A Usability Study of Social Media Credentials As A Single-Sign-On Mechanism: Student Access to Online Teaching Materials

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***Abstract*—Web single-sign-on (SSO) is a mechanism that enables a user to login to the systems once and allows the user to access all authorized computer resources without the need to reenter the authentication information in each application. One example of web SSO mechanism is through the use of social media credentials. This paper presents an experimental study that aimed to investigate whether the SSO mechanism provides better usability compared to traditional authentication method. This study revealed significant results where web SSO through social media credentials had better usability compared to traditional login for accessing teaching materials. It demonstrates the evidence to guide future web development particularly for designing authentication in a course web site.**

***Index Terms*—single-sign-on, social media credentials, usability, teaching materials, course web site**

I. Introduction

In this digital era, instructors use learning management systems (LMS) or public websites for sharing learning materials with students. The current site-centric paradigm requires students to supply their personal information multiple times for registration purpose and login to each of the web applications by supplying their login credentials (i.e., usernames and passwords). In general, normal Internet users manage multiple login credentials at one time. Due to this scenario, many users often practice poor login credential management that may expose themselves to many security threats.

Generally, this issue can be solved by using an identity management tool for authenticating users on different web applications specifically web single-sign-on (SSO). SSO is a mechanism that enables a user to login to the system once and allows the user to access all authorized computer resources without the need to reenter their profile in each application. A popular example of web SSO mechanism is through the use of social media credentials such as Facebook and Twitter.

In this paper, we present an experimental study that aimed to evaluate the usability of web SSO compared to traditional authentication method to access teaching materials. This study is expected to provide evidence to guide instructors and web developers when designing authentication facility of a web site.

The remaining of this paper is organized as follows: Section II presents an overview to SSO. Then, the experimental study is explained in Section III. Section IV presents the results and discussions on the findings. Finally, Section V concludes the paper as well as highlighting future research recommendations.

II. Web Single-Sign-On (SSO)

User authentication is a fundamental security requirement for most of the systems nowadays. Authentication allows service providers to monitor their user access to the web sites. Traditional login that uses a pair of user ID/name and password is still the primary means to authenticate users in web applications [1].

Web users are responsible on their own account creation, and handling of their usernames and passwords for each registered web site. Furthermore, they are required to enter the same data multiple times in different web sites to populate their profile in order to complete the sign up process [2].

Many studies have been conducted in the past to investigate the number of passwords a user owned. It was estimated that a typical web user has about twenty-five accounts that require passwords and a user enters approximately eight passwords in a day [3]. A survey by Brown, Brocken, Zoccoli, & Dauglas [4] reveals that students have an average of 8.18 passwords with 4.45 unique passwords. This shows that web users are now handling quite a number of login credentials. Unfortunately, study by Miller [5] revealed that a human only capable to remember seven distinct items in his/her short-term memory. A question rises that is, how the web users manage their login credentials effectively.

A large number of applications with individual traditional authentication can affect the ease of use [6] and burden the web users in managing their identity which can lead to "password fatigue" [7]. Besides, online profile and content information are restricted and only available to administrators of single domain in site centric environment; hence, making the profile sharing is difficult across different domains [8].

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Maintaining credentials can be easier, with recent technology where users and applications providers can simply eliminate the hassle to maintain a large number of user profiles. This is where the web SSO plays its role. OpenGroup defined SSO as "a mechanism that after a single action of user authentication enables a user to access all computer and systems where he/she has the access right, without the need to reenter the multiple passwords" [9]. Web SSO is conceptually similar to regular SSO, but they are limited to browser-based applications. Social media credentials are a popular SSO mechanism that is widely used including, Facebook, Twitter and GoogleID.

There is an abundance of research papers [2], [7], [10]-[12] highlighted the multifold benefits of SSO including reduce the password memorization and resetting burden , improve user experience, reduce "password fatigue" and increase user productivities.

III. The Experimental Study

A. Method

A controlled experimental study was designed to answer the research questions: "Do social media credentials have better usability than traditional authentication method?"

A one-way within subject design analysis that compared usability of social media credentials and traditional login facility was conducted. Based on the research question outlined earlier, the independent variable was identified as the type of login facility (i.e., traditional and social media credentials). The dependent variable is usability that was measured in three dimensions: usefulness, ease of use and satisfaction. The alternative and null hypotheses for this study are presented below:

H1: There is a difference in terms of usability of social media credentials and traditional login facility for student to access the course web site

H0: There is no difference in terms of usability of social media credential and traditional login facility for student to access the course web site

B. Participants.

A total of 68 students from INTI College Penang volunteered to participate in this study. However, only 66 participants attended and completed the whole experimental session, and these data were used for the following analysis. There were total of 52 (79%) males and 14 (21%) females. The female participants were less than the male participants because all the participants were from School of IT which has male students as the dominating gender. The average age of the participants was 18.79 years, range between 17 – 22 years.

The participants were divided into two groups equally to counterbalance the presentation of the interface: Group 1 (26 males and 7 females) participants performed traditional login before Social media credentials, Group 2 (26 males and 7 females) participants performed social media credentials login before traditional login.

C. Instrumentation.

A web application known as Course Website (CWS) and a usability questionnaire were the instruments used to facilitate the data collection of this experimental study.

CWS was the main instrument used to understand usability of social media credentials and traditional login for the participants to access the teaching materials. The social media credentials and traditional login facility features were available in this system served as the experimental and control condition respectively. Table I summarizes the differences between the two login facilities.

TABLE I. The Differences of Social Media Credentials and Traditional Login

	Social media credentials	**Traditional Login**
Registration process	Semi-auto. Users were directed to Social media credentials provider and user profile information was extracted from the Social media credentials provider and a linked account will be created automatically.	Manually. Users were required to create a user account by entering user profile information.
New user name and password required	No. Users used the existing Social media credentials user name and password	Yes. User needed to remember the new username and password created.
Auto Login feature	Yes. If users already login to another system (non-CWS) using Social media credentials. No authentication was required while accessing CWS. CWS automatically login the user into the system.	No. Users were required to supply user name and password each time login to the system after logout.

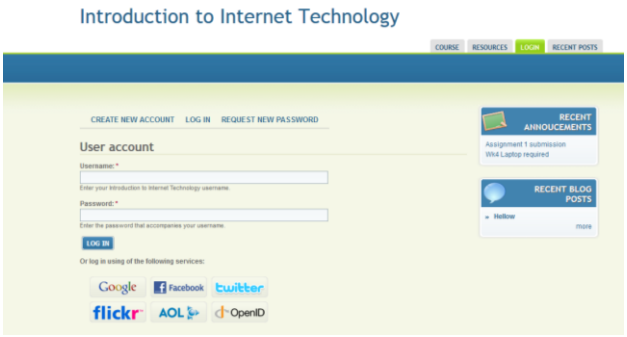

Figure 1. The main interface for CSW

Fig. 1 shows the CWS user interface of two login facilities, traditional and social media credentials. Traditional login facility required the users to enter the user name and password to access to the system. CWS adapted the Yahoo recommended social media credentials login user interface to improve usability. It allows options for the users to select popular providers' logo that can eliminate data entry of social media credentials account in URL format.

Registration for a new account is required for the first time access to the system. Information such as username, email address and password were needed for traditional

login account creation. Password must follow the policy with minimum of 6 characters, combination of uppercase, lowercase, and at least a number and a symbol. For social media login facility, CWS will create and link the user account automatically based on user profile extracted from Social media providers. User's social media credentials will not be stored in the CWS.

The post-task usability questionnaire was adapted from ASE IBM [13] and was used to measure the users' satisfaction (2 items) of the task (upon a task execution completion). The post-session questionnaire was adapted from [14] which used to measure the usability in three dimensions: Usefulness (7 items), ease of use (11 items) and satisfaction (7 items) were measured after the participants completed the whole tasks scenario in the experiment. A seven-point Likert Scale (i.e., one represented 'strongly disagree' and seven represented 'strongly agree') was used in the questionnaire.

The result of a reliability analysis of the usability responses and its subscales suggested the Cronbach's Alpha coefficients that of greater than 0.7 (i.e., ranging from 0.750 to 0.926), indicating high internal consistency of the data.

D. Procedures

The experiment was conducted face to face for each individual participant to ensure each task was perform as requested and any doubt from the participants could be clarified immediately. This experiment was carried out in an isolated room with wired connection to avoid any interruption and slow wireless connection which could impact the test. All cases were performed using the same client laptop to ensure the result will not be influenced by the processor's speed.

Before the start of the experiment, each participant was briefed with an information sheet about the study, informing how the experiment would be performed. Then, a consent form was given to each participant. Each participant had to give consent to participate in this study.

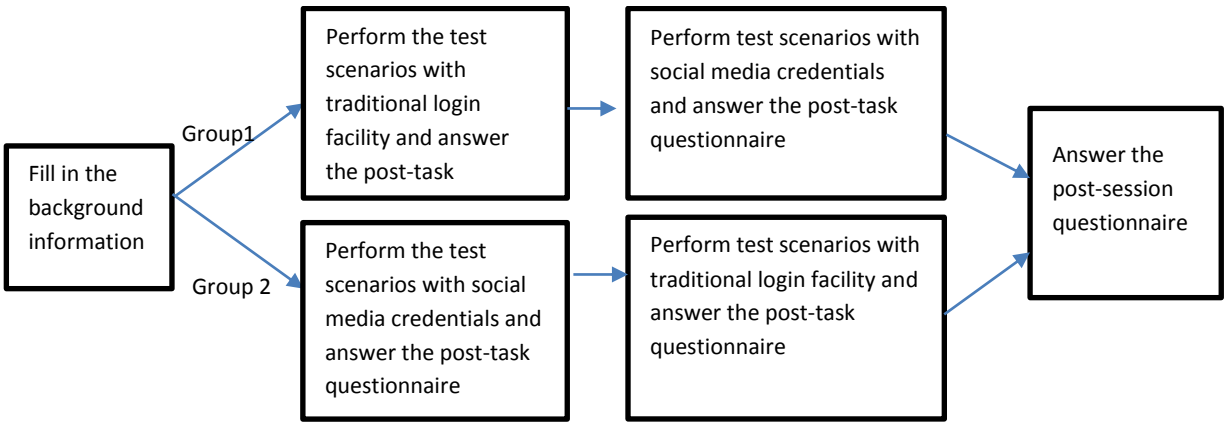

Figure 2. Procedure for conducting the experiment

After completing the background information, each participant was instructed to perform two sets of similar task scenarios using both social media credentials and traditional login facility. To reduce learning effects, the procedure has counterbalance the order in which login facility would be performed by assigning participant in one of two groups. Participant in Group 1 (G1) performed traditional login first, while Group 2 (G2) worked with social media credentials first. Fig. 2 illustrates the procedure.

As this experiment separated the participants into two groups and presented the user interface in different orders (G1 – Traditional UI first, G2 – Social Media credentials UI first) thus, a non-parametric Mann Whitney U test has been performed to investigate whether the order of conditions affects the users' usability ratings.

The participants' responses in cocial media credentials gained higher median score than the traditional login for all usability measurement in term of usefulness, ease of use and satisfaction for both group, G1 and G2. These indicated the orders of UI presentation did not impact the usability rating.

Further analysis with Mann Whitney U test revealed no statistical significant different between G1 and G2 ($z = -0.308$ to -1.583, $p = 0.123$ to 0.758) for all the usability ratings and login preferences. Thus, the results suggested that the order of UI presentation did not affects the rating of usability in this experiment.

IV. Results and Discussions

All data analyses and statistical tests for this study were performed using SPSS Version 19. A code book was developed to ease the author to enter data into the SPSS system without any confusion. Prior to perform any major statistical analysis, data screening procedure by using descriptive statistic and frequency count was performed to identify and correct the integrity of data entry, missing values and outliers together with a reliability test.

A normality test following the Kolmogorov-Smirnov (K-S) showed that the dependent variables were not normally distributed ($p < 0.05$). Hence, the discussion of the results in the next section of this article will be reported based on non-parametric data analyses. Non-parametric statistical tests following Wilcoxon Signed Rank Test was used to test on the hypotheses of this study. The study used an alpha level of .05 for all the statistical tests.

A. Participants' Background Knowledge

The Internet usage was considered high for all the participants. 97% of the participants browsed the Internet daily. The number of web accounts managed by the participants is considered high as well. Only 20% of the participants had 3 or less web accounts. There are 45% of the participants who had 4-10 web accounts, 27% of the participants had 11-20 web accounts and 8% of the participants had more than 21 web accounts. Most of the participants had SSO experience however, they did not aware that they had used it. There were 77% of the participants used single copy of username and password to log into multiple websites. However, only 12% of participants heard about single sign-on and 29% heard about social media credentials.

B. Usability

After completing the interaction with CSW, the participants were asked to rate 1 to 7 (1-strongly disagree, 7-strongly agree) on the overall usability of the traditional and social media credentials in three dimensions: usefulness, ease of use and satisfaction.

Table II presents the median and signed ranks of the usability scores. The overall usability of social media credentials (Md=5.69) in CWS was higher compared to the traditional login facility (Md=3.90). Looking at the specific individual dimensions of usability, all dimensions (usefulness, ease of use and satisfaction) received higher scores in social media credentials compared to traditional login. These descriptive analyses indicated that social media credential was useful, easier to use and able to provide higher satisfaction compared to the traditional login facility. Among the three dimensions, usefulness scored the highest ranking and ease of use scored the lowest ranking.

The Wilcoxon Signed Rank test revealed statistically significant differences in usability and all its dimensions (usefulness, ease of use and satisfaction) between social media credentials and the traditional login facility, where $z=-6.509$ to -6.890, $p < 0.05$, with large effect size, $r = 0.57$ to 0.60. All positive mean ranks were higher than the negative mean ranks. Thus, the results suggested that social media credentials had higher usability in terms of usefulness, ease of use and satisfaction compared to the traditional login facility.

TABLE II. THE MEDIANS FOR THE USABILITY SCORES

	Traditional Login	**Social media credentials**	**Social media credentials – Traditional**					**Statistic Significant**
	(n=66) Median	**(n=66) Median**	**Negative Rank**		**Positive Rank**		**Tie**	
			N	**Mean Rank**	**N**	**Mean Rank**		
Usefulness	3.63	5.88	1	28.50	63	32.56	2	z=-6.766, p<0.05. Sig.
Ease of use	4.09	5.64	3	18.50	63	34.21	0	z=-6.708, p<0.05, Sig.
Satisfaction	3.71	5.86	8	8.38	56	35.95	2	z=-6.509, p<0.05,Sig.
Overall	3.90	5.69	2	13.5	64	34.13	0	z=-6.890, p<0.05,Sig.

C. Discussion

This study aimed to compare the usability of social media credentials and traditional authentication method.

This experimental study revealed significant differences between social media credentials and the traditional authentication method in terms of their usability. The finding showed that social media credentials obtained higher ranking in terms of the overall usability. Further analysis on the individual dimensions of usability: usefulness, ease of use and satisfaction revealed that social media credentials obtained higher ranking for all three dimensions than the traditional login with statistically different. Among the three dimensions, usefulness obtained the highest scores. In contrast, ease of use obtained the lowest scores.

This research provides evidence that social media credentials is able to provides better usability compared to the traditional login. These finding can serve as a guide for instructors when designing a web site that requires authentication. They shall consider in providing alternative login facility to the traditional login for web site to speed up registration process and increase usability of the system. Furthermore, this study can be adopted and used by web site developer when designing a similar material-sharing web site to improve their system usability.

Although, the design of the study had successfully answered the research questions as discussed earlier, yet the result of the experimental study has certain limitations. Firstly, all the participants were volunteers from INTI College Penang School of IT students. Participation from other tertiary institutions can offer more generalized results. Apart from that, there were more males compared to females participated in this study. The unequal gender might confound the result in this study. Secondly, all the participants used the two-click feature to access social media credentials account which eliminated the steps that required participant to enter the social media credentials account URL.

Lastly, this experimental study restricted the participants to use the provided computer to perform the designed tasks in different time frame. The experimental study assumed the network connection and speed were the same across the time frame. Besides that, the experimental study only examined the first-time user experience without examined participants' daily usage behaviors due to limited time (within 3-4 months) given to complete this research.

V. Conclusion

This research aimed to identify whether social media credentials is more usable (in terms of usefulness, ease of use and satisfaction) than the traditional authentication method. The usability evaluation proved that social media credentials is able to provide better usability in term of usefulness, ease of use and satisfaction compared to the traditional login. The findings provide a guideline to instructors, web site designers and developers to consider offering alternative login facility in their web sites. However, this might be limited to applications that do not involve non-sensitive data.

In future, it is recommended that another similar study shall involve participants with diverse background (mixture of IT and non-IT participants across multiple institutions). Besides that, an investigation on the daily usage of social media credentials behaviors shall be studied to provide more realistic results. In additional, investigation on the perception and awareness about social media credentials among different age level would be another interesting research area. Lastly, future research shall investigate the relationship between usability and security.

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References

[1] L. Holt, "Increasing real-world security of user IDs and passwords," in *Proc. Information Security Curriculum Development Conference (InfoSecCD '11)*, New York, NY, USA, 2001, pp. 34-41.
[2] E. Maler and D. Reed, "The venn of identity: Options and Issues in federated identity management," *IEEE Security & Privacy*, vol. 6, pp. 16-23, March-April 2008.
[3] D. Florencio and C. Herley, "A large-scale study of web password habits," in *Proc. 16th International Conference on World Wide Web*, 2007, pp. 657-665.
[4] A. S. Brown, E. Bracken, S. Zoccoli, and K. Douglas, "Generating and remembering passwords," *Applied Cognitive Psychology*, vol. 18, pp. 641-651, 2004.
[5] G. A. Miller, "The magical number seven, plus or minus two: Some limits on our capacity for processing information," *Psychological Review*, vol. 101, pp. 343, 1994.
[6] F. Alecu, P. Pocatilu, G. Stoica, C. Ciurea, and S. Capisizu, "OpenID, a single sign-on solution for e-learning applications," *Journal of Mobile, Embedded and Distributed Systems, North America*, vol. 3, pp. 136-141, 2011.
[7] S. T. Sun, Pospisil, E. I. Muslukhov, N. Dindar, K. Hawkey, and K. Beznosov, "What makes users refuse web single sign-on?: An empirical investigation of OpenID," in *Proc. Seventh Symposium on Usable Privacy and Security*, July 2011, pp. 4.
[8] S. T. Sun, K. Hawkey, and K. Beznosov, "Secure web 2.0 content sharing beyond walled gardens," in *Proc. Computer Security Applications Conference*, 2009, pp. 409-418.
[9] Open Group. (2010). Single Sign on [Online] Available: http://www.opengroup.org/security/sso/
[10] D. Anchan and M. Pegah, "Regaining single sign-on taming the beast," in *Proc. 31st Annual ACM SIGUCCS Fall Conference*, New York, NY, USA, 2003, pp. 166-171.
[11] A. Myllyniemi. "Identity management systems: A comparison of current solutions," *Security and Privacy in Pervasive Computing*, 2006.
[12] S. James. Web Single Sign-On Systems. [Online]. Available: http://www1.cse.wustl.edu/~jain/cse571-07/ftp/websso.pdf
[13] J. R. Lewis, "IBM computer usability satisfaction questionnaires: Psychometric Evaluation and instructions for use," *International Journal of Human-Computer Interaction*, vol. 7, pp. 57-78, 1995.
[14] A. M. Lund, "Measuring Usability with the use questionnaire," *Usability Interface*, vol. 8, pp. 3-6, 2001.

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