Effects of security and privacy concerns on educational use of cloud services

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ABSTRACT

Cloud computing, which offers software, platform, and infrastructure services, focuses on effective use of shared resources to achieve economies of scale and coherence. This paper aims to understand the effects of security and privacy concerns on educational use of cloud services. We have proposed a research model based on Ajzen's (1991) Theory of Planned Behaviour (TPB). Following the TPB, we developed a research model, which posits that student attitudes predicted by security and privacy perceptions and behavioural intentions are predicted by attitudes towards using cloud services. A Structural Equation Model was used to assess the model based on the data collected by means of survey questionnaires from 200 pre-service teachers. Results supported the proposed model, validating the predictive power of the TPB. The results also indicate that security and privacy have a strongly significant influence on the students' attitudes towards using cloud services in educational settings. Implications of these findings are discussed.

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1. Introduction

Educational use of cloud services is desirable as these services can provide several advantages. Possible advantages such as any-time/anywhere access to documents and files, synchronization of data across devices, easy to share data, data redundancy, bespoke learning with no up-front capital investment and maintenance responsibility (Cenka & Hasibuan, 2013; Leipert & Simandl, 2012). Given the arrival of cloud services the limitations such as interoperability and compatibility issues, low storage capacity, installation, backup, and recovery overheads have been largely resolved (Lacity & Reynolds, 2014; Rizzardini, Linares, Mikroyannidis, & Schmitz, 2013). However, some challenges still need to be addressed such as security and privacy issues (Dillon, Wu, & Chang, 2010; Park & Kim, 2014).

Cloud computing refers to expandable and on demand services that are served via the Internet from specialized data centres (Johnson, Brown, Cummins, & Estrada, 2012). These services have a potential to enable and facilitate both formal and informal learning by allowing students and academics share learning resources, interact and brainstorm solutions, elaborate reports, and create conceptual designs (Rizzardini et al., 2013). In this study, cloud services

refer to the Internet based applications that provide different services such as social networking, distributed file systems, and structured storage systems such as Google Drive, Dropbox (allow users to store, synchronize, and share files) and Evernote (allows users to create text, audio, and video memos). An investigation into the determinants of educational use of cloud services was studied aiming to identify the impact of security and privacy concerns on use behaviour. The results of this study may lead to successful understanding for the use of cloud services in educational settings.

The paper proceeds as follows. In the next section, we review the literature on studies of cloud computing adoption and use, followed by the research methods and the results of data analysis. Finally, discussion of the research findings and their implications are provided along with the limitations of the study.

2. Literature review

Cloud computing has recently received increasing attention in information systems and computer science disciplines (Armbrust et al., 2010; Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011; Pallis, 2010; Zhang, Ma, Wu, Ordonez de Pablos, & Wang, 2014). Recently, Lin, Wen, Jou, and Wu (2014) proposed a cloud-based reflective learning environment to enhance student reflection motivation and performance. Results of the experimental study verify that the proposed learning environment is able to effectively assist students and instructors in administering and conducting reflective

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learning activities during and after a class. In a similar study, Alamri et al. (2014) proposed a cloud-based game that monitor health conditions of obese people. The proposed game enables ubiquitous and real-time access of health data by the therapists and supports therapist-mediated dynamic change of game level and recommendation. A sample of 150 undergraduate obese students played the game and filled a questionnaire after game-play. Results show that they were self-aware and motivated to play the game for weight loss. In another study, Schepman, Rodway, Beattie, and Lambert (2012) investigated use of a multi-platform cloud based note taking software (Evernote) to provide mobile support to students' learning. Results demonstrate that the students mostly used Evernote in their independent study behaviours, including information acquisition, organization, and management.

Jou and Wang (2013) compared college students with high school and vocational high school backgrounds in terms of learning attitudes and academic performances induced by the utilization of resources driven by cloud computing technologies. They found no cognition differences between academic or vocational students. However, vocational students were better motivated. In another study, Park and Ryoo (2013) used two-factor theory to investigate switching behaviour to cloud services. Results demonstrate that key switching enablers are omnipresence and collaboration support, while switching inhibitors are satisfaction with incumbent IT and breadth use of incumbent IT. The results also show that personal innovativeness and social influence positively moderated the relationship between positive perception on switching to cloud as well as negative perception on switching to cloud and intention to switch.

Stantchev, Colomo-Palacios, Soto-Acosta, and Misra (2014) investigated the motivations that lead higher education students to use Learning Management Systems (LMS) services or cloud services for information sharing and collaboration. Based on the Technology Acceptance Model (TAM; Davis, 1989), they conducted a questionnaire survey with a sample of 121 students. Results show that the perceived ease of use of cloud services is above that of LMS services. In addition, cloud services presented higher levels of perceived usefulness than LMS services and attitude towards using cloud services is well above that of using LMS services. In a similar study, Park and Kim (2014) investigated factors affecting user perceptions of and attitude towards mobile cloud computing services based on the TAM. They found that perceived mobility, security, connectedness, satisfaction, and quality of service have a significant effect on user acceptance of mobile cloud services.

Ratten (2012) investigated how ethics influence individuals' decision to adopt cloud computing based on social cognitive theory. Results show that ethics and marketing are important determinants of individuals' behavioural intention towards technology innovations. However, entrepreneurial orientation, learning, and outcome expectancy have no effect on their intention to adopt this technology. In another study, Bharadwaj and Lal (2012) used a case study approach to explore the cloud computing adoption drivers and its impact on organizational flexibility. Their results suggest that decision to adopt cloud computing depends on factors like perceived usefulness, relative advantage, perceived ease of use, vendor credibility, and attitude towards using technology.

Low, Chen, and Wu (2011) investigated the factors that affect the adoption of cloud computing based on a questionnaire based survey data collected from 111 firms belonging to the high-tech industry in Taiwan. Their findings show that relative advantage, top management support, firm size, competitive pressure, and trading partner pressure have a significant effect on the adoption. In another study, Behrend, Wiebe, London, and Johnson (2011) examined the factors that lead to cloud computing adoption and usage in a higher education setting. They found that background characteristics such as the student's ability to travel to campus

have an effect on the usefulness perceptions, while ease of use is largely determined by first-hand experiences with the platform and instructor support.

Lin and Chen (2012) conducted a survey by interview approach to understand IT professionals' understandings and concerns about cloud computing. Their findings suggest that while the benefits of cloud computing such as its computational power and ability to help companies save costs, the primary concerns that IT managers and software engineers have are compatibility of the cloud with companies' policy, IS development environment, and business needs. The findings also suggest that most IT companies in Taiwan will not adopt cloud computing until the challenges of cloud computing, including security and standardization are reduced. In another study, Dillon et al. (2010) identified the challenges and issues of cloud computing from the adoption perspective. They found that the security issue has played the most important role in hindering cloud computing. They claimed that security issues such as data loss, phishing, and botnet pose serious threats to sensitive data.

Overall, the studies reviewed here suggest that cloud services may have advantages not only for organizations but also individuals as these services provide the opportunity for students and academics ubiquitous and interactive access to various applications and resources. This automatically reduces the cost of licensing, installation, and maintenance while offering more powerful functional capabilities such as recovery and scalability. However, there is a gap in research investigating the key determinants of educational use of cloud services. In this study, we aim to fill that gap by examining the effects of security and privacy concerns on educational use of cloud services.

3. Research model

Theory of Planned Behaviour (TPB) suggests that behaviour is determined by intention. Intention, which refers to individuals' plans and motivations to commit a specific act, is predicted by attitude towards the behaviour, subjective norms, and perceived behavioural control (Ajzen, 1985). Attitude directly affects the intention to perform a behaviour and may directly affect behaviour in situations where an individual intends to perform the behaviour (Ajzen, 1991).

In TPB, beliefs that are specific to each situation are antecedent to attitude. The theory does not assume that beliefs that apply in one context also apply in other contexts. Likewise, TPB taps the important control variables for each situation independently and is more likely to capture situation specific factors (Mathieson, 1991). Compatible with this theory, we consider security and privacy perceptions of students are significant predictors of attitude towards using the cloud services in an educational context (see Fig. 1).

4. Constructs and associated hypotheses

4.1. Security and privacy

Security refers to the degree to which students believe that cloud services are secure platforms for storing and sharing sensitive data. Security is relevant to introduce to our model, because when one uses cloud services, there is a perception of risk involved in transmitting sensitive information. One important aspect that can affect use of cloud services is the security of wireless data transfer and cloud applications. The perception of a low level of security may affect students' attitudes towards using such services. Students with low tolerance for technological risks may defer their use of these services. On the other hand, privacy refers to the