https://doi.org/10.48009/4_iis_2019_86-92

Issues in Information Systems
Volume 20, Issue 4, pp. 86-92, 2019

PERCEPTIONS OF CLOUD STORAGE PRIVACY AMONG UNIVERSITY STUDENTS

Kevin S. Floyd, Middle Georgia State University, kevin.floyd@mga.edu
Kembley Lingelbach, Middle Georgia State University, kembley.lingelbach@mga.edu

ABSTRACT

*Cloud storage platforms are rapidly becoming a more efficient and affordable alternative for traditional storage devices at institutions of higher education. It is now common practice for institutions to provide students with access to a cloud storage provider because of its collaborative and scalable nature. With the growth of cloud storage provider usage comes the challenge of how to manage the security risks and mitigate student privacy concerns associated with these service*s. *This paper outlines a research framework to determine student perceptions of privacy associated with cloud storage usage and whether there are statistically significant differences in privacy concerns among various student demographics. This information will help universities develop appropriate security and privacy training for a diverse student population.*

Keywords: Cloud Storage, Privacy, Higher Education

LITERATURE REVIEW

Cloud computing is an emerging technology that promises to provide many opportunities and benefits to both higher education institutions as well as to university students. It is crucial for higher education to examine factors that play an important role in influencing students to accept cloud storage services as part of their educational environment (Changchit, 2014). The United States National Institute of Standards and Technology (NIST) defines cloud computing as:

> *"Cloud Computing is a model for enabling ubiquitous, convenient on-demand network access to a shared pool of configurable computing resources (e.g., networks, servicers, storage, application and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction"*
> (Mell & Grance, 2011).

According to NIST (Mell & Grance, 2011), there are three delivery models: Application/Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). SaaS provides services to consumers to utilize applications running on a cloud infrastructure, PaaS services provides tools, that enable developers to deploy their applications, where IaaS provides the consumer the physical framework and computing resources to run software (Mell & Grance, 2011). Each has its own challenges to privacy and security; however, this study focuses on the use of cloud storage use in higher education.

Usage in Higher education

Collaboration between students, faculty, and researchers has provided contributions to society and the world economy (Lazowska, Lee, Elliottt & Smarr, 2008). Collaborative environments, such as cloud computing, enable students' mobility to access data through mobile devices and other device platforms. Many universities are offering virtual classrooms and innovative teaching methods through cloud services that can be accessed anywhere and on devices such as tablets, laptops and smartphones. The scalability of cloud storage is also another benefit that many colleges and universities can quickly expand their capabilities as well as increased efficiency (Mircea & Andreescu, 2011). Cloud services also provide excellent opportunities to manage limited resources while providing access to data across multiple devices to students at any given point in time (Pardeshi, 2014).

Traditional students in universities today have not known a world without computers and the internet. Through social media platforms such as Facebook, Twitter, Instagram, Gmail, they have been immersed and are consumers of cloud-

based technologies (Ercan, 2010). Students expect to have 24/7 access to their data and digital technologies in their educational environment, including cloud services (Ercan, 2010). Research has shown that cloud-based solutions can be very effective in supporting collaborative learning as well as other socially oriented theory of teaching and learning (Ercan, 2010). Higher education is facing increasing financial challenges in combatting issues in managing IT support for educational research and development activities that cloud services can provide. However, the major challenges facing these institutions are how to manage the security and privacy risks associated with of cloud storage services (Pardeshi, 2014). A 2019 McAfee report on cloud adoption and risk reports that the amount of sensitive data stored in the cloud has increased 53% and sharing sensitive information has increased by 23% over the last two years. It was also reported that 80% of all organizations have experienced at least 1 compromised account threat per month and 92% of all organizations have stolen cloud credentials for sale on the Dark Web (McAfee, 2019). The issue is to balance the benefits while mitigating or managing the privacy and security of cloud usage.

Usage and Advantages

Cloud storage services are considered to be in the Infrastructure as a Service (IaaS) platform model (Pardeschi, 2014). "This model is used to satisfy the infrastructure needs of the students, faculties and researchers globally or locally with some specific hardware configuration or specific task" (Pardeschi, 2014, p. 593). Pardeschi (2014) also stated that cloud services provide "virtual hosting services for file storage and allows the user to save and access files regardless of file type from any location as long as they have internet access" (p. 593). Examples of IaaS and cloud storage services are Dropbox, Google Drive, Apple ICloud, Box, Mega, M and Microsoft OneDrive.

Cloud Storage is gradually replacing on-site physical servers and management of those servers. The benefits of cloud storage include access from multiple locations, expand or contract the service as needed, downtime protection, and better performance, and saves money of managing in-house storage that requires hardware, software and support. Cloud storage is also more economical – by saving money of managing in-house storage that requires hardware, software, and support (Pardeschi, 2014).

However, these benefits do not come without its issues and concerns. One of the greatest concerns is of privacy and security (Lian, Yen & Wang, 2014; Yatin, Alias, Awang, & Burhanud-din, 2018).

Privacy & Security Research

Historically, it has been difficult to get cloud providers to address security and privacy in their contract clauses or service level agreements. However, by doing so, would not only offer customer reassurances, but would also be a competitive advantage. (Daun & Kimble, 2019). Despite the benefits, sending data to the cloud raises security and privacy concerns as mobile users do not have direct control over their data in the cloud. Other research revealed that perceived usefulness, perceived ease of use, perceived security, and perceived speed of access and perceived cost of usage are important factors that would encourage students to accept cloud computing as part of a curriculum (Changchit, 2014). However, many of the students trusted the universities to protect their private information, but not all felt secure enough to store their personal information on other cloud provider platforms (Changchit, 2014). The results of this study and others revealed that students are more likely to accept cloud-computing services as a useful learning tool if they perceive it to be a secure means of storing their data (Arpaci, 2015; Ashtari & Eydgahi, 2015; Changchit, 2014).

Gender has been seen in studies that indicate there is a significant difference in how male and female students view privacy and security in the usage of cloud services (Michalopoulou & Kalloniatis, 2017). Michalopoulou and Kalloniatis' (2017) objective was to determine if gender and educational background of general internet users had any effect on the perception of cloud services in the social media networks (Facebook, Linkedin and Google+). The results of their study showed that females had higher levels of privacy concerns than the male participants did, but they did not have the necessary knowledge to protect themselves, however, they were willing to change their privacy behavior to protect their personal information. The significance of this study is giving women a voice in privacy issues may lead to better and more creative privacy solutions. Allen (1998) suggested, "The quality of group culture and individual lives is improved if women have the meaningful opportunities for privacy that foster larger and more varied contributions" (p. 37). Other recent studies indicate women investigate problems differently than men and may provide better overall creative solutions (Caldwell, 2013; Ingalhalikar et al., 2014). Caldwell (2013) suggested that diversity in groups of people with a common purpose will perform better when functioning together and those groups with more gender equity will perform 26% better than male-only groups. Ingalhalikar et al . (2014) suggested that men are

'more likely better at learning and performing a single task, whereas women have superior memory and social cognition skills, making them more equipped for multitasking and creative solutions that work for a group'. Female respondents are also more aware of potential risk-taking behavior and more careful about their privacy settings (Pedersen, 2013).

Educational background had an impact, but not a direct impact on online privacy. In general, the participants with technology and military studies background were more cognizant on matters of online privacy. The 219 participants were 42% male, 58% females, 45.2% had bachelor's degrees, 32.9% possessed a master's degree, 20.5% had high school diplomas and 1.4% did not possess a high school diploma. The fields ranged from 41.6% technology and engineering sciences, 2.7% military studies, 5% health and life sciences, 39%, humanities and social sciences and 11% in economics and business administration sciences. The majority of men were from the technology and engineering sciences at 65.2% when the majority of the women were from the humanities and social sciences (62.2%).

Given the increased use of cloud storage services in higher education and the need to address the associated privacy concerns, this study will investigate student usage and perceptions of privacy associated with cloud storage services. The results will be compared with previous studies that investigated the impacts of gender and educational background on the perception of privacy concerns surrounding the usage of cloud storage services. Specifically, the research will seek to answer the following questions:

R1: What are university student perceptions of cloud storage providers' privacy?
R2: Does gender have an affect on students' perceptions of cloud storage providers' privacy?
R3: Does academic major or area of study have an impact on student perceptions of cloud storage providers' privacy?
R4: Does the frequency of usage of a cloud storage provider affect perceptions of privacy?

RESEARCH METHODOLOGY

Participants

A convenience sample consisting of students at enrolled at a small public University located within the Southeastern United States during the spring 2019 semester was utilized as part of this study. The sample consisted of students from the University's six academic units: College of Arts and Sciences, School of Aviation, School of Business, School of Health Sciences, and School of Information Technology. Both graduate and undergraduate students were included in the sample. One hundred sixty-three usable surveys were completed. Participant characteristics are shown in table 1.

Instrumentation

The instrument for this study consisted of 18 questions. Questions 1-6 were used to retrieve demographic information. Questions 7-18 utilized a seven-point Likert scale which ranged from (1) "completely disagree" to (7) "completely agree" to measure student perceptions of cloud storage privacy concerns. Cloud storage provider was defined in the instrument as cloud storage providers such as Google Drive, pCloud, Microsoft OneDrive, Dropbox, etc. (either free of charge or fee-based) is a company that offers individuals and organizations the ability to house and keep data in their storage system. The instrument was adapted and based on an instrument developed and validated by Koohang (2017) to measure privacy concerns with social media sites. The instrument consists of four privacy constructs – control, improper access, secondary usage, and awareness.

Procedures

The survey was administered electronically using Survey Monkey©. An email containing a hyperlink to the instrument was sent electronically to the University's student email distribution list. The participants were guaranteed the anonymity of responses and assured that responses would not be shared. One hundred sixty-four surveys were completed. The raw data was imported into SPSS version 25 for data processing and analysis.

RESULTS

Demographic data was collected and is presented in Table 1. Students from all of the University's academic departments were represented. Results indicated that the majority of respondents were females and most students were in the 18-24 age range. Freshman represented the largest class, with fairly equal participation among the other class standings. More than half of the students were information technology students and most participants indicated that they had good or excellent experience with the cloud storage provider(s) they use.

Questions 7-18 were used to measure perceptions of cloud storage providers' privacy. The Cronbach's alpha coefficient was calculated to test the reliability of the 12 items. The items were found to be reliable (α=0.93). According to Field (2009), an alpha level above 0.70 is considered acceptable.

Table 2. Descriptive Statistics for Cloud Computing Privacy

Characteristic	n	%	M	SD
Gender				
Male	73	45	5.80	1.22
Female	90	55	6.10	0.91
Age				
18-24	89	55	5.93	1.11
25-29	18	11	6.12	1.06
30-34	23	14	5.80	1.04
35 or older	33	20	6.09	1.00
Class Standing				
Freshman	41	25	5.74	1.30
Sophomore	28	17	6.15	0.85
Junior	33	20	6.09	1.02
Senior	32	20	5.79	0.85
Masters (Graduate)	29	18	6.15	1.14
Cloud Storage Usage				
Once Every Day	65	40	5.61	1.26
Every other Day	55	34	6.08	0.91
Three to four times a week	35	22	6.32	0.75
More than four times a week	8	5	6.47	0.66
Academic Department				
College of Arts and Sciences	22	14	5.92	1.08
School of Health Sciences	34	21	6.12	0.98
School of Aviation	13	8	6.12	0.79
School of Business	18	11	5.79	1.04
Academic Department				
School of Information Technology	56	34	6.02	0.97
School of Education and Behavioral Sciences	20	12	5.66	1.57
Cloud Storage Proficiency				
Average	34	21	6.22	0.79
Good	73	45	5.98	0.91
Excellent	56	34	5.78	1.36

Regarding research question one, the results indicate that overall, students are concerned about privacy when using cloud storage services (M=5.96; SD=1.07). More specifically, female students tend to be more concerned than males. In addition, students in the 25-29 age range were on average more concerned with privacy. In terms of privacy concern by class standing, sophomores and graduate students had equal levels of concern. Students who used cloud storage services more than four times a week along with average usage proficiency had higher levels concern regarding their privacy. Finally, students in the Health Sciences and Aviation disciplines reported higher levels of privacy concerns.

To answer research questions 2-4, a series of one-way ANOVAs were conducted to compare the effect of the independent variable on student perceptions of privacy associated with the use of cloud storage provider. In regards to research question two, the results [$F(1,130) = 3.13$, $p = .08$] indicated there was no significant difference in privacy concerns by gender. For research question three, the results indicated no significant differences in privacy concerns by academic major or area of study [$F(5,157) = 0.64$, $p = 0.67$]. Finally, in terms of research question four, there was a significant difference at the 0.05 level [$F(3,159) = 4.81$, $p = 0.03$]. Post hoc comparisons using the Tukey HSD test indicated that the mean privacy score for once every day cloud storage usage (M=5.61, SD=1.26) was significantly different than the mean privacy score for three to four times a week cloud storage usage (M=6.32, SD=0.75). No other significant differences were found.

SUMMARY

This study found that more than half of the respondents use a cloud storage provider more than once a day. It is clear from the responses that university students are concerned about privacy associated with the use of cloud computing providers. On average, female students, students in the 25-29 age range, sophomores and graduate students, those who use cloud storage more than four times per week, and those in the Health Sciences and Aviation fields had higher levels of concern. The findings on gender are consistent with research conducted by (Michalopoulou & Kalloniatis, 2017), who reported that females were more concerned about privacy than the male participants. Given the increased use of cloud storage services in higher education and the concern about associated privacy issues, institutions will need to ensure that appropriate training and measures are in place to ensure students have the resources and training needed to protect their privacy.

While female students were on average more concerned than males about cloud storage privacy, further analysis indicated that there were no statistically significant differences between gender and perceptions of cloud storage privacy. In addition, academic major or a student's area of study did not have a significant impact on student perceptions of cloud storage privacy concerns.

Based upon the results of our study, significant differences existed between frequency of cloud storage usage and student's perceptions of cloud storage privacy concerns. Specifically, students who use a cloud storage provider three to four times a week had higher levels of privacy concern versus those students who use a cloud storage service once every day. This suggests that students who use cloud storage services more often are more concerned about associated privacy issues.

This study focused on general privacy concerns. Additional research is needed to understand what specific constructs of privacy are of concern to student users. The survey used in this study was based on an instrument developed and validated by Koohang (2017) to measure privacy concerns with social media sites. The instrument consists of four privacy constructs – control, improper access, secondary usage, and awareness. Further analysis is needed to determine if the four privacy constructs are applicable in cloud storage usage. This can help institutions of higher education to develop or incorporate cloud storage services security and privacy best practices into new or existing security training modules.

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