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Learning management systems and cloud file hosting services: A study on students' acceptance

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ABSTRACT

The aim of this paper is to investigate the motivations that lead higher education students to replace several Learning Management Systems (LMS) services with cloud file hosting services for information sharing and collaboration among them. The research approach is based on the Technology Acceptance Model (TAM). More specifically, the model is devoted to identifying barriers and enablers to the acceptance of these technologies. A questionnaire comprising three factors (*Attitude toward using technology, Perceived ease of use and Perceived usefulness*) was applied to a sample consisting of 121 higher education students. Results show that the *perceived ease of use of* cloud file hosting services is above that of LMS tools and services and that cloud file hosting services presented higher levels of *perceived usefulness* than standard learning management tools. In addition, attitude toward using cloud file hosting services is well above that of using LMS tools.

1. Introduction

Information and communication technologies (ICT) rapid evolution is influencing both the public and private contexts (Soto-Acosta, Martinez-Conesa, & Colomo-Palacios, 2010). In this sense, the degree of development of certain domains is considered to be linked to the level of implementation of ICT (Lucio-Nieto, Colomo-Palacios, Soto-Acosta, Popa, & de Amescua-Seco, 2012). However, the adoption of ICT has followed different patterns depending on the environment. Thus, although the business context has reached high levels of ICT adoption, other important contexts for the future of generations such as higher education remain certainly laggard in comparison (Park, 2009).

International reports point out that the implementation of ICT within higher education is still very basic, with high levels of resources underutilization, considering its potential (OECD, 2005; UNESCO, 2011). Therefore, it is necessary to move from the use of ICT as a support tools to efficient learning instruments (e.g. Park, 2009). To address these issues, there is therefore a need for further works that show how to cope with problems and practical issues with regard to the development of current and future ICT to support the learning process (González, 2010; Ossiannilsson & Landgren, 2012). These ICT tools support traditional and complement new forms of learning (e.g. e-learning), which make use of the Internet and other information-related ICT to create experiences that foster and support the learning process (Bose, 2003; Macgregor & Turner, 2009).

One of the main objectives of higher education in today's information technology enabled classroom is to make students more active in the learning process (Saadé, Morin, & Thomas, 2012). Among the tools available to do so are Learning Management Systems (LMS). These systems, known as Virtual Learning Environments too, present high levels of functionality regarding learning activities as well as features for course management and tracking. However, LMS still have several limitations which decrease the learning effectiveness (Yasar & Adiguzel, 2010). Most educational institutions are currently developing the non-attendance aspect with regard to much of their course material by setting up virtual campuses (Sánchez & Hueros, 2010) and LMS. The use of LMS provides students and lecturers with a set of tools for improving the learning process and its management. Nonetheless, as argued by García-Peñalvo, Conde, Alier, and Casany (2011), despite the high levels of LMS adoption, these systems have not produced the desired and expected learning outcomes yet. More specifically, these authors gathered a set of reasons to explain why the adoption of LMS have not contributed further to the learning processes, among these reasons are:

1. Tools are not properly used and often merely become spaces to publish course documents and learning materials.

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2. LMS constrain student collaboration and opportunities of social constructivism, which should not be limited to a period of time (i.e. academic year).
3. LMS are usually focused on the course and institution rather than on students and their needs.

Furthermore, recent research (e.g. Alier et al., 2012) suggests that social networks, cloud based services and mobile applications come to support and complement the lack of LMS' features. In other words, LMS suffer from several limitations such as the lack of openness, resistance to change, failure to take into account the user, lack of integration with the informal context and so on (García-Peñalvo et al., 2011). In this scenario, instructional designers who work in the context of e-learning environments often face with the challenge of incorporating diverse instructional resources to create engaging and coherent e-learning experiences (Dodd & Antonenko, 2012). Among these resources are cloud file hosting services. In addition, students attending traditional off-line learning are starting to use these systems as collaboration tools. The aim of this paper is to investigate the motivations that lead higher education students to replace several LMS services with cloud file hosting services for information sharing and collaboration among them.

The remainder of this paper is structured as follows. The next section presents the background of the work. Following that, the methodology used for sample selection and data collection is discussed. Then, data analysis and results are examined. Finally, the paper ends with a discussion of research findings, future research and concluding remarks.

2. Background

Cloud computing is getting increasing attention and represents nowadays one of most important research topics in computing science. As a result, "cloud computing" is becoming a buzz word in the computing industry (Motika & Weiss, 2012). Thus, the demand for cloud computing is rising because of the popularity of digital devices and the wide use of the Internet (Chung, Park, Lee, & Kang, 2012). Cloud computing refers to both the applications delivered as services over the Internet and the hardware and software systems within the data centers which provide those services (Armbrust et al., 2010).

Cloud computing opens the doors for large economies-of-scale, but it also faces a number of challenges (Jiménez-Domingo, Gómez-Berbís, Colomo-Palacios, & García-Crespo, 2011). The cloud offers benefits such as fast deployment, pay-for-use, lower costs, scalability, rapid provisioning, rapid elasticity, ubiquitous network access, greater resiliency, hypervisor protection against network attacks, on-demand security controls, real time detection of system tampering and rapid re-constitution of services (Subashini & Kavitha, 2011). Thus, moving to cloud services makes users more efficient, facilitates collaboration with their co-operators, and helps users to have seamless access to other digital devices (Park & Ryoo, 2013). Moreover, cloud computing enables the optimization of resources (Duran-Limon, Siller, Blair, Lopez, & Lombera-Landa, 2011) under the consideration of performance evaluation (Stantchev, 2009) and self-optimitization (Krallmann, Schröpfer, Stantchev, & Offermann, 2008). However, cloud applications, like any other disruptive technologies, present also many practical problems (Colomo-Palacios, Fernandes, Sabbagh, & de Amescua Seco, 2012). In other words, the cloud computing service model creates new risks in the computing industry scenario (Rebollo, Mellado, & Fernández-Medina, 2012). These risk issues are related to the maintenance of high service availability and dependability (Stantchev & Malek, 2011), the provision of end-to-end secure solutions, the management of longer-standing service workflows (Wei & Blake, 2010) as well as the IT governance aspects (Stantchev & Stantcheva, 2013) of organizations that use cloud computing (Petruch, Stantchev, & Tamm, 2011).

Cloud storage is a major service offered by cloud computing, which allows data owners to move data from their local computing systems to the Cloud (Yang & Jia, 2012). Companies are becoming more and more aware of the advantages of storing data anywhere in the cloud (Hamlen & Thuraisingham, 2013). Moving data into the cloud offers great convenience to users, since users do not need to care about the complexities of direct hardware management (Wang, Wang, Ren, Cao, & Lou, 2012). Despite of the advantages, this new paradigm of data storage service introduces several security challenges, which must be addressed in the future, these challenges come mainly from confidentiality, integrity and data availability issues (Kumar, Ashok, & Subramanian, 2012).

One popular class of applications utilizing cloud storage are the various file hosting services such as Apple iCloud, Ubuntu One, Dropbox, iCloud, Microsoft SkyDrive, SugarSync, Google Drive, Amazon Cloud Drive, Cubby, YouSendIt and ZumoDrive. A recent review from these services can be found in Needleman's (2012) work, whereas a more research-oriented comparison is conducted by Hu, Yang, and Matthews (2010). Users of these file hosting services are able to store and share files over the Internet through file synchronization. Copies of this files are maintained at two or more places (server and user devices) and changes are automatically introduced at all the other locations.

Dropbox is one the most popular file hosting services. It can be considered as a file/folder synchronization service, since shared folders are synchronized after a certain time depending on file size and available bandwidth. All the contents (files and folders) get automatically synchronized (Garcia-Arenas et al., 2011). Moreover, if work is conducted on a Dropbox file, while the device is offline, changes are synchronized automatically when the device comes back online. However, if concurrent work is performed on a file from different devices, the resulting multiple copies must be manually reconciled (Marshall & Tang, 2012). Despite of Dropbox's users base and its commercial success, recently several issues with regard to privacy, security and trustworthy have been raised (e.g. Caldwell, 2012). In any case, given that Dropbox is a reality that many users employ for professional or academic work, the aim of this paper is to extend previous research that has investigated (e.g. Hunsinger & Corley, 2012) or reported (Lorenz, Kalde, & Kikkas, 2012) the use of Dropbox to cover certain weaknesses of LMS within the higher education setting.

3. The study

In this section, the research approach, sample and data collection as well as instruments validation are presented.

3.1. Research approach

The research approach is based on the Technology Acceptance Model (TAM). Davis' (1989) TAM is an evolution of the Theory of Reasoned Action (TRA) developed by Icek Ajzen and Fishbein (1980). The TRA posits that the intention to accept or reject a particular technology is based on a series of tradeoffs between the perceived benefits of the system to the user and the complexity of learning or using the system. The TRA proposes that behavior results from the formation of specific intentions to behave (Ajzen & Fishbein, 1980). According to the TRA model, two major factors determine behavioral intentions namely: user attitude toward the behavior and subjective norms. Attitude toward the behavior refers to the person's judgment that performing the behavior is

good or bad. The subjective norms reflect the person's perception of social pressures put on him/her to perform or not the behavior in question. According to the theory, attitudes are a function of beliefs. In this sense, a person who believes that performing a given behavior will lead to positive outcomes will hold a favorable attitude toward performing the behavior.

The TAM is devoted to identifying barriers and enablers to the adoption of new technologies in a particular setting. The model suggests that perceived usefulness, defined as "the degree to which an individual believes that using a particular system would enhance his or her productivity", and perceived ease of use, defined as "the degree to which an individual believes that using a particular system would be free of effort", are key determinants of the actual usage of a particular technology or system (Davis, 1989). Research has validate the model in a variety of situations, including Internet banking (Adamson & Shine, 2003; Chau & Lai, 2003), mobile commerce (Bruner & Kumar, 2005), online games (Hsu & Lu, 2004) and educational environments (Edmunds, Thorpe, & Conole, 2012; Pynoo et al., 2011; Stewart, Bachman, & Johnson, 2010; Un Jan & Contreras, 2011) citing the most relevant and recent ones.

The global objective of this study is to analyze why higher education students replace LMS tools and services with cloud file hosting services in the classroom as collaboration tools and knowledge repository. Taking this into account, the research questions that motivated our work are as follows:

RQ1: When comparing LMS and cloud file hosting services, is perceived ease of use higher for the case of cloud file hosting services?
RQ2: When comparing LMS and cloud file hosting services, is perceived usefulness lower for the case of LMS?
RQ3: Is the attitude toward using cloud file hosting services above that of LMS tools?
RQ4: Is LMS usage more motivated by the obligatory of its use rather than users' preference?

The above questions are addressed in the following sections.

3.2. Sample and data collection

The sample consisted of a set of 121 subjects (n = 121), 27 were graduate students from Master in Computer Science (22.31%), while the other 94 were final year students from BA in Computer Science studies (77.69%). Regarding the demographic characteristics, the sample included 39 women (32.23%) and 82 men (67.77%). This gender imbalance is a particular characteristic of the computer science students population as reported previously in the literature (Balachandar & Gurusamy, 2012; Colomo-Palacios, Casado-Lumbreras, Misra, & Soto-Acosta, 2012). The average age was 25.22 years, with ages ranging from 22 to 48 years and a standard deviation of 4.589. The study was carried out during the academic years 2011–2012 and 2012–2013. LMS is used as a tool to support classes, upload course information an exercises along with a way to communicate among parties.

A paper-based questionnaire was developed and administered to participants in the classroom. All students who attended the lecture on the day of data collection completed and returned the questionnaires. Before carrying out the task, all participants received instructions. The activity was performed by respondents with the support of, at least, one member of the research group. The mission of research group members was to assist respondents during the process and, in case of need, further explain questions and procedure. Subsequently, raw data from the questionnaires was manually digitized, coding responses through commercial statistical analysis software. While this sampling strategy provides clear advantages in terms of time- and cost-savings, as suggested by Margaryan, Littlejohn, and Vojt (2011), it does not account for the total number of potential participants, although it can be considered with enough statistical power given the total sample size.

3.3. Instrument validation

The purpose of this section is to analyze the different threats to the study conducted regarding conclusion validity, construct validity, internal validity and external validity.

3.3.1. Threats to content and conclusion validity

Content validity is the degree to which items in an instrument reflect the content universe to which the instrument will be generalized (Boudreau, Gefen, & Straub, 2001). This validity was verified by checking the meanings of indicators and by a careful literature review. To ensure content validity, a pilot questionnaire was made prior to the final implementation of the instrument. The sample for this pilot study was composed of seven e-learning experts and member of the academia. The objective of this pilot study was the improvement and assurance of the associated documentation. This resulted in several changes regarding the wording of questions.

Conclusion validity is concerned with the relationships between dependent and independent variables, that is, the provision of statistically-correct conclusions based on correct measures and appropriate statistical analyses. In the case of this study, authors considered that the sample and its size were convenient and significant enough to test the proposed research questions.

3.3.2. Threats to internal and external validity

The internal validity is concerned with factors that may affect dependent and which are out of researchers' control. In this case, authors believe that this threat should come from the fact that subjects may not have comparable levels of knowledge or expertise. Given that respondents were in all cases chosen because of their expertise and experience, the authors tested whether both group of students possessed a comparable level of knowledge and expertise. To achieve this objective, the dataset was examined for potential bias in terms of type of respondent. Since respondents included both undergraduate and graduate computer science students, one could argue that graduate students may have more expertise. More specifically, to test this possible bias, the sample was divided into two groups: graduate students versus final year undergraduate students. One-way ANOVA was used to compare the means of factor scores between the two groups. No significant differences were found, suggesting that the type of respondent did not cause any survey biases.

Construct validity is the extent to which a construct measures the concepts that it purports to measure (Straub, 1989). It has two components: convergent and discriminant validity. Convergent validity assesses consistency across multiple constructs, while discriminant validity examines whether different constructs diverge from one another. Moreover, construct reliability measures the degree to which measures are free from random error, and therefore yield consistent results. As reported in the following sections, multiple tests to ensure construct validity and reliability were performed.

External validity refers to the extent to which research findings can be generalized, and to what extent the findings are of interest to other purposes. Regarding external validity, two different threats are assumed. The first is the size of the sample, which can complicate the generalization of the results. The second is the fact that the sample was not taken randomly, it depended on the students who attended lectures in a given day or a fixed set of days.

3.4. Measures

Given that the TAM is a well-established model with refined measures for each variable, the questionnaire items for each variable were adapted from previous research using the model and its adaptations. The questionnaire included four sections and measures: respondent profile, LMS and Dropbox use and expertise, overall evaluation, perceived ease of use and perceived usefulness. The final measure of each construct used in the data analyses was created as an average of the items included in each variable. The formulation and criteria for answering the questionnaire is defined in Appendix A.

The validity of constructs is confirmed by relating a measuring instrument to a general theoretical framework in order to determine whether the instrument is tied to the concepts and theoretical assumptions employed. In order to obtain evidence of construct validity, this work assessed convergent validity and discriminant validity. For the first one, the item-to-total correlation was examined. The lower limit suggested in the literature is 0.4. Discriminant validity was checked by a factor analysis. Each variable must have a factor loading on a single factor over 0.5. As shown in Table 1, results confirmed that each construct was one-dimensional and factorially different and that all items employed for operationalizing a particular construct loaded on a single factor. The reliability is the accuracy or precision of a measuring instrument, that is, the extent to which the respondent can answer the same or practically the same value each time. Internal reliability was assessed by calculating the Cronbach alpha. It can also be observed that acceptable values (above 0.70) were obtained in all cases. Relatively high values of reliability and validity imply that the instruments used in this study were adequate. As presented in Table 1, tests of reliability and validity for the scales presented acceptable values in all cases.

Closer examination on the interpretability of the analyses showed that the resulting constructs clearly reflected overall evaluation, perceived ease of use and perceived usefulness as originally identified in the literature. Construct 1 consisted of variables measuring purely attitude toward using technology, while constructs 2 and 3 were formed of items related to perceived ease of use. Considering these characteristics and given the presence of the variables grouped in constructs 2 and 3, they were named perceived ease of use (required effort) and perceived ease of use (usability), respectively. With regard to factor 4, it genuinely represented perceived usefulness. Therefore, the constructs obtained allowed us to measure attitude toward using technology, perceived ease of use and perceived usefulness of both LMS and cloud file hosting services. Constructs and associated items can be consulted in Table 2.

To begin the data analysis, a bivariate correlation analysis was performed that included all the constructs and associated items considered in our study. High correlations among many of these items were found, suggesting the data reduction techniques used were highly appropriate. Descriptive statistics and bivariate correlation coefficients of constructs and associated items are presented in Table 2.Next results regarding the detailed and comparative analysis between LMS and cloud file hosting services (Dropbox) are presented.

4. Results

To analyze whether differences existed between LMS and Dropbox, difference of means tests were used. More specifically, equal variances were assumed when homogeneity of group variances existed (Levene's test > 0.05), while unequal variances were considered when data presents heterogeneity of group variances (Levene's test < 0.05).

To begin the data analysis, we explore actual system use of both technologies. One of the more informative variables about the utilization of these tools is the frequency of use. As shown in Table 3, statistically significant differences between LMS (Mean = 4.31) and Dropbox (Mean = 4.79) were not found regarding frequency of use ($t(240) = 5.029$, $p > 0.01$). Homogeneity of group variances was considered when the significance of Levene's test was above 0.05. Thus, both tools share similar frequency of use among users. Nonetheless, statistically significant differences are found for the users' tool choice between LMS (Mean = 1.85) and Dropbox (Mean = 6.45), Dropbox being by far the users' primary choice ($t(240) = 24.774$, $p < 0.01$). Also, statistically significant differences are found with regard to the hours spent per week with these tools (($t(240) = -33.800$, $p < 0.01$). Dropbox is used an average of 38.85 h per week, while LMS are used an average of 3.21 h per week.

Although, as commented above, a similar frequency of adoption of both tools was found, these levels of adoption do not seem to guarantee similar levels of expertise. As a result, statistically significant differences between LMS (Mean = 2.62) and Dropbox (Mean = 3.67) were obtained for users' expertise ($t(240) = -7.707$, $p < 0.01$). Differences regarding expertise may be explained through technology use, since the adoption of both technologies is very similar.

Next we proceed with data analysis regarding the three factors considered from the TAM: attitude toward using technology, perceived ease of use and perceived usefulness. As far as attitude toward using the technology is concerned, Dropbox received a better overall evaluation than LMS, as shown in the last row of Table 4. In this sense, differences were found for the attitude toward using the technology construct by technology [$t(240) = -15.851$, $p < 0.01$]. In addition, item by item, Dropbox was judged as a better [$t(240) = -20.377$, $p < 0.01$], wiser [$t(240) = -17.448$, $p < 0.01$], more favorable [$t(240) = -10.950$, $p < 0.01$], more beneficial [$t(240) = -6.876$, $p < 0.01$] and positive tool [$t(240) = -8.842$, $p < 0.01$] than LMS.

Regarding perceived ease of use, Dropbox obtained more favorable results than LMS for both constructs: perceived ease of use (required effort) and perceived ease of use (usability). As presented in Table 5, statistical significant differences with respect to the constructs perceived ease of use (required effort) [$t(240) = 19.440$, $p > 0.01$)] and perceived ease of use (usability) [$t(240) = -21.247$, $p > 0.01$)] existed in favor of Dropbox. As a

Table 1
Statistics for reliability and validity tests.

Constructs	Items	Reliability (Cronbach α)	Convergent validity (correlation of item with total store-item)	Discriminant validity (factor loading on single factors)
1. Attitude Towards Using (ATU)	5	0.914	0.886; 0.913; 0.863; 0.827; 0.861	0.889; 0.505; 0.817; 0.760; 0.914; 0.884; 0.919; 0.809; 0.744
2. Perceived Ease of Use (PEU) (required effort)	5	0.900	0.789; 0.892; 0.879; 0.861; 0.827	0.759; 0.881; 0.872; 0.886; 0.854
3. Perceived Ease of Use (PEU) (usability)	4	0.907	0.807; 0.875; 0.939; 0.930	0.804; 0.856; 0.949; 0.942
4. Perceived Usefulness (PU)	9	0.918	0.879; 0.611; 0.803; 0.789; 0.877; 0.855; 0.893: 0.814; 0.710	0.505; 0.817; 0.760; 0.914; 0.884; 0.919; 0.809; 0.744

Table 2
Bivariate correlation coefficients for Constructs and indicators. Bold denotes aggregated constructs.

Construct and items	Av	S.D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1. **ATU**	2.8	1.1																										
2. Good–bad	3.3	1.5	0.8[c]																									
3. Wise–foolish	3.0	1.3	0.9[c]	0.8[c]																								
4. Fav.–unfavor.	2.7	1.1	0.8[c]	0.7[c]	0.8[c]																							
5. Benef.–Harm.	2.4	1.1	0.8[c]	0.6[c]	0.6[c]	0.6[c]																						
6. Positive–Negat.	2.5	1.1	0.8[c]	0.6[c]	0.7[c]	0.6[c]	0.9[c]																					
7. **PEU (r. effort)**	5.1	1.2	−.7[c]	−.7[c]	−.7[c]	−.6[c]	−.5[c]	−.6[c]																				
8. Cumbersome	5.0	1.6	−.7[c]	−.7[c]	−.7[c]	−6[c]	−.5[c]	−.6[c]	0.8[c]																			
9. Rigid and inflex.	4.7	1.5	−.6[c]	−.7[c]	−.6[c]	−.5[c]	−.4[c]	−.5[c]	0.9[c]	0.6[c]																		
10. Mental effort	5.3	1.3	−.5[c]	−.5[c]	−.5[c]	−.5[c]	−.4[c]	−.4[c]	0.8[c]	0.5[c]	0.6[c]																	
11. Effort skillful	5.5	1.2	−.5[c]	−.5[c]	−.5[c]	−.5[c]	−.4[c]	−.4[c]	0.8[c]	0.4[c]	0.6[c]	0.8[c]																
12. Frust. Interac.	4.7	1.6	−.6[c]	−.6[c]	−.6[c]	−.5[c]	−.4[c]	−.5[c]	0.9[c]	0.6[c]	0.7[c]	0.7[c]	0.8[c]															
13. **PEU (usabil.)**	2.6	1.3	0.8[c]	0.8[c]	0.8[c]	0.7[c]	0.5[c]	0.6[c]	−.8[c]	−.7[c]	−.7[c]	−.6[c]	−.9[c]	−.7[c]														
14. Easy learning	2.2	1.3	0.6[c]	0.6[c]	0.6[c]	0.5[c]	0.4[c]	0.4[c]	−.6[c]	−.5[c]	−.6[c]	−.5[c]	−.5[c]	−.5[c]	0.8[c]													
15. Easy operate	3.1	1.7	0.7[c]	0.8[c]	0.7[c]	0.6[c]	0.4[c]	0.5[c]	−.7[c]	−.7[c]	−.7[c]	−.6[c]	−.6[c]	−.7[c]	0.8[c]	0.6[c]												
16. Easy rememb.	2.7	1.4	0.7[c]	0.7[c]	0.7[c]	0.6[c]	0.5[c]	0.6[c]	−.7[c]	−.6[c]	−.7[c]	−.5[c]	−.5[c]	−.6[c]	0.9[c]	0.6[c]	0.7[c]											
17. Easy interact.	2.7	1.4	0.7[c]	0.7[c]	0.7[c]	0.6[c]	0.5[c]	0.6[c]	−.7[c]	−.7[c]	−.7[c]	−.5[c]	−.5[c]	−.6[c]	0.9[c]	0.6[c]	0.7[c]	0.9[c]										
18. **PU**	4.5	0.9	0.4[c]	0.4[c]	0.4[c]	0.3[c]	0.2[c]	0.3[c]	−.4[c]	−.3[c]	−.4[c]	−.3[c]	−.3[c]	−.4[c]	0.5[c]	0.3[c]	0.5[c]	0.4[c]	0.4[c]									
19. Improv. work	4.7	1.1	0.2[c]	0.3[c]	0.3[c]	0.2[c]	0.1[c]	0.2[c]	−.2[c]	−.2[c]	−.1[b]	−.2[c]	−.2[c]	−.2[c]	0.2[c]	0.2[c]	0.3[c]	0.2[c]	0.2[c]	0.9[c]								
20. Improv. contr.	3.6	1.7	0.6[c]	0.7[c]	0.6[c]	0.5[c]	0.4[c]	0.5[c]	−.7[c]	−.6[c]	−.5[c]	−.6[c]	−.6[c]	−.7[c]	0.7[c]	0.5[c]	0.7[c]	0.6[c]	0.6[c]	0.6[c]	0.4[c]							
21. Accom. Tasks	4.6	1.0	0.3[c]	0.3[c]	0.2[c]	0.2[c]	0.2[c]	0.2[c]	−.3[c]	−.3[c]	−.2[c]	−.2[c]	−.2[c]	−.3[c]	0.2[c]	0.2[c]	0.3[c]	0.2[c]	0.2[c]	0.8[c]	0.8[c]	0.4[c]						
22. Critical supp.	4.3	1.2	0.4[c]	0.4[c]	0.4[c]	0.3[c]	0.2[c]	0.3[c]	−.4[c]	−.4[c]	−.3[c]	−.4[c]	−.4[c]	−.4[c]	0.4[c]	0.3[c]	0.5[c]	0.4[c]	0.4[c]	0.8[c]	0.6[c]	0.5[c]	0.6[c]					
23. Inc. Productiv.	4.6	1.1	0.1[c]	0.1[c]	0.2[c]	0.2[c]	0.1	0.1	−.1[c]	−.1[a]	−.1[a]	−.2[c]	−.2[c]	−.1[b]	0.2[c]	0.1[a]	0.1[c]	0.2[c]	0.2[c]	0.9[c]	0.8[c]	0.3[c]	0.7[c]	0.6[c]				
24. Job perform.	4.6	1.1	0.2[c]	0.2[c]	0.2[c]	0.2[c]	0.1	0.1	−.2[c]	−.1[c]	−.1[b]	−.2[c]	−.2[c]	−.2[c]	0.2[c]	0.1[b]	0.2[c]	0.2[c]	0.2[c]	0.8[c]	0.7[c]	0.3[c]	0.6[c]	0.6[c]	0.8[c]			
25. I do more job	4.6	1.0	0.2[c]	0.2[c]	0.3[c]	0.2[c]	0.1[b]	0.2[c]	−.3[c]	−.2[c]	−.2[c]	−.3[c]	−.3[c]	−.3[c]	0.3[c]	0.2[c]	0.2[c]	0.3[c]	0.3[c]	0.9[c]	0.7[c]	0.4[c]	0.7[c]	0.6[c]	0.9[c]	0.8[c]		
26. Effectiveness	4.4	1.2	0.3[c]	0.3[c]	0.2[c]	0.3[c]	0.1[a]	0.1[c]	−.3[c]	−.3[c]	−.2[c]	−.3[c]	−.3[c]	−.3[c]	0.4[c]	0.3[c]	0.4[c]	0.4[c]	0.3[c]	0.8[c]	0.6[c]	0.4[c]	0.5[c]	0.5[c]	0.7[c]	0.7[c]	0.7[c]	
27. Easier job	4.4	0.9	0.1[b]	0.1[a]	0.1[c]	0.1[c]	0.1	0.1	−.2[b]	−.2[b]	−.1[b]	−.1[b]	−.1[b]	−.1[a]	0.2[c]	0.2[c]	0.1[c]	0.2[c]	0.2[c]	0.7[c]	0.6[c]	0.2[c]	0.5[c]	0.5[c]	0.6[c]	0.6[c]	0.6[c]	0.5[c]

Note: OE: Overall Evaluation; PEU: Perceived ease of use; PU: Perceived usefulness.
[a] Significance level: $0.05 < p \leqslant 0.1$.
[b] Significance level: $0.01 < p \leqslant 0.05$.
[c] Significance level: $p \leqslant 0.01$.

Table 3
LMS and Dropbox use and expertise.

	LMS Mean	Dropbox Mean	Levene's test Levene (sig.)	Equal variances *t* (sig.)	Unequal variances *t* (sig.)
Frequency of use (1–5)	4.31	4.79	0.000	–	0.000
User choice (1–7)	1.85	6.45	0.000	–	0.000
Hours spent (#)	3.21	38.85	0.000	–	0.000
Expertised user (1–7)	2.62	3.67	0.512	0.000	–

Note: (1–5): five-point Likert-type scale (1 – extremely unfrequent; 5 – extremely frequent); (1–7): seven-point Likert-type scale (1 – strongly disagree; 7 – strongly agree); (#): continuous variable.

Table 4
Attitude toward using technology by tool.

	LMS Mean	Dropbox Mean	Levene's test Levene (Sig.)	Equal variances *t* (sig.)	Unequal variances *t* (sig.)
Good–bad	4.56	2.08	0.911	0.000	–
Wise–foolish	4.02	2.07	0.001	–	0.000
Favorable–unfavorable	3.33	2.07	0.477	0.000	–
Beneficial–harmful	2.85	1.98	0.135	0.000	–
Positive–negative	3.05	1.93	0.727	0.000	–
Attitude toward using	3.56	2.03	0.000	–	0.000

Note: Seven-point semantic differential rating scales.

result, concerning perceived ease of use as required effort, Dropbox was found to be less cumbersome [$t(240) = 18.414$, $p < 0.01$], less frustrating [$t(240) = 17.360$, $p < 0.01$], less rigid and inflexible [$t(240) = -16.711$, $p < 0.01$] as well as with less mental effort [$t(240) = -9.701$, $p < 0.01$] and time to become skillful [$t(240) = 8.549$, $p < 0.01$] than LMS. Similarly, items associated with perceived ease of use (usability) indicated that Dropbox was easier to learn [$t(240) = -10.289$, $p < 0.01$], easier to operate [$t(240) = -10.289$, $p < 0.01$], easier to remember [$t(240) = -17{,}047$, $p < 0.01$] and easier to use for interacting than LMS. In sum, it can be concluded that perceived ease of use is higher for Dropbox than LMS.

As shown in the last row of Table 6, statistical differences with respect to perceived usefulness between LMS and Dropbox were found [$t(240) = -7.399$, $p < 0.01$]. In general, results indicated that the perceived usefulness of Dropbox is above that of LMS. Item by item, Dropbox better improves work quality [$t(240) = -3.560$, $p < 0.01$], improves control [$t(240) = -19.726$, $p < 0.01$], increases task accomplishment [$t(240) = -3.987$, $p < 0.01$], supports critical aspects [$t(240) = -7.696$, $p < 0.01$], increases productivity [$t(240) = -2.045$, $p < 0.05$], improves performance [$t(240) = -2.838$, $p < 0.01$], permits doing more job [$t(240) = -4.036$, $p < 0.01$], enhances effectiveness [$t(240) = -5.891$, $p < 0.01$] than LMS. However, results indicated that for the item "using it makes it easier to do my job" statistical differences were not found. Thus, it can be concluded that perceived usefulness is higher for Dropbox than LMS.

Based on the TAM model, results showed that Dropbox receives better valuation than LMS for the three considered constructs: *attitude toward using, perceived ease of use and perceived usefulness.*

5. Discussion

This research applied TAM to investigate the motivations that lead higher education students to replace several LMS services with cloud file hosting services in the field of information sharing

Table 5
Perceived ease of use by tool.

	LMS Mean	Dropbox Mean	Levene's test Levene (sig.)	Equal variances *t* (sig.)	Unequal variances *t* (sig.)
Cumbersome	3.82	6.27	0.656	0.000	–
Interacting is frustrating	3.47	5.98	0.844	0.000	–
Rigid and inflexible	3.55	5.81	0.060	–	0.000
Lot of mental effort	4.66	6.04	0.987	0.000	–
Lot of effort to become skillful	4.90	6.12	0.159	0.000	–
Perceived Ease of Use (required effort)	4.08	6.04	0.000	–	0.000
Easy learning to operate	2.93	1.40	0.000	–	0.000
Easy to do what I want to do	4.55	1.66	0.223	0.000	–
Easy to remember	3.75	1.58	0.070	–	0.000
Easy and clear interaction	3.67	1.65	0.200	0.000	–
Perceived Ease of Use (usability)	3.72	1.57	0.167	0.000	–

Note: Seven-point Likert-type scales (1 – strongly agree; 7 – strongly disagree).

Table 6
Perceived usefulness by tool.

	LMS Mean	Dropbox Mean	Levene's test Levene (Sig.)	Equal variances *t* (sig.)	Unequal variances *t* (sig.)
Improves work quality	4.99	4.51	0.033	–	0.000
Improves control	4.93	2.21	0.206	0.000	–
Accomplish tasks	4.89	4.40	0.069	0.000	–
Support critical aspects	4.90	3.76	0.000	–	0.000
Increases productivity	4.79	4.51	0.265	0.042	–
Improves performance	4.77	4.38	0.145	0.005	–
I-do-more-job	4.86	4.35	0.237	0.000	–
Enhances effectiveness	4.88	4.02	0.182	0.000	–
Easier to do the job	4.54	4.34	0.856	0.092	–
Perceived usefulness	4.84	4.05	0.436	0.000	–

Note: Seven-point Likert-type scales (1 – strongly agree; 7 – strongly disagree).

and collaboration. Research findings extend previous research that has investigated (e.g. Hunsinger & Corley, 2012) or reported (Lorenz et al., 2012) the use of Dropbox to cover certain weaknesses of LMS within the higher education setting. More specifically, results showed that Dropbox obtained better results for the three considered constructs: *attitude toward using, perceived ease of use and perceived usefulness*. As a consequence, our four research questions were answered in favor of the cloud file hosting tool (Dropbox). More specifically, perceived ease of use is higher for the case of cloud file hosting services than LMS (RQ1), while perceived usefulness is lower for LMS than for cloud file hosting services (RQ2). Moreover, attitude toward using cloud file hosting services is above that of using LMS tools (RQ3) and, finally, LMS usage is more motivated by the obligatory of its use rather than users' preference (RQ4), given that Dropbox presents notable results in the User Choice aspect (6.45) compared to LMS (1.85).

Our study complements recent research, which using other theories such as the theory of planned behavior (e.g. Hunsinger & Corley, 2012) analyzed the factors that motivate users to use tools such as Dropbox. The theory of planned behavior models the relationship of attitude to behavior by identifying a social factor called the subjective norm and perceived behavioral control. Hunsinger and Corley (2012) found that attitude, subjective norm and perceived behavioral control are positively related to users' intention to use a tool such as Dropbox. Thus, our results suggest that evaluating the effectiveness of these tools based on the three considered constructs (attitude toward using, perceived ease of use and perceived usefulness) is correct, given that high reliability and validity of the measures were found in these constructs. However, these constructs may not fully predict complex aspects such as intention to use, attitude or behavioral motivation. For instance, whereas this study evaluated attitude toward using the technology, the factor subjective norm (influence from lectures or colleagues), which has a strong affective component, may affect behavioral intention. Moreover, the affect factor, although measured indirectly through items pertaining to Perceived ease of use, is an absent factor in our investigation. Despite of the acknowledged limitations, our findings suggest that standard learning tools outcomes are limited with regard to productivity, effectiveness and student performance. In contrast, cloud file hosting services such as Dropbox allow the integration of the tool within the learning process, which favors productivity, effectiveness, flexibility and less required mental effort. Overall, these results corroborate that academic institutions prioritize academic and institutional objectives rather than focus on general learning needs and student collaboration.

6. Conclusions, limitations and future research

Grounded in the TAM, this paper analyzes the motivations that lead higher education students to replace LMS tools and services with cloud file hosting services for information sharing and collaboration among them. Recent research (García-Peñalvo et al., 2011) suggests that LMS suffer from several limitations such as the lack of openness, resistance to change, failure to take into account the user, lack of integration with the informal context and so on. In contrast, file hosting tools such as Dropbox enable new function such as storing and sharing files over the Internet through file synchronization. As a consequence, folders shared among different users, after a certain time are automatically updated.

Results showed that Dropbox receives better valuation than LMS for the three considered constructs: *attitude toward using, perceived ease of use and perceived usefulness*. These results show the limitations of LMS with regard to collaborative work and information/knowledge sharing. Thus, higher education institutions must prioritize general learning needs and student collaboration rather than focusing on academic and institutional objectives. A possible solution to the question in hand here is to integrate cloud file hosting services within the e-learning process and, for certain activities such as student collaboration and file sharing, avoid using LMS. Also, LMS tools could be upgraded to incorporate the features that nowadays differentiate LMS tools from cloud file hosting services.

This study has some obvious limitations, which will be addressed in future research. First, the study was conducted on a narrow sample of the overall student population. Second, the sample was taken from individuals who have long experience with computers and e-learning and should not be used to represent individuals who are not very much involved with ICT. In future research, a sampling frame that combines individuals with less computer expertise and a larger sample should be used. Third, this study is cross-sectional. Future research designs could include a longitudinal study to increase the ability of making causal inferences. Fourth, whereas this study evaluated attitude toward using the

technology, the factor subjective norm (influence from lectures or colleagues), which has a strong affective component was not used. Thus, future research designs should incorporate other factors such as subjective norm and/or perceived behavioral control.

Appendix A. Measures

Constructs and items	Description
Overall evaluation (LMS/Dropbox)	
	Using LMS/Dropbox in your job is:
Good–bad	1 – extremely good; 2 – quite good; 3 – slightly good; 4 – neither good or bad; 5 – slightly bad; 6 – quite bad; 7 – extremely bad
Beneficial–harmful	1 – extremely beneficial; 2 – quite beneficial; 3 – slightly beneficial; 4 – neither beneficial or harmful; 5 – slightly harmful; 6 – quite harmful; 7 – extremely harmful
Wise–foolish	1 – extremely wise; 2 – quite wise; 3 – slightly wise; 4 – neither wise or foolish; 5 – slightly foolish; 6 – quite foolish; 7 – extremely foolish
Positive–negative	1 – extremely positive; 2 – quite positive; 3 – slightly positive; 4 – neither positive or negative; 5 – slightly negative; 6 – quite negative; 7 – extremely negative
Favorauble–unfav.	1 – extremely favourab.; 2 – quite favourab.; 3 – slightly favourab.; 4 – neither favourab. or unfav.; 5 – slightly unfav.; 6 – quite unfav.; 7 – extremely unfav.
Perceived ease of use (LMS/Dropbox)	
	I find LMS/Dropbox cumbersome to use (1–7)
	Learning to operate LMS/Dropbox is easy for me (1–7)
	Interacting with LMS/Dropbox is often frustrating (1–7)
	I find it easy to get LMS/Dropbox to do what I want I to do (1–7)
	LMS/Dropbox is rigid and inflexible to interact with (1–7)
	It is easy for me to remember how to perform tasks using LMS/Dropbox (1–7)
	Interacting with LMS/Dropbox requires a lot of mental effort (1–7)
	My interaction with LMS/Dropbox is clear and understandable (1–7)
	I find it takes a lot of effort to become skillful at using LMS/Dropbox (1–7)
Perceived usefulness (LMS/Dropbox)	
	Using LMS/Dropbox improves the quality of the work I do (1–7)
	Using LMS/Dropbox gives me greater control over my work (1–7)
	LMS/Dropbox enables me to accomplish tasks more quickly (1–7)
	LMS/Dropbox supports critical aspects of my job (1–7)
	Using LMS/Dropbox increases my productivity (1–7)
	Using LMS/Dropbox improves my job performance (1–7)
	Using LMS/Dropbox allows me to accomplish more work than would otherwise be possible (1–7)
	Using LMS/Dropbox enhances my effectiveness on the job (1–7)
	Using LMS/Dropbox makes it easier to do my job (1–7)

Note: (1–7) Seven-point Likert-type scale (1 – strongly agree; 7 – strongly disagree).

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