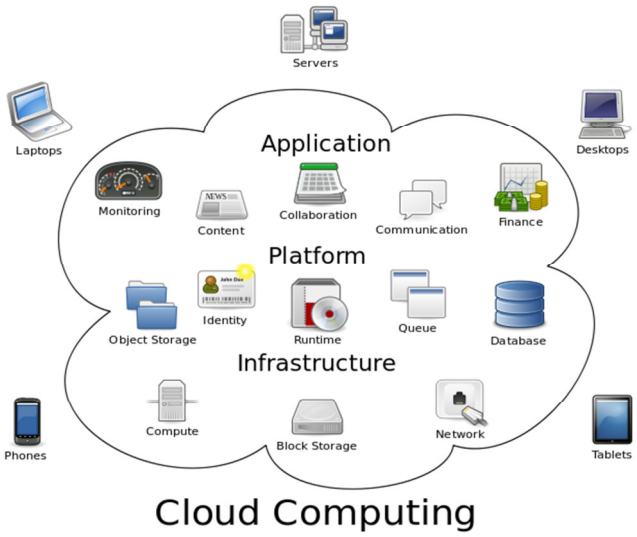
In the last couple of years "cloud computing" has increasingly been discussed. This is a relatively new trend of IT industry development, focused on users, and driven by the increasing use of various mobile devices such as laptops, tablet PCs and smartphones. Research has shown that it is one of the fastest growing sectors of the digital economy. European governments and industry plan to invest 45 billion euros in the development of cloud computing by the year 2020 [15]. In cloud computing networks of remote servers, storage systems (data centers and server farms) and their resources are being used upon user request. Term "cloud" is used as a metaphor for the Internet since it doesn't matter where the hardware and software resources that are used are located [14]. For IT professionals cloud computing is a new business model and a new technology platform for developing and deploying applications, and for end-users a new and cheaper way to use applications [3]. Cloud computing has many advantages but also some limitations, both arising from the fact that all data and applications are located somewhere on the Internet. It can be used in various activities of everyday life, including in education. In addition to providing students and teachers (usually free of charge) access to many applications and services in the cloud, which can be used in formal and informal education, cloud computing allows for greater flexibility and mobility in the use of resources for teaching and learning, greater degree of collaboration, communication and sharing of resources, and creates a personalized learning environment or virtual communities of learning and teaching.

II. THEORETICAL FRAMEWORK

National Institute of Standards and Technology of U.S. Department of Commerce defines cloud computing as a „model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction“ [10]. Gartner defines cloud computing as a „style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service using Internet technologies“ [16]. „For everyday users of the Internet and computers, cloud computing is any online activity, such as accessing data or using a software program, which can be done form different devices regardless of the on-ramp to the Internet, as in Figure 1. In this vision, the data or software applications are not stored on the user's computer, but rather are accessed through the web from any device at any location a person can

get web access.“ [6]. For end-users, cloud computing means that you don't have to worry about maintaining hardware or purchase new equipment, obtaining software licenses, updating or upgrading existing software, data synchronization, etc. because all of these are included in the "cloud" service. One can say that cloud computing is the new driver of IT revolution, in which new IT services are being developed, changing the ways of access, usage, maintenance and financing services on demand. Cloud computing is characterized by scalability (extent and amount of used resources according to the needs of the application and paid on the actual use of resources), mobility and platform independency (the ability to access anytime, from any location and device). There are three types of cloud computing: Infrastructure as a Service (IaaS) is the hardware component with different forms of virtual technology rentals, platform as a service (PaaS) involves the use of the operating system and development tools in the cloud and software as a service (SaaS) which refers to the use various web-based applications that run and execute on the server [12]; [3]. These models differ in the type and extent of resources accessed and managed by users. Connecting to the cloud and using "hidden" resources enables sharing of information always and everywhere, great application scalability, service availability anytime and anywhere, data security, storage, backup copies, and more [4]. „The potential benefits of adopting cloud computing can be assessed from both the financial savings and resource management perspectives“ [8].

Figure 1. Representation of cloud computing



Source: http://en.wikipedia.org/wiki/Cloud_computing

III. CLOUD COMPUTING IN EDUCATION

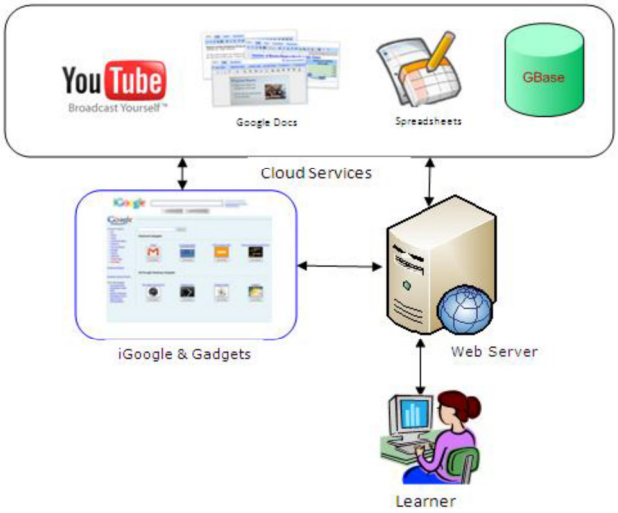
According to [11], „the potential of cloud computing for improving efficiency, cost and convenience for the educational sector is being recognized by a number of US educational establishments. For some universities, the availability of an awesome computing power through cloud computing for research purposes was welcome“. „Many educational institutions have begun their movement to cloud computing by outsourcing their student email provision … Educational institutions are also beginning to use lower level cloud services for purposes such as data storage. This may be attractive where data security is of lower concern such as where video and audio is provided as open educational resources. Another use of cloud computing which is beginning to emerge in education is for the hosting of institutional learning management systems (LMSs) in the cloud. Outsourcing the provision of LMSs such as Blackboard or Moodle to a third party makes sense for institutions who cannot justify the costs of purchasing, maintaining and supporting the hardware and software themselves“ [5]. Cloud computing is often associated with e-learning and m-learning [9]. This refers to e-learning environment mainly distributed on the cloud, in which Open Educational Resources were produced, researched and shared by participants worldwide [7].

With applications in the cloud (SaaS), students and teachers can flexibly access their data via a web browser from a computer at home, school, library, student room or some other place, and achieve rapid and efficient communication, collaboration, exchange or share documents, contacts, notes, audio / video and other data. With their use students can create „Cloud-Based Personalized Learning Environment“ (Figure 2) [1]. "The first idea that comes to mind when assessing such a cloud space for learning, would be the creative potentials that could be nurtured i.e. the endless ideas, thoughts and knowledge that could be shared, created and inspired" [7].

In addition to individual applications in the cloud, bundled applications are also available (eg. Google Apps for Education or Microsoft Live@edu with Office 365 and other applications for Education) that combine tools for communication and collaboration, office tools for working with documents, and space to store and synchronize data on demand. „Whereas a university computing service department may aim to achieve 99.5% availability for its educational services such as the LMS, Google offers 99.9% availability for its educational application suite and appears to outperform this target „ [5].

Using services and applications in the cloud, students and teachers can achieve mobility because their educational resources and necessary applications are available via portable computers and Internet-connected devices. For example, classes can be implemented outside the school / faculty or students can perform duties at various places.

Figure 2. Example of Cloud-Based Personalized Learning Environment



Source: Al-Zoube, M. [1]

According to Kop and Carroll, „cloud computing has the potential for new interaction metaphors and new ways of thinking about learning design and learning experiences“. However, capabilities of cloud computing should be recognized by all participants of educational process in order to find its uses and application in education. According to Gartner analysis the cloud is used for "school and educational services" by only 4% [2]. Another research [9] shows that only 12% of respondents are familiar with the use of cloud computing in education while 88% of them would agree that cloud computing should be implemented in the education sector.

IV. PROBLEM AND HYPOTHESES

The broader problem domain of this paper is to investigate the preconditions for the implementation of cloud services and applications in higher education. This implies the acceptance and active use of such services by students and teachers. The study is focused on the use of cloud services (SaaS) for students. The reason for selecting students as a target population of research lies in the fact that students are increasingly dependent on online services for learning and assessment [5].

The aim of this study is to determine if students show a need for cloud services and applications (SaaS) and how often they use them. It also aims to investigate the relationship between the reported need for cloud services and their active use, since it may not always be correlated. According to goals, the following null hypotheses are posted:

H1a: There is no significant difference in reported need for cloud services between male and female students.

H1b: There is no significant difference in reported use of cloud services between male and female students.

H2: There is no positive correlation between reported need for cloud services and frequency of use them.

H3: There is no positive correlation between number of devices from which students access the Internet and frequency of cloud services use.

V. RESEARCH METHODOLOGY

Research began in November 2012 and lasted until mid-January 2013. The subjects of this study were students from the University of Rijeka. For the purpose of this research a questionnaire (consisting of three sections) was created in GoogleDocs - Forms and distributed online. The first section collected general data about the respondent (gender, faculty, year of study) and data on the use of computers (number of computers and similar devices, frequency of accessing Internet). This was followed by eight statements in which participants estimated the frequency of situations indicating the need for cloud applications and services, based on a 4-point scale. The third section of the questionnaire contained 10 questions about the frequency of use of cloud applications and services. Here we listed cloud applications and in parentheses names of the most popular ones from categories, for respondents to be clear on what the question was about. In statements and questions in the second and third section of the questionnaire, the responses were given on a 4-point frequency scale (1 = none, 2 = rarely, 3 = sometimes, 4 = often / very often). The questionnaire was distributed through the website of the Student Union, Polytechnic of Rijeka. The survey was anonymous, and the questionnaire was completed by 158 students. Empirical data were analyzed using descriptive statistics, and hypothesis testing was done using nonparametric tests: Mann-Whitney U test and Spearman correlation.

VI. RESULTS AND ANALYSIS

The questionnaire was completed by 158 respondents; 58% males and 42% females. The proportion of students was 78% from the Informatics study program and 22% from other study programs; all from the Polytechnic of Rijeka. A vast amount of the students (90%) attended professional studies (first 3 years), and only a small proportion of students (10%) were from specialized studies (4th and 5th year).

On the question "Which devices do you use for accessing Internet and data?" respondents could select multiple answers, and distribution is shown on Figure 3. The respondents mostly use laptop computers (74%) and smartphones (67%) indicating their mobility. A lower number of users selected desktop computers at home (64%) and faculty (54%), and the smallest

number used tablet computers (13 %), and ultra-portable computers (5%).
Respondents reported the frequency of Internet access, and responses were grouped into three categories: weekends or a few times a week (5%), several times a day (18%), all of the time or whenever I get an opportunity (77%). Another survey by [17], on a population of 15-30 years, indicates that 80% of respondents use online services daily, and nearly 50% use the Internet via mobile phone [17].

Items with statements about frequency of situations that indicate a need for services in the cloud are grouped by category of service to which the statement relates. Respondents expressed the frequency on a 4-point scale, and the distribution of responses is shown in Table 1. These data show that the respondents expressed the greatest need for communication software to the cloud, then cloud multimedia sharing, cloud docs / office software, and the smallest need for cloud storage and file synchronization software. However, mean scores indicate that all of the needs for services in the cloud fall into the category "sometimes", with similar standard deviation.
Through the 10 questions in the final section of the questionnaire respondents expressed the frequency of the active use of various cloud services (SaaS). Question items are grouped and response distribution is shown in Table 2. Arithmetic mean of responses indicate that respondents use cloud communication software often and very often, they sometimes use cloud services for multimedia sharing and learning, and are little less likely to use cloud storage and file synchronization software and cloud docs / office software. The largest scattering in answers was regarding to using cloud services for multimedia sharing and learning.
Research [6] analyzing cloud computing activities of online Americans also reported frequency of cloud communication services being most used, and least use of cloud storage and file synchronization software, while the cloud docs / office software use was in the middle.

Figure 3. Use of computers and devices for accessing Internet and data, distribution of answers

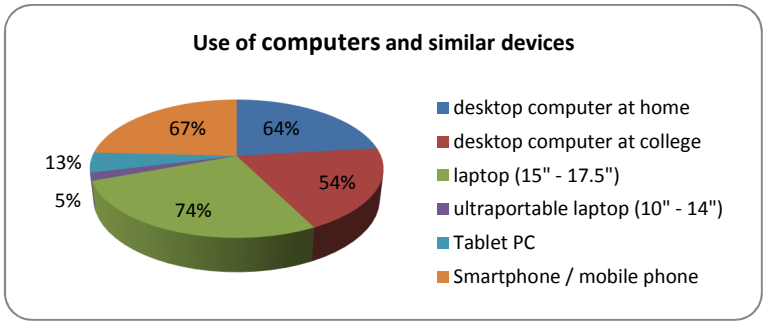


Table 1. Expresses need for cloud services, descriptive statistics

Category of service:	M	SD
Cloud storage and file synchronization SW (2 items)	2,52	0,76
Cloud docs / office software (2 items)	2,82	0,79
Cloud services for multimedia sharing (2 items)	3,05	0,85
Cloud communication software (2 items)	3,38	0,70

Table 2. Frequency of use of cloud services, descriptive statistics

Category of service:	M	SD
Cloud storage and file synchronization software	2,49	1,05
Cloud docs / office software	2,46	0,98
Cloud services for multimedia sharing	2,79	1,15
Cloud communication software	3,62	0,76
Cloud services for learning	2,55	1,00

VII. TESTING THE HYPOTHESES

A Mann-Whitney U test was conducted to evaluate the H1a hypothesis that there is no difference in need of using cloud computing services between male and female students. The results of the test were not significant, according to z = -0,109; p = 0,98 (Table 3). Thus, we can accept the stated null-hypothesis.

A Mann-Whitney U test was also conducted to evaluate the H1b hypothesis which says that there is no difference in using cloud computing services between male and female students. The results of the test were not significant, as indicated z = -1,054; p = 0,29 (Table 4). Thus, we can accept the stated null-hypothesis.

Although in the past there were significant differences in the frequency and way of using computers between men and women, so people would talk about "gender-gap", recent data shows that there is no big difference when it comes to the use of cloud services and applications [18]; [19]. Some experts believe that the road to increasing the number of female in IT sector is through cloud computing … because the characteristics of the "cloud", such a big impact on socializing, collaboration and project management, increase the interest of the women for IT [13].

For testing H2 we have used Spearman's Correlation Coefficient. The results shown in Table 5 indicates an association between variables need and use of cloud computing services and applications with rs = 0.563 and statistical significance of $p < 0.05$. The statistical analysis has shown moderate correlation. Thus, we can discard the hypothesis that there is no positive correlation between expressed need of cloud computing services and frequency of their use. Therefore we can expect that students who recognize the need for cloud services in their everyday activities on the computer will begin more actively use some of those cloud services and applications.

The third hypothesis (H3) was also tested using the Spearman Correlations. The Spearman's Correlation Coefficient indicates an association between variables "number of devices" and "use of cloud computing services" with rs = 0.164 and statistical significance of $p < 0.05$ (Table 6). But, the statistical analysis has shown weak correlation with borderline statistical significance.
The cloud services were designed for people who often use different computers and mobile devices, which is what these students do (according to Figure 2). However, in this study the correlation between these two variables has not proved strong enough as would have been expected to.

Table 3. Results of testing H1a

variable	Mann-Whitney U Test (Spreadsheet1) By variable spol Marked tests are significant at p <,05000						
	Rank Sum Group 1	Rank Sum Group 2	U	Z	p-level	Z adjusted	p-level
potreba oblak	7308,500	5252,500	3030,500	-0,019390	0,984530	-0,020967	0,983272

Table 4. Results of testing H1b

variable	Mann-Whitney U Test (Spreadsheet1) By variable spol Marked tests are significant at p <,05000						
	Rank Sum Group 1	Rank Sum Group 2	U	Z	p-level	Z adjusted	p-level
uporaba oblak	7015,000	5546,000	2737,000	-1,05414	0,291821	-1,12573	0,260281

Table 5. Results of testing H2

Variable	Spearman Rank Order Correlations (oblak) MD pairwise deleted Marked correlations are significant at p <,05000	
	potreba oblak	uporaba oblak
potreba oblak	1,000000	0,563467
uporaba oblak	0,563467	1,000000

Table 6. Results of testing H3

Variable	Spearman Rank Order Correlations (oblak) MD pairwise deleted Marked correlations are significant at p <,05000	
	Br uređ	Uporaba oblak
Br uređaja	1,000000	0,164522
Uporaba oblak	0,164522	1,000000

VIII. CONCLUSION

Cloud computing represents a new model of providing IT services which includes rental of resources located somewhere in the "cloud" and is considered to be the direction of future development of the IT sector. Ordinary people are increasingly online and more work is done online, from checking e-mails and using other forms of communication, writing and editing documents and collaboration, through watching movies and videos or listening to music, up to the fact that personal documents and images are being stored on web. There is no need for installation, licensing and updating of program, and there are no maintenance costs because all programs and services are available through a web browser. Cloud computing (SaaS) is based on "on-demand self-services" with "pay as use" model, although for ordinary users and for applications in education such software is usually free of charge. Cloud computing usability in education is very broad, as recognized by many educational institutions around the world. The reasons for the worldwide introduction of cloud computing for educational establishment are mainly of a financial nature, but it should be noted that „cloud“ has creative potentials because it enables that ideas, thoughts and knowledge can be created, used and shared easily. Students may create their own "Cloud-Based Personalized Learning Environment" or use m-learning and access to Open Educational Resources from the cloud. However, to achieve this, students and teachers should be willing to use services in cloud and be familiar with their advantages and limitations. The study shows that the respondents (students) are often online and at the same time using multiple computers and similar devices (tablet computers, smartphones). When using computers they are (on average) sometimes in situations that require the use of applications and services in the cloud. The largest use is noted with cloud communication software, the smallest with cloud docs / office software. Gender difference in reported need for services in the cloud, or in the frequency of use of applications in cloud is not confirmed. However, a significant correlation between the reported need for cloud applications / services and the frequency of their use is found. There is also a correlation between the number of computers and mobile devices used for Internet access and frequency of use of cloud applications / services. The students have expressed, based on the average of their answers, that they “sometimes” need and use cloud applications / services, which means that they are not yet ready for a "move to the cloud". It is necessary to educate and motivate them about cloud applications and services to make them become aware of the benefits.

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