Cloud computing: The beliefs and perceptions of Swedish school principals

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ABSTRACT

This article highlights the importance of cloud computing in education and explores the environment surrounding schools' adoption of cloud services. Based on the technology leadership literature, the study investigates the beliefs and perceptions of school principals toward cloud computing. Principals of primary and high schools in Sweden were invited to participate in an online survey and 342 responses were received. Results suggest principals of Swedish schools believe the main benefits of cloud computing to be its ability to allow users to access data and software anywhere as long as there is Internet access and its ability to facilitate sharing of learning materials and data. The biggest obstacle is the concerns about security and privacy of data. Moreover, principals of public schools perceived more obstacles than those of private schools. Results also indicate a misalignment of beliefs between the principals and other stakeholders such as the municipalities' information technology (IT) departments and lawyers. This lack of shared views is another major obstacle for cloud computing adoption. Results provide useful first-hand information to municipalities, school administrators, and teachers on the beliefs and perceptions of the principals toward this new technology.

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1. Introduction

Cloud computing is a new paradigm in the 21st century. It comprises technologies that allow users to use computing resources whenever and wherever they want (Andriole, 2012; Paquette, Jaeger, & Wilson, 2010; Reed, Gannon, & Larus, 2012; Shawish & Salama, 2014). A recent survey of information technology (IT) and business executives shows that 75 percent of 625 organizations use cloud computing to some degree (RightScale, 2013). The spending on cloud services was forecasted to increase from almost 50 billion US dollars in 2013 to more than 100 billion US dollars in 2017 (IDC, 2013). Many businesses have reportedly increased their profits as a result of their adoption of cloud computing (Nicholson, Owrak, & Daly, 2013). For example, 1300 executives in the US and UK participated in a survey and more than 60 percent stated that they had saved IT costs and increased profits.

Because of its popularity and financial significance, cloud computing has been widely researched. Some studies collect data from business and IT executives to examine the status quo of the use of cloud computing in organizations (CDW, 2011; Citrix, 2012; KPMG, 2012; McKendrick, 2011; Microsoft, 2012; Nicholson et al., 2013; Ponemon Institute, 2013; PWC, 2011; RightScale, 2013; Techsoup Global, 2012). Other studies discuss the importance as well as the pros and cons of cloud computing (Brian et al., 2012; Kshetri, 2010; Lee & Mautz, 2012; Mircea & Andreescu, 2011; Smith, 2013; UNESCO, 2010; Vujin, 2011; Weber, 2013). Some researchers examine cloud computing from a technical perspective and examine the issue of the best practice, such as architecture of cloud computing (Wang & Huang, 2011; Zhang & Liu, 2010).

In addition to influencing the business world, cloud computing also plays an important role in the educational environment especially in developing countries (Kshetri, 2010). The topic is so important to education that the United Nation Educational Scientific and Cultural Organization (UNESCO) has a prepared a policy document on it (UNESCO, 2010). Yet despite the potential of cloud computing for education,

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only limited prior research exists regarding the adoption of cloud computing in practice. There are some empirical studies of cloud computing adoption or implementation. However, all of them examine cloud computing at the tertiary level and none examines it from the management perspective (Behrend, Wiebe, London, & Johnson, 2011; Bhattacherjee & Park, 2014; Burda & Teuteberg, 2014; Oyeleye, Fagbola, & Daramola, 2014; Tan & Kim, 2011; Taylor & Hunsinger, 2011; Yuvaraj, 2013) even though prior research has shown that leadership is salient to the success of technology adoption or integration in the education environment (Afshari, Bakar, Luan, Samah, & Fooi, 2008; 2009; Anderson & Dexter, 2005; Flanagan & Jacobsen, 2003; Schiller, 2002; Wang, 2010; Yuen, Law, & Wong, 2003). In the context of schools, principals are the ones who are ultimately accountable for the success of cloud computing. Often, new technologies adopted by schools are limited to those that principals are familiar with or feel comfortable with (McGarr & Kearney, 2009).

Based on the technology leadership literature, this exploratory study aims to provide empirical data about the use of cloud computing in Swedish schools from the perspective of the principals. The research question of this study is: What are the beliefs and perceptions of principals toward cloud computing in Swedish schools? In particular, what are their perceived benefits and obstacles of adopting cloud computing? As resources allocation from municipalities to schools in Sweden is typically not decided purely by the number of students in schools, the results are useful to municipalities when they make decisions (Swedish National Agency for Education, 2012). The results are also useful to school administrators and teachers who are interested in adopting the new technology in their schools.

2. Characteristics of cloud computing

Different definitions of "cloud computing" have been proposed by academics and practitioners (Yang & Tate, 2012). For example, Wang and Von Laszewski (2008) define cloud computing as "a set of network enabled services, providing scalable, quality of service (QoS) guaranteed, normally personalized, inexpensive computing platforms on demand, which could be accessed in a simple and pervasive way" (p. 5). However, the most commonly quoted definition in the literature comes from the National Institute of Standards and Technology (NIST) which states that cloud computing has five essential characteristics: on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service (Mell & Grance, 2011). The first key characteristics of cloud computing is its ability to allow users to call upon the service whenever necessary without human interaction. The second characteristic is that users can use the services regardless of the type of network or platform. The third characteristic is the pooling of service providers' resources to achieve the best benefits. The fourth characteristic provides users with the flexibility to scale up or down their demand at any time. The fifth characteristic refers to the close monitoring and control of resources (Mell & Grance, 2011).

Regardless of its characteristics, cloud computing is all about services. NIST identifies three types of service models for cloud computing: software, platform, and infrastructure. Over time, researchers have proposed more service models such as hardware, communication, and desktop (Mariya, 2011; Rimal, Choi, & Lumb, 2009). Ultimately, the classification does not matter because cloud computing is an *ecosystem* that "covers all steps from delivering infrastructure to developing environments" (Edlund, 2012 p. 22).

3. Cloud computing in education

Cloud computing can help overcome many problems in schools by having the right types of technologies, including hardware and software (Brush, Glazewski, & Hew, 2008). Selection criteria of cloud computing application in education include mission criticality and sensitivity of activities (Alabbadi, 2011). The most obvious area of application is in course delivery (Jou & Wang, 2013; Vaquero, 2011).

Another common application of cloud computing in education is in the area of distance learning (Jiao, Wang, An, & Fang, 2011; Sun, Tsai, Finger, Chen, & Yeh, 2008; Wang, Pai, & Yen, 2011; Zhang & Liu, 2010). Moreover, the day-to-day communication between students and teachers is an important application area. Emails and instant messaging have become an important part of the communication within and outside schools (Lee & Mautz, 2012). In a recent study, the most commonly used cloud tool in higher education is Gmail (CDW, 2011). Other application areas include learning management systems (Aljenaa, Al-Anzi, & Alshayeji, 2011; Al-Zoube, 2009), library management systems (Han, 2010; Kan, Yang, Wang, & Qi, 2010), and document creation/storage.

With so many cloud services available for education, it is difficult for users to find suitable services after considering factors such as scalability, licensing, curriculum, costing, and security (Edlund, 2012; Gardner & Feng, 2010; Koch, Assunção, & Netto, 2012; Mikroyannidis, 2012; Ryan, 2013; Smith, 2013). Typically, users need to decide on issues such as service models, types of clouds, application areas, and service providers. Budgeting decision is also an indispensable component that directly affects hardware adoption and usage, software licensing and accessing fees, and network infrastructure and capabilities.

The various decisions listed above involve different groups of stakeholders. Within any school system, students, teachers/researchers, school administrators, and IT staff all play an important part in the adoption or use of cloud services. Outside the school system, there are the computer hardware vendors, computer software vendors, cloud service providers, local and national government agencies and regulators (e.g., the Swedish National Agency for Education and the Swedish Data Inspection Board), super-national institutions (e.g., the European Union), and the IT industry associations such as Cloud Computing Association (Kshetri, 2013; Lin & Chen, 2012; Marston, Bandyopadhyay, Zhang, & Ghalsasi, 2011; Smith, 2013).

4. Perceived benefits and obstacles

Naturally the foremost perceived benefit of cloud computing to education is its ability to support learning processes: self-learning, peer-to-peer learning, classroom learning, distance learning, virtual laboratories, students with special needs, assessment systems, and so on (Aljenaa et al., 2011; Ding, Li, Liu, & Shi, 2012; Jiao et al., 2011; Pyzik, 1999). It allows teachers to create flexible learning environment such as virtual labs and it is expected to increase student participation and student satisfaction and eventually student performance (Sun et al., 2008). The support for on-demand learning systems is particularly valuable to assist students in rural areas in developing countries to overcome the digital divide problem (Le Roux & Evans, 2011; Noor, Mustafa, Chowdhury, Hossain, & Jaigirdar, 2010).

As the amount of data has exploded in the last decade (Reed et al., 2012), it is unsurprising that the large, flexible and scalable storage capacity of cloud computing is perceived beneficial to different types of organizations including schools (Ab Aziz, Ab Aziz, Yusof, & Paul,