ONLINE SOCIAL NETWORKING-BASED HEALTH EDUCATION: EFFECTS ON STUDENTS' AWARENESS AND PRACTICE OF LABORATORY SAFETY

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ABSTRACT
This study examined the effects of integrating instructional materials in Facebook on students' awareness and practice of laboratory safety. A quasi-experimental pretest-posttest two-group design was used in the study. The results indicate: 1.) The exposure to (Online Social Networking-Based Health Education) OSNBHE can improve students' awareness of laboratory safety (ALS) ($p < 0.05$); 2.) The exposure to OSNBHE can improve practice of laboratory safety (PLS) ($p < 0.05$); and, 3.) The ALS does not predict PLS ($R^2 = 0.09$, $CI = 95\%$).
Keywords: Online social networking; Health education; Awareness of laboratory safety; Practice of laboratory safety

INTRODUCTION

The school laboratories are essential venue for learning. However, these laboratories are endowed with hazards which can lead to the occurrence of accidents and jeopardize the safety of all its users, especially the students (IUPAC, 1992; Weigmann & Shappell, 2002). The incidence of accidents in the school laboratories has increased in the previous years. In The Charlotte Observer article, "Mishaps in School Labs Reveal Lack of Safety", Tammy Webber (2002) of the Associated Press (AP) reported the following: "…. at least 150 students have been seriously injured in school lab accidents in the past four years in the United States; and…. in Iowa, there were 674 accidents in the three school years from fall 1990 through spring 1993, but more than 1,000 in the following three years".

In the Philippines, the Biochemistry laboratory of the 100-year-old Institute of Chemistry Building at the Pavilion 2 of Palma Hall at the University of the Philippines in Diliman, Quezon City, was burnt down last 2010 (Botial, 2010). In addition, a mixture of chemicals released toxic fumes in the science laboratory of San Isidro High School in Makati City on November 27, 2006. Following the incidence, 10 teachers and staff were sent to the hospital after bouts of vomiting and skin rashes. Classes were also suspended and nearby residents were evacuated (National Research Council of the National Academies, 2011). Furthermore, on February 16, 2006, a mercury spill incidence occurred in the science laboratory of St. Andrew School in Paranaque City. Ten students were admitted to the Philippine General Hospital for reported symptoms of mercury exposure. Local and national public health officials closed the school to prevent the further spread of mercury and poisoning of more students (United States Environmental Protection Agency, 2008).

The increasing prevalence of accidents involving students in the science laboratory calls for efficient measures to eradicate, or if not, lessen accident occurrences. One of these measures is the development of awareness and practice of laboratory safety. Harvard University (2012) emphasized, "….awareness is the most fundamental rule of safety". Thus, the provision of information on the awareness and practice of laboratory safety among students is seen as a primordial step in the attainment and maintenance of an accident-free laboratory (Dyer & Andreasen, 1999; Georgia State University, 2008; Harvard University, 2012, Penker & Elston, 2003; Zhao, Li, & Wen, 2007).

Safety promotion, through health education, among adolescent students can be done in various teaching and learning approaches (Dyer & Andreasen, 1999; Redden, 1987; Syrek, 2011; Towner, 1995). However, studies have found out that more students are supplementing or replacing lectures, seminars, and course materials with educational resources that they can access via the World Wide Web or the Internet (Katz, 2008; Liu, 2010). Hence, contemporary learners are said to belong in a "Net-centric" (Baird & Fisher, 2006), "Digital Natives" (Prensky, 2001) and "Web 2.0" (Liu, 2010) generation.

Lenhart (2009) reported that 93% of teens use the Internet in the United States. In the Philippines, social networking is the single most popular online activity among Filipino Internet users, with about nine in ten (89%) have ever used online social networking sites like Facebook or Friendster (Labucay, 2011, p.12). In addition to its social utility, various studies have documented the positive effects of online social networking on learning outcomes such as improvement on interpersonal skills (Yu, Tian, Vogel & Kwok, 2010), acquisition of

knowledge on medicine (Weicha, Cheti, Pollard & Shaw, 2006) and development of self-regulation which includes motivational factors in learning (Mario, 2009).

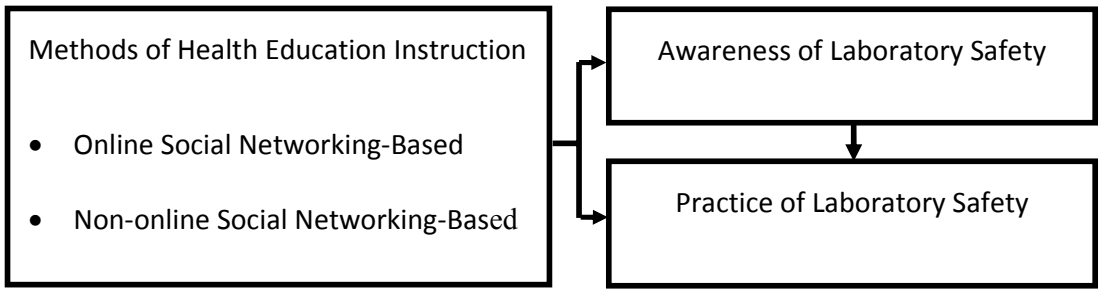
With its prominence among the youth (Labucay, 2011; Lenhart 2009; Liu, 2010) and its potential as an alternative learning resource as posited by various studies (Koishi, 2004; Liu, 2010; McLoughlin & Lee, 2007; Yu et al., 2010), online social networking is a potential tool on the promotion of awareness and practice of laboratory safety and may subsequently serve as an efficient medium of teaching and learning on the creation and maintenance of an accident-free school laboratory.

The undertaking of this research significantly contributed to the areas of theory, research, practice and policy. In theory, this study affirmed Alfred Bandura's Social Learning Theory (1977) whereby social activities, such as online social networking, are posited as media for the expression of a learner's self-directed active engagement function- an impetus for achieving learning outcomes (viz., awareness and practice of laboratory safety). In research, this study essentially magnified the effectiveness and limitations of online social networking as an alternative and supplementary medium of instruction on developing students' awareness and practice of laboratory safety. In practice, this study provided relevant data for academicians and other stakeholders on the significance and methodology of incorporating online social networking into the pedagogy of safety education among adolescent learners. Lastly, in policy, this study served as reference and impetus among policy-makers, legislators and the like to further spearhead efficient and sustainable policies on the development and improvement of Information and Communication Technology (ICT) in the field of safety education locally and internationally.

THEORETICAL FRAMEWORK

The potential of online social networking in the provision of an alternative pedagogical milieu can be explicated by the social learning theory. According to Bandura's social learning theory (1977), individuals' self-directed active engagement functions as an initial motive for achieving desirable learning outcomes. In the online social networking sites, individuals are equipped with an extraordinary capacity to express themselves, establish various relationships, and interact with others at any distance in time and space, addressing their self expressive, networking and informational needs. To activate such learning and fulfill these needs, online social networking engagement is required (i.e., devoting time and psychological energy to these sites). Individuals can present themselves in an online viewable profile and articulate their social networks. Also, they can establish and maintain extensive relationships with peers and selectively develop further interactions. Those advanced social networking applications greatly expand the number of individuals' learning objects (i.e., connected friends) and their information seeking scope. They can mimic the targeted models/peers by viewing the profiles and exploring the hobbies, interests, or specific knowledge of others, as well as learn a particular topic of interest (i.e., academic subjects) by joining a network or group page and thus finding the information of the topic. Second, it is the individuals' interactions with peers and the situated environment that actually achieve learning outcomes (Bandura, ibid.), functioning as carriers of their initial learning engagement to desirable outcomes. These interactions have been characterized as social acceptance and acculturation in the socialization literature (Bauer, Bodner, Erdogan, Truxillo, & Tucker, 2007; Morrison, 1993; Morrison, 2002). In addition to the direct effect of online social networking engagement on learning outcomes, social acceptance and acculturation, as being important socialization processes, can transform individual online social networking behavior into learning outcomes (Yu, Tian, Vogel & Kwok, 2010).

CONCEPTUAL FRAMEWORK



The framework shows the relationship of the two methods of instruction for health education to the awareness and practice of laboratory safety. The independent variable of the study is the method of instruction. The dependent variables of the study are the awareness and the practice of laboratory safety. An arrow connects the two constructs to show the relationship between the awareness and practice of laboratory safety.

An arrow connecting the methods of health education instruction and the constructs (viz., awareness and practice of laboratory safety) is shown to emphasize the significance of the different methods of instruction in the promotion of awareness and practice of laboratory safety among students. The conventional method in the promotion of safety is lecture-seminar. Internet-based learning resources have been posited to have a positive influence on the improvement of learning outcomes (Mario, 2009; Yu et al., 2010; Weicha et at., 2006). The learning outcomes are cognitive (i.e., awareness of laboratory safety) and skill-based (i.e., practice of laboratory safety) (Kraiger, Ford & Salas, 1993; Schmidt & Ford, 2003).The two constructs represent the two goals of the chemistry laboratory safety program -- raising awareness and encouraging enthusiasm for safe practice among laboratory users (Becker, 1987; Dyer & Andreasen, 1999). Furthermore, an arrow connecting the constructs is illustrated to present the possible relationship of the awareness and practice in the promotion of safety in the laboratory. According to Becker (ibid.) and Dyer and Andreasen (ibid.), an awareness of the need to operate safely in the laboratory is required before knowledge is put to effective use.

RESEARCH HYPOTHESES

The research hypotheses of the study are the following:

1. The ALST posttest scores of the students exposed to OSNBHE are significantly higher than of those who were not.
2. The PLST posttest scores of the students exposed to OSNBHE are significantly higher than of those who were not.
3. Awareness of laboratory safety is a significant and positive predictor of laboratory safety.

METHODOLOGY

The Sample

The sample consisted of 16 college students, 6 males and 10 females, with the mean age of 18 years. They were enrolled in a chemistry laboratory course in a private college in Pasay City, Metro Manila, The Philippines, in the 1st semester of Academic Year 2012-2013. They were randomly assigned to either OSNBHE or NOSNBHE group. There were 10 students in the OSNBHE group, 4 males and 6 females. The NOSNBHE group had 6 students, 2 males and 4 females. The number of respondents cannot assume a normal distribution (i.e., mean scores of each student cannot be representative to that of the general population's) thus non parametric statistics (Wilcoxon signed rank and sum rank tests) was used in the study. Ranks of the scores of each student were given more significance in the analysis of data.

Research Design

The study utilized a quasi-experimental pretest-posttest two-group design to determine the effects of OSNBHE on students' awareness and practice of laboratory safety. Visually, the design is as follows:

EG:	**A**	**P**	**X**	**A'**	**P'**
CG:	**A**	**P**	**-X**	**A'**	**P'**

Where;

EG: experimental group
CG: control group
A: Awareness of Laboratory Safety pretest for the experimental and control groups
P: Practice of Laboratory Safety pretest for the experimental and control groups
X: exposure to Online Social Networking-Based Health Education (OSNBHE)
-X: exposure to Non-online Social Networking-Based Health Education (NOSNBHE)
A': Awareness of Laboratory Safety posttest for the experimental and control groups
P': Practice of Laboratory Safety posttest for the experimental and control groups

The Instruments

The instruments used in the study were the Awareness of Laboratory Safety Test (ALST) and the Practice of Laboratory Safety Test (PLST). Prior to their use in the study, the content and construct of the instruments were validated by a group of experts in the field of chemistry laboratory safety which was composed of a licensed chemist, MS Chemistry student and chemistry instructor; a Food Safety and Sanitation laboratory instructor and MS Food Science graduate; and, a Department of Chemistry and Life Sciences chairperson and chemistry

professor. The ALST was print-tested to college students in a different university, who were also enrolled in a chemistry laboratory course, for item analysis, done one week prior to the actual administration of tests to both groups. The coefficient of reliability was recorded at $\alpha = 0.80$ which suggests a satisfactory internal consistency and reliability (i.e., the chance that the ALST is measuring the awareness of laboratory safety of students in chemistry is 80%)(George, 2000).

- **Awareness of Laboratory Safety Test (ALST)**

This is a researcher-developed checklist on the components of a laboratory design and their safety conditions and safe practices in the laboratory. This was utilized to assess the awareness of the students on the actual presence of physical hazards in their chemistry laboratory and their awareness on the ideal and safe practices during the conduct of experimentation. This consisted of 20 items on the awareness of safe laboratory conditions and 15 items on the awareness of safe laboratory acts -- both of which are answerable by yes or no.

- **Practice of Laboratory Safety Test (PLST)**

This is a researcher-developed checklist on fundamental safe laboratory practices. This was used by the licensed chemist, the chemistry laboratory instructor of the respondents and the researcher, to evaluate the actual performance of safe laboratory practices of students during their conduct of laboratory experimentations. This is composed of 15 questions on the fundamental safe laboratory practices which are answerable by yes, no or N/A (not applicable).

Data Collection Procedure

The duration of the data collection procedure lasted for two weeks for both OSNBHE and NOSNBHE groups, from the administration of the pretests to the posttests of the ALST and PLST. The ALST and PLST pretests were administered on the first and second days of data collection for the OSNBHE and NOSNBHE groups, respectively. A licensed chemist also used the ALST to evaluate the presence of physical hazards in the laboratory anytime between the administration of ALST pretest and posttest. The answers of the chemist in the ALST served as the standard to which the answers of the OSNBHE and NOSNBHE respondents in the ALST pretest and posttest were compared with for correctness. Furthermore, the OSNBHE respondents provided their Facebook account names on the ALST pretest.

In the PLST, the respondents of both groups were evaluated by the licensed chemist, the chemistry laboratory instructor of the respondents and the researcher on their actual performance of safe laboratory practices during the conduct of three chemistry laboratory experimentations (viz., Solubility, Acids and Bases, and Metals and Acids). The three experiments (i.e., one in the pretest and two in the posttests) that were performed were similar in both groups. The respective scores of each respondent on the PLST as graded by the three evaluators were averaged.

Once the two groups' scores were found comparable in the ALST and PLST pretests, the teaching methodologies were implemented to both groups. The OSNBHE respondents were invited to visit the researcher-made Facebook group page account entitled, "Awareness and Practice of Laboratory Safety", where discussions (thread), photos and videos on the awareness and practice of laboratory safety were incorporated/ uploaded in. The respondents were given a 48-hour period to accept the invitation to be officially part of the OSNBHE group. Furthermore, they were instructed to like the discussions, photos or videos after viewing any of these in order for the researcher to monitor their access to and use of the instructional materials. On the other hand, the NOSNBHE group was facilitated with a lecture-seminar on the promotion of awareness and practice of laboratory safety. The contents and presentation of the lessons in the lecture-seminar were similar to those on the Facebook group page for the OSNBHE group. To control teacher factor, the researcher facilitated both the lecture-seminar for the NOSNBHE group and video presentations and discussions in the group page for the OSNBHE group. Furthermore, the duration of the lecture-seminar was also similar to the duration of the video uploaded in the group page.

The PLST posttests were administered twice during the conduct of two laboratory experimentations of the respondents one week after the implementation of the teaching methods (viz., lecture-seminar for NOSNBHE group and visit to the Facebook group page account for the OSNBHE group) to evaluate the retention and application of the knowledge on the awareness and practice of laboratory safety of the students in each group. The ALST posttest, on the other hand, was administered on the second week of data collection after the two posttests of PLST had been administered to both groups. For the OSNBHE group, the survey-checklist on the OSNBHE was administered after the administration of the ALST posttest.

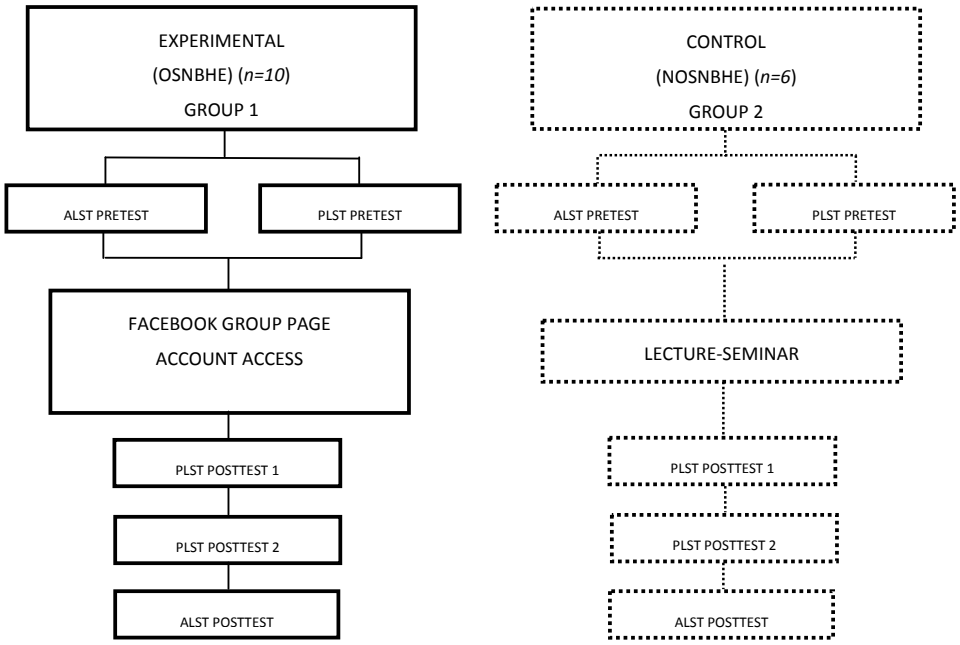


Figure 3. Flowchart of the data collection procedure of the study.

RESULTS

Awareness of Laboratory Safety

Table 1 enumerates the posttest scores of the OSNBHE and NOSNBHE groups in the ALST. A directional Wilcoxon rank sum test for the ALST posttest scores of the two groups concludes that the ALST posttest scores of the OSNBHE are not higher than the scores of the NOSNBHE group in the ALST posttest ($p = 0.0559$).

Table 1. Wilcoxon rank sum test for the ALST posttest scores of the OSNBHE and NOSNBHE groups.

NOSNBHE			OSNBHE		
Student	**ALST posttest score (%)**	**Rank**	**Student**	**ALST posttest score (%)**	**Rank**
A_1	89	9.5	B_1	94	15
			B_2	94	15
A_2	71	2	B_3	89	9.5
A_3	83	6	B_4	91	12.5
			B_5	94	15
A_5	89	9.5	B_6	74	3
			B_7	91	12.5
A_5	80	4.5	B_8	66	1
A_6	80	4.5	B_9	89	9.5
			B_{10}	86	7

To evaluate if there is a significant difference between the pretest and posttest scores of the OSNBHE group in the ALST, a nondirectional Wilcoxon signed rank test was performed on the said two scores. The result suggests that there is a significant difference between the two tests ($p < 0.05$). Hence, the exposure to OSNBHE can be inferred to have positively influenced the level of awareness of laboratory safety of the respondents in the experimental group. However, since the ALST posttest scores of the OSNBHE group are not higher than the ALST posttest scores of the NOSNBHE group and no significant difference is noted between the ALST posttest

scores of the two groups (p = 0.1118), it can be deduced from the study that both the exposure to the lecture-seminar of the NOSNBHE group and the visit to the Awareness and Practice of Laboratory Safety Facebook group page of the OSNBHE group were effective in increasing the level of awareness of laboratory safety.

Practice of Laboratory Safety

Table 2 shows the mean scores of the OSNBHE and NOSNBHE groups in the two PLST posttests. A directional Wilcoxon rank sum test for the PLST posttest scores of each respondent in the two groups indicates that the PLST posttest scores of the OSNBHE group are higher than the PLST posttest scores of the respondents in the NOSNBHE group ($p < 0.05$). Hence, it can be deduced from the result that the students exposed to OSNBHE performed laboratory experimentations more safely than the students exposed to NOSNBHE.

Table 2. Wilcoxon rank sum test for the PLST posttest scores of the OSNBHE and NOSNBHE groups.

NOSNBHE			OSNBHE		
Student	**PLST posttest score (%)**	**Rank**	**Student**	**PLST posttest score (%)**	**Rank**
A_1	60	5.5	B_1	71	8.5
A_2	60	5.5	B_2	71	8.5
			B_3	73	11
A_3	40	1	B_4	72	10
			B_5	83	16
A_4	59	4	B_6	69	7
A_5	46	2.5	B_7	74	12
			B_8	76	13.5
A_6	46	2.5	B_9	82	15
			B_{10}	76	13.5

Table 3. PLST pretest and posttest scores of the OSNBHE group.

Student	PLST pretest score (%)	Mean PLST posttest score (%)	D= post-pre	*I* D *I*	Sign of D	R
B_1	65	71	6	6	+	3
B_2	62	71	9	9	+	4.5
B_3	64	73	9	9	+	4.5
B_4	58	72	14	14	+	6
B_5	81	83	2	2	+	1
B_6	66	69	3	3	+	2
B_7	58	74	16	16	+	7.5
B_8	60	76	16	16	+	7.5
B_9	64	82	18	18	+	9
B_{10}	53	76	23	23	+	10

A directional Wilcoxon signed rank test result indicates that there is a significant difference between the pretest and posttest scores of the OSNBHE in the PLST ($p < 0.05$). Thus, the experimental group improved significantly in their performance of safe laboratory practices on two laboratory experimentations after their exposure to OSNBHE. Furthermore, it can be inferred from the findings that the incorporation of instructional materials (e.g., discussions, photos and videos) in the Facebook group page can positively influence and is more

effective in promoting practice of safe laboratory practices among students as compared to the conventional method of lecture-seminar.

Through the utilization of nondirectional Wilcoxon signed rank test, it was found that there is a difference between the PLST mean pretest scores and mean posttest scores of the respondents in the NOSNBHE group ($p < 0.05$). The difference, however, is not positively significant since the PLST mean posttest scores are lower than the PLST mean pretest scores. Thus, it can be inferred from the findings that the lecture-seminar did not promote practice of laboratory safety.

Awareness and Practice of Laboratory Safety

The study further investigated if the awareness of laboratory safety (ALS) influences and predicts practice of laboratory safety (PLS). Since the OSNBHE and NOSNBHE groups' ALST posttest scores are comparable, both were included in the analysis. The posttest scores in the ALST of both groups were subjected to simple linear regression analysis with the mean posttest scores in the PLST of both groups.

The linear regression equation for the PLST score in terms of ALST score is: PLST score = 28.21 + 0.4460 (ALST score). Results of the simple regression analysis indicate that the variation in the ALST scores does not significantly predict the variation of the PLST scores ($R^2 = 0.087$, $CI = 95\%$). Thus, it can be deduced from the findings that ALS does not significantly influence and predict PLS.

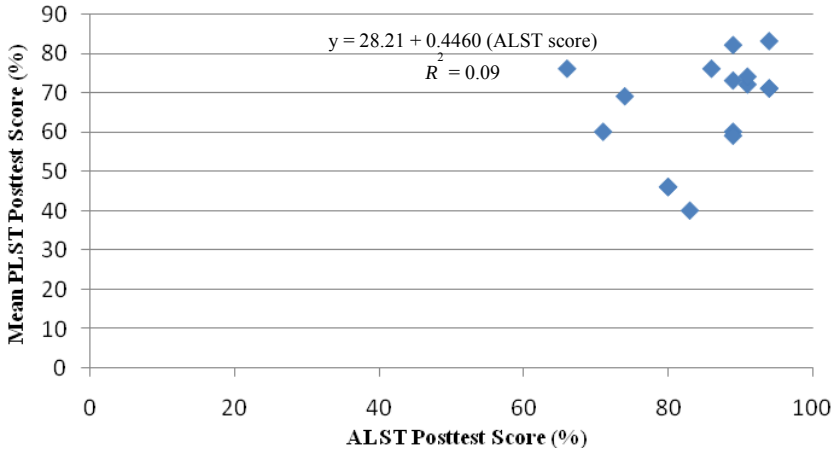


Figure 3. Linear regression analysis of the ALST and mean PLST posttest scores of the OSNBHE and NOSNBHE respondents.

Figure 4. Photograph of proper laboratory decorum used in the OSNBHE.

Figure 5. Video presentation on the Awareness and Practice of Laboratory Safety used in the OSNBHE.

DISCUSSION

Various studies have suggested that online social networking can directly influence social learning and can positively influence academic learning and learning outcomes (Mario, 2009; Weicha, Cheti, Pollard & Shaw, 2006; Yu, Tian, Vogel & Kwok, 2010).

Learning outcomes span three domains: cognitive, affective and skill-based (Kraiger, Ford, & Salas, 1993; Schmidt& Ford, 2003). The knowledge-based cognitive domain is associated with intellectual learning, and thus cognitive learning outcomes include knowledge, comprehension, and application. The attitudinal-based affective domain is related to emotional learning, feelings, being, relationships, and the ability to deal with situations. Affective learning outcomes include students' attitudes, satisfaction, and appreciation of the learning experience. The skill-based domain of learning outcomes concerns the development of critical thinking and the technical skills to solve problems or perform tasks (Yu, Tian, Vogel & Kwok, 2010, p.2). This study investigated the effects of the use of Facebook as a medium of instruction on the development of awareness and practice of laboratory safety among adolescent students. The results of the study suggest that online social networking can significantly improve students' awareness and practice of laboratory safety. This positive effect can be influenced by following factors characterized by and can be offered to users by online social networking.

According to the study by Yu and Tian et al., (2010, p.1), online social networking applications, such as Facebook, offer an efficient platform for college students' socialization by expanding their network scope and maintaining close relationships. Apart from its social significance, Facebook has been posited to contribute essentially in the educational sector. Thus, online social networking is bi-faceted: social and educational. Online social networking sites (SNS) users learn social or interpersonal skills facilitated by the SNSs features or configurations that can enable users to: enhance and maintain friendships, build social networks/establish virtual relationships, diminish barriers to making friends, follow peer trends, share photos, for fun and leisure and to keep in touch with family. On the aspect of learning, Facebook allows connectivity of the faculty and other students in terms of friendship/social relationship, provide comments to peers/share knowledge, share feelings with peers, join Groups established for subjects, collaboration: notification, discussion, course schedule, project management calendar and to use educational applications for organizing learning activities (Yu et al., ibid.).

Online learning has extended its scope of academic utility from the acquisition of fundamental skills (viz., interpersonal skills) to the improvement of learning in the field of medicine. The potential of online learning on improving learning outcomes in medical education has been recently investigated. In a study by Weicha et al., (2006), online learning caused learning improvement of medical students on Diabetes management case study as opposed to face-to-face learning.

Furthermore, this study suggested at least equivalence, if not superiority, of the online method of instruction against the face-to-face method of instruction--a finding consistent with other recently published, well-controlled studies evaluating effectiveness of online learning in medical education.
In addition, this study posited the multi-faceted effects of online social networking on learning and self-improvement as confirmed by related studies. In addition to its significance on the improvement of learning outcomes, social networking has been found out to essentially improve one's physical and psychological health. Recent research has illustrated that young people's online social networking behavior can bring them physical and psychological well-being (Ellison, Steinfield & Lampe, 2007; Steinfield, Ellison, & Lampe, 2008). Furthermore, several studies have investigated and affirmed the positive effects of online-based instruction to

students' self-regulation, which includes metacognitive, motivational, and behavioral factors of one's learning process (Mario, 2009).

Lastly, through this study, a promising future can be envisioned in theory, research, policy and practice on the use of online social networking as an alternative medium of instruction as compared to the teaching methodologies existent in an orthodox learning milieu. With online-based resources, students can have more opportunity to access, review and mimic lessons they uncover from these resources. Thus, the physical and time constraints a conventional classroom teaching is endowed with are overcome by the use of learning resources online. In the lecture-seminar method, students can only have a single opportunity to learn and interact with their mentor, thus the attainment of the retention of practice of laboratory safety among students poses to be a limitation in this method (Daniel, 1997; Lewis, Alexander & Farris, 1997).

CONCLUSION

This study investigated the effects of online social networking on the development of awareness and practice of laboratory safety among adolescent learners. After the treatment, the following conclusions were obtained: 1.) The exposure to the OSNBHE can improve students' awareness of laboratory safety. The improvement, however, is not significantly different from the improvement on the awareness of laboratory safety obtained through the students' exposure to the conventional method of lecture-seminar (NOSNBHE); 2.) Students exposed to OSNBHE performed laboratory experimentations more safely than students exposed to NOSNBHE; and, 3.) The awareness of laboratory safety does not influence and predict practice of laboratory safety.

In reference to the aforementioned results, this study provided a significant reference on the effectiveness of utilizing online social networking as an alternative medium of instruction in the discourse of health and safety education among adolescent learners. With the growing number of adolescent learners locally and internationally and inherent presence of hazards in the school laboratories, online social networking can essentially be utilized by academicians, school administrators, policy-makers, researchers and the like to lessen or eradicate accident occurrences in the laboratories. Thus, this study further posited the vast array of educational benefits that that 21st century's online-based resources can offer today and in the future.

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