Influence of Students' Affective and Conative Factors on Laboratory Learning: Moderating Effect of Online Social Network Attention

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ABSTRACT

According to aptitude theory, the measures of aptitude include not only cognitive factors but also affective factors (i.e., emotions) and conative factors (i.e., motivation) that can influence students' learning achievement (LA). Therefore, this study employed structural equation modelling from experimental data of 96 college students to investigate the effects of affective factors and conative factors on LA using online social network (OSN) attention as a moderating factor. The results confirmed that there are significant differences between student engagement and LA for overall group and student engagement, affective scores, and LA for the high OSN attention group. There are no significant differences for the low OSN attention group. Moreover, learning achievement can better facilitate the effects of the affective and conative levels for students with high rather than low OSN attention. In conclusion, the moderation of OSN attention shows that there are relationships that differ significantly across the high and low OSN attention groups.

Keywords: affective factor; conative factor; learning achievement; online social network attention

INTRODUCTION

Due to aptitude theory, the measures of aptitude include not only cognitive factors but also affective and conative factors that can influence students' learning achievement (LA) (Corno et al., 2001). Affection refers to emotions and conation encompasses motivation (Hilgard, 1980). Except cognition, affection and conation are essential for understanding learning and learning performance (Shavelson et al., 2002). Therefore, this study attempts to investigate the

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State of the literature

- Student engagement and affective scores can be direct factors influencing students to reach higher learning achievement.
- Online social network attention also is a factor that predicts expected learning achievement.
- Whether the relationship between online social network attention and learning achievement is direct or indirect remains unclear.

Contribution of this paper to the literature

- This study investigates the effect of affective factors (e.g., affective scores) and conative factors (e.g., student engagement and online social network attention—as a moderator) on learning achievement.
- The findings demonstrate significant differences between student engagement and learning achievement for overall group and student engagement, affective scores and learning achievement for the high online social network attention group, with no significant differences for the low online social network attention group.
- Further, moderation of online social network attention shows that there are relationships that differ significantly across the high and low online social network attention groups.

effects of affective factors (i.e., affective scores (ASs)) and conative factors (i.e., student engagement (SE) and online social network (OSN)) on LA. Kupermintz (2002) and Fancsali (2014) reported that ASs and SE have a positive relationship with LA, while the relationship between OSN attention and LA remains unknown. Davis III, Deil-Amen, Rios-Aguilar, and Gonzalez Canche (2012) reviewed several studies to examine the value of OSNs in ten educational settings. These researchers found the greatest value of OSNs to reside in the marketing and delivering of college information to students, whereas their value in LA was low. Therefore, this study used the OSN factor as a moderating variable to explain differences between groups of students who pay high and low attention to OSNs.

This study also employed structural equation modelling (SEM) for exploring scale research structural models and hypotheses. SEM generally uses survey data. However, the experiment can also identify SEM cause–effect relationships (Wood, Wood, & Boyd, 2010). Thus, this study attempts to use experimental data. Further, the study has been designed to investigate the effect of ASs and SE on LA and examine the moderating effect of OSN attention. Finally, the implications and limitations of these findings are discussed in terms of social network use.

LITERATURE REVIEW

The affective and conative factor

The aptitude theory was proposed for understanding academic performance and learning factor. It defines an aptitude, as a degree of readiness to learn and to perform well in a particular situation or in a fixed domain, and it includes not only cognition but also affection and conation. Therefore, aptitude measures should include cognition, affection, conation, and achievement (Corno et al., 2001). Further, Snow, Corno, and Jackson (1996) defined affection as a function that describes learning objectives that emphasize emotion and the degree of latitude of acceptance or rejection. Affection consists of attitudes, perceptions, values, interest, and mood. Conation is a function of mental processes, attention or behaviour that tends to develop certain activities, such as motivation, impulse, self-regulation, engagement, attention, and volition. Cognition is a generic term for any process which produces knowledge about an object. This includes perceiving, recognising, conceiving, judging, and reasoning. Due to the aptitude concept, Shavelson et al. (2002) conducted an experiment in high school science courses to further explore the concept of aptitude using a multidimensional approach, comprising mixed methods for large-scale statistical analyses and small-scale interview studies. Also, Kupermintz (2002) established a study to examine the role of affection and conation in high school students' science test performances. The study examined the relationship between motivation and achievement, concluding that motivation, which consists of affection and conation, can explain performance on academic tasks, as predicted by Snow's theoretical argument. Moreover, the studies of Um, Plass, Hayward, and Homer (2012) and Park, Flowerday, and Brünken (2015) concluded that positive affective factors (i.e., emotion) impact the various cognitive processes relevant for learning. In addition, research on conation factors (e.g., Keller, 2010) proposed the Attention, Relevance, Confidence, Satisfaction (ARCS) model demonstrating that motivation indirectly affected learning performance through personal effort.

In summary, the aptitude theory indicates that the factors cognition, affection, and conation are related to achievement. In addition, Kupermintz (2002) has examined the effects of students' affection and conation on their achievement in science. Therefore, the current study investigates the relationship between affection and conation factors on achievement in computer science.

The use of online social networks as a learning management system (LMS)

In recent years, the OSN phenomenon has altered the way in which people communicate with others, anywhere, anytime, and on any device (Wilson, Gosling, & Graham, 2012; Valenzuela, Park, & Kee, 2009). Therefore, many schools/colleges have adopted OSNs for academic purposes (such as for communication or notification), synchronous discussion boards (Lin, Hou, Wang, & Chang, 2013), knowledge construction tools (Prestridge, 2014) and LMSs. Several studies have concluded that OSNs help students to improve learning and

understanding, including their learning achievement (Lampe, Wohn, Vitak, Ellison, & Wash, 2011).

This study focused on the use of OSN group as an LMS for facilitating communication between class members. Recent trends and outcomes of OSN-based research can be summarized as follows. Mazman and Usluel (2010) used Facebook as a social network tool to investigate the relationship between adoption, users' purposes and educational usage of Facebook. Wang, Woo, Quek, Yang, and Liu (2012) conducted an experiment in which OSNs were used as an LMS in two courses for putting up announcements, sharing resources, organising weekly tutorials, and conducting online discussions at a teacher education institute. The conclusion of this study showed that students were satisfied with the affordances of Facebook, as the fundamental functions of an LMS could easily be implemented in a Facebook group. Arquero and Romero-Frías (2013) reported an experience in the use of OSNs to support student involvement, showing that students who used more OSNs had significantly better performance than students with a low usage profile.

To sum up, an OSN as an LMS can be useful in facilitating the following academic purposes: faculty communication with students; creating stronger learning communities; posting portions of lectures for downloading; and facilitating class discussion groups, study groups, project work, and other in-class collaborations (Davis III et al., 2012).

Online social network attention

This literature provides a conceptual measurement of OSN attention (also known as social media attention). For instance, Wang, Liu, Mao, and Fang (2015) noted that open access (OA) articles receive much more social media attention from researchers than non-OA articles. Social media discussion data (the average number of Twitter and Facebook articles) can be used to compare differences between OA and non-OA articles in Nature Communications. Further, Daugherty and Hoffman (2014) measured the dynamics affecting consumer attention (dependent variable) on eWOM communication within social media platforms, using eye tracking as a measurement tool. Attention was operationally defined as the total amount of time participants fixated on pre-identified areas of interest (AOIs). To determine consumer attention, eWOM messages were coded as 16 AOIs (8 images, 8 text elements) relating to the content of each luxury brand. The study indicated that the eWOM message valence interacts with brand type to affect attention differently. In another study, Kushin and Yamamoto (2010) investigated whether social media attention, online expression, and traditional Internet attention for campaigning provided information in relation to political self-efficacy and situational political involvement in a presidential election. The measure of social media attention was based on popular and emerging social media platforms that served as political information traffic leading up to the 2008 campaign. Attention measures were used to assess the information-seeking dimension because they capture cognitive engagement with an information source. Participants used social media sites like YouTube, Facebook, Twitter, and blogs to source political content and commentary from other members of the social media

community as well as to obtain information from news sources and campaigns. The results show that attention to social media for receiving campaign information was not significantly related to political self-efficacy or involvement. Aydin (2014) presented a review of Twitter as an educational environment: Twitter can be used to improve collaboration, develop reflective and critical thinking faculties and to encourage learners to create information and knowledge. Twitter facilitates informal learning, and e-learning positively impacts upon attention and network awareness. Finally, Blankenship (2011) discussed the expanding universe of social media in education and how social media can impact higher education in relation to the five interconnected areas of social media–attention, participation, collaboration, network awareness, and critical consumption.

METHOD

Participants and procedures

In this study, a Facebook group was used as an LMS (Wang et al., 2012) for two classes on Linux networking conducted in 2013 and 2014. The procedures were based on five overall steps: (1) class orientation and pre-test 1; (2) collection data 1—laboratory report and assignments 1 to 3; (3) midterm exam and pre-test 2; (4) collection data 2—laboratory report and assignments 4 to 6 and (5) final exam and interviews.

The participants were 96 undergraduate students. The study was administered from March to May 2013 (35 students) and March to May 2014 (61 students) at a university in Thailand. The 96 participants comprised 46 sophomores (47.92%), 45 juniors (46.88%), 3 seniors (3.13%) and 2 super seniors (2.08%), all of whom were majoring in the Department of Computer and Information Science. There were 66 female participants (68.75%) and 30 males (31.25%).

Research factor and data collection

The study data was collected from students' behaviours and achievements in class and students' activities in the OSN group. Details of ASs, SE levels, LA, pre-test results, and year of study were collected using a 1–5 adjusted score, with OSN attention presenting as ordinal data. From this data, the following research factors were proposed:

1. SE: Students' behavioural engagement and attention in laboratory class. Class engagement was assessed via students' behaviours and the number of completed assignments undertaken in laboratory class (Kupermintz, 2002).

2. AS: Students' affective level regarding emotions, values and importance. The instructor observed the ASs from students' emotions in laboratory class and assessed two open questions regarding value and importance in laboratory report number 6 (Kupermintz, 2002).

3. LA: The total score for the midterm and final exam.

4. OSN attention: The degree of attention on OSNs comprised high OSN attention students (HOASs) and low OSN attention students (LOASs). A HOAS is a student who has two of three online social networking variables (such as 'comment' and 'reached post') that were higher than the mean average value or half of the maximum value (Chin & Dibbern, 2010).

5. Pre-test: Pre-tests 1 and 2 were students' exam scores before the class and after the midterm exam, respectively.

6. Year of study: The four years of undergraduate education comprising freshman, sophomore, junior, senior, and super senior years.

Research model and hypotheses

This study applies Snow's theory of aptitude (Corno et al., 2002, chap. 6), which uses affection and conation to find research factors, create a proposed model, and describe results. Kupermintz (2002) conducted one experiment to examine the effect of students' affection and conation on high school science achievement. In addition, this study deployed OSNs to facilitate student learning as mentioned earlier. We proposed the following hypotheses:

Hypothesis 1 (H1). The greater the level of SE, the higher the LA will be.

Hypothesis 2 (H2). The greater the AS, the higher the LA will be.

Hypothesis 3 (H3). The influence of SE on LA will be moderated by OSN attention, such that the effect will be stronger for HOASs.

Hypothesis 4 (H4). The influence of AS on LA will be moderated by OSN attention, such that the effect will be stronger for HOASs.

In order to eliminate possible systematic errors that could bias results, pre-test and year of study were used as control variables. Prior research reported pre-test (Alexander & Judy, 1988; Dochy, Segers, & Buehl, 1999) and year of study (Meiselwitz, 2002; Forcino, 2013) as factors that affect students' LA levels.
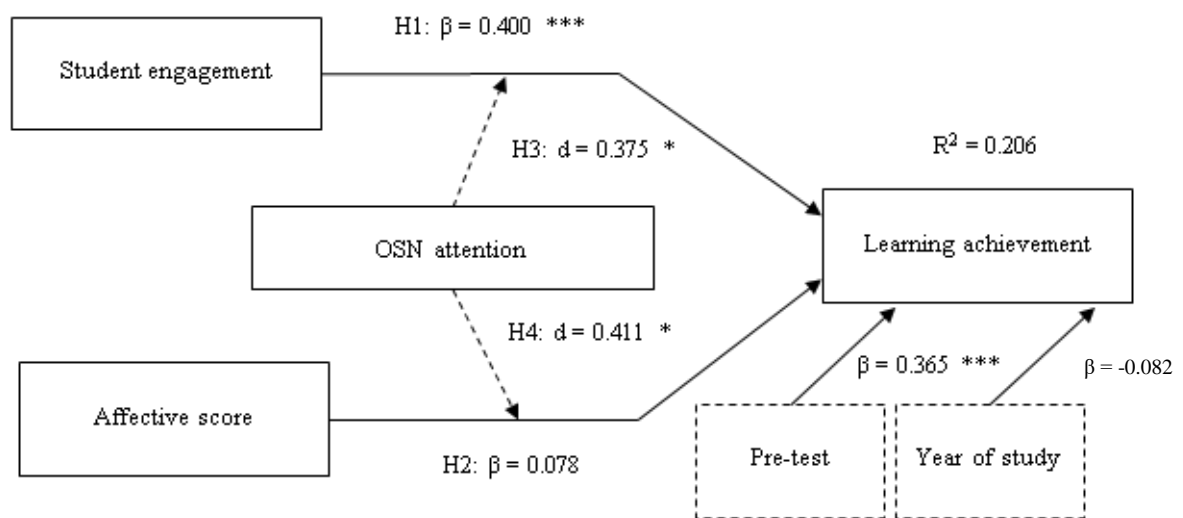
Data analysis and results

This study employed the partial least squares (PLS) approach using the software SmartPLS (Ringle, Wende, & Becker, 2015) for the analysis of scale accuracy, the structural model, and the research hypotheses. The current study used PLS because it renders analysis possible with a relatively small sample size and does not require a normal distribution of data (Chin, Marcolin, & Newsted, 2003).

Model quality criteria

The proposed model necessitated an analysis of the quality criteria (reliability and validity). The scale reliability assessment included Cronbach's alpha, the composite reliability

value and the AVE index. In line with prior literature, corresponding thresholds were 0.70, 0.70 and 0.50, respectively. The current study used experimental data, therefore, all scale reliability values were 1.0 and above thresholds. As a result, the overall sample demonstrated good reliability. The authors assessed convergent validity by factor loading of each scale item on its corresponding construct, using a value of 0.5 as the threshold. As shown, all item loadings exceeded the threshold. In addition, R^2 was evaluated to assess the model fit of the proposed model, and a threshold of R^2 higher than 0.10 was used. The R^2 for this model was above 0.1, as shown in **Figure 1**.

Dotted outline refers to control variables, while dotted lines denote moderating relationships.
Significance level: *p < .05. **p < .01. ***p < .001.
Figure 1. Proposed research model

Model testing and data analysis results

Table 1 shows mean average, standard deviation and minimum/maximum model factors. **Table 2** shows PLS multi-group analysis (PLS-MGA) results of both the HOASs and the LOASs group. As can be seen, both relationships differ significantly across the two groups. However, only the HOAS group has a significant positive relationship between SE (β = 0.419, p < .001), ASs (β = 0.515, p < .001) and LA. The proposed model is shown in **Figure 1**. As observed, the hypotheses H1 (β = 0.400, p < 0.001), H3 (d = 0.375, p < 0.05) and H4 (d = 0.411, p < 0.05) confirm the predictions. However, H2 (β = 0.078, p > 0.05) was not confirmed. As for the two control variables, year of study had an insignificant effect, while the results provided a significantly positive effect of the pre-test result on LA.

Table 1. Factor analysis results

Factor	Mean	S.D.	Minimum	Maximum
Student engagement	3.823	0.632	1	5
Affective score	3.688	0.670	3	5
Learning achievement	2.698	1.134	1	5
OSN attention				
-Number of likes	1.99	2.41	0	20
-Number of comments	0.38	0.98	0	5
-Number of reached posts	54.93	3.24	28	60

Table 2. PLS-MGA results

	Group: HOAS		Group: LOAS		Group: HOAS vs. Group: LOAS			
	$P^{(1)}$	$se(P^{(1)})$	$P^{(2)}$	$se(P^{(2)})$	$\|P^{(1)} - P^{(2)}\|$	t Value	Significance Level	p Value
SE-->LA	0.419***	0.125	0.008	0.151	0.375	2.110	*	0.038
AS-->LA	0.515***	0.115	0.140	0.143	0.411	2.055	*	0.043
n	47		49					

Significance level: *p < .05. **p < .01. ***p < .001.

The results of students' interviews

The results of students' interviews also show that most students agreed that OSN group, which provide learning content, can enable them to learn more effectively in the laboratory. Most learners made comments similar to the following:

- *I always see announced posts from the teacher when I log in to the OSN. Therefore, I download learning material for lab preparation.*

- *I saw some discussion about assignments on the OSN group; they helped me to complete my assignments.*

- *The OSN group is easier than LMS because LMS has too many functions. I cannot use all LMS functions.*

- *Since this course uses the OSN group as an LMS, I never miss any announcements because I am usually on the OSN.*

DISCUSSION AND CONCLUSION

The purpose of this study was to investigate the role of ASs and SE levels on increasing LA in students. The research findings support the hypothesis for SE. The study also introduced a determinant factor, i.e., OSN attention, which moderated the above relationships. As mentioned previously with reference to PLS-MGA, the group's overall results reveal that only SE has a significantly positive effect on LA. For the HOAS group, both relationships were

significantly positive, whereas, LOAS group has no significant relationships. This finding demonstrates three things.

(1) SE, meaning students' classroom behaviour, influences student achievement when they engage in more activities during laboratory classes. This conclusion resembles that of Kupermintz (2002) and corroborates Keller's (2010) ARCS model, which suggests that motivation is influenced by the instructor and the learning materials. Therefore, motivation can be increased if the instructor plans lessons thoughtfully with learners' needs in mind. Also, students will achieve greater learning when they have greater motivation to be engaged in laboratory classes.

(2) AS is a special score that the instructor gives to each student, depending on his/her emotions, values, and importance of contributions in laboratory class. Given the format of the proposed model, the AS factor could not apply to both groups because instructors usually give their students high ASs. In this study, scores ranged between 3 and 5; the small variation in the data revealed no significant differences between groups. However, students in the HOAS group obtained higher achievement levels when they had high ASs. Um et al. (2012) revealed that positive emotions are an important factor in instructional design, especially in multimedia learning environments. Further, they called for laboratory environments that are designed to foster positive emotions using multimedia learning materials such as colorful papers, videos, and web media. Therefore, instructors should use multimedia learning materials to create a positive learning environment in the laboratory classes. For example, this study we provided students an OSN group for distributing learning materials (e.g., text, pictures, documents files, and video clips).

(3) OSN attention as a moderator allows for a categorisation of students into two groups. There are significant differences in factor relations between the two groups. This implies that when students spend greater time on OSNs, the relationships between SE, ASs, and LA are strengthened. Therefore, OSN attention can act as a direct factor in SEM for future research. Further to this study, we facilitated an OSN group as an LMS to students for educational uses such as communication, collaboration, and resource/material sharing (Celik et al., 2015). In student interviews about OSN group use, the participants revealed perceived benefits in using the OSN group for enhancing their learning in laboratories (Valenzuela, Park, & Kee, 2009). In addition to the number of reached posts, it displayed which posts were most announced in the OSN group. Out of 60 posts, each student received on average 54.93 posts. These findings suggest that an OSN group has the potential to be used as an LMS.

There are some limitations that need to be acknowledged in relation to this study. First, the measurement of OSN attention is quite difficult to assess. Future research ought to apply some automatic tracking of participants' attention level on OSN group. Second, in this study, a relatively small sample size was employed. This limited the broad generalisation of results. Future studies should have a greater number of participants.

IMPLICATION

Cognitive processes not only enhance learning and achievement; affective and conative processes can also have this effect. Thus, instructors should provide both learning materials and a suitable environment for enhancing all cognitive, affective and conative processes.

Moreover, OSN attention can lead to higher LA. Therefore, this study suggests the following. First, the instructor should post on OSN group with interesting material, such as video clips and extra Linux instruction, because this results in 'likes' from students. Second, the instructor should ask students to answer questions, which can help students to gain a better understanding (Celik et al., 2015). This occurred when we asked students to answer homework questions or extra questions (those not contained in homework). In these cases, students usually provided comments in response to questions. Extra questions generated a great deal of student feedback via extra comments. Finally, the instructor should announce news or activities on OSN group with short messages notifying students of what will occur in the next class. This can help ensure that students are ready for their next class.

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