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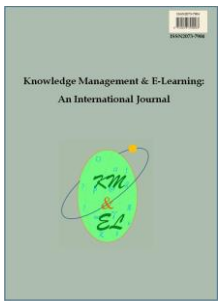

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Self-efficacy in a MOOC environment: A comparative study of engineering students in Taiwan and Vietnam

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Abstract: Most previous studies have focused on learners' self-efficacy in face-to-face learning environments, while few have delved into that of MOOC learners. No research has touched upon the MOOC self-efficacy of engineering students in developed and developing countries. This research compared the self-efficacy levels of engineering students in Taiwan and Vietnam and examined factors predicting their MOOC self-efficacy. An online 11-point Likert scale was sent to 222 students in two sites. An independent t-test was run to compare the MOOC self-efficacy levels of the students. A regression analysis model was used to understand which demographic variables were associated with the students' MOOC self-efficacy. Focus group discussions were conducted with 30 students. Quantitative and qualitative data helped to converge and corroborate research findings. There were no significant differences ($p > 0.05$) in the MOOC self-efficacy levels of the students in the two sites. Students in both universities gave the lowest ratings to the English self-efficacy subscale and the highest to the self-efficacy in the independent learning subscale. Mean scores ranged from 5.24 to 6.44. Students in Taiwan and Vietnam were moderately self-efficacious in three dimensions of the MOOC self-efficacy scale. Factors predicting self-efficacy included English proficiency levels, the number of prior MOOCs, age, and self-regulation. Implications for MOOC design and study were also given in the research.

Keywords: Developing countries; Engineering; MOOCs; Self-efficacy; Comparative study

Biographical notes: Dr. Nga Thi Tuyet Phan is a Vice-Dean in the Faculty of Foreign Languages, the Industrial University of Ho Chi Minh City, Vietnam. Phan got her M.A. in TESOL Studies from the University of Queensland, Australia, in 2005 and a Ph.D. in Education from Waikato University, New Zealand, in 2015. Her research interests include self-efficacy, motivation, and course effectiveness.

1. Introduction

Unlike other online learning modes, Massive Open Online Courses (MOOCs) aim to reach a massive number of students (Liang et al., 2014). One of the principles of MOOCs is that knowledge should be provided freely and openly to any learner regardless of their location or socio-economic status (Aljaraideh, 2019). MOOCs seem to be a good solution

for students in developing countries as they have access to free and world-class knowledge (Ma & Lee, 2018). However, Ma and Lee (2018) highlighted that most MOOCs learners are from Western industrialized countries, while the number of learners from Asia and Africa is limited. In addition, past reports stated that learners in developing countries are more likely to drop out of MOOCs than those in developed areas (Kizilcec & Halawa, 2015). Many reasons for MOOCs' limited participation and higher drop-out rate in developing countries have been listed, including cultures and educational backgrounds (Liang et el., 2014), economy and technology (Ma & Lee, 2018), language problems (Chung, 2015), previous experience with MOOCs, and poorly designed peer activities (Elizondo-Garcia et al., 2019). It seems that figuring out ways to encourage the adoption of MOOCs in developing countries and increase the persistence of MOOC learners is necessary for teachers and educators.

In Social Cognitive Theory, perceived self-efficacy is defined as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997). Several researchers (e.g., Chang et al., 2015) have pointed out that self-efficacy is one important factor influencing learners' participation in online learning. Students who display a strong sense of online learning self-efficacy are more likely to prefer online instruction over campus-based teaching (Martin et al., 2010), persist in an online learning environment (Rodriguez & Armellini, 2017), and succeed in online courses (Zimmerman & Kulikowich, 2016). Since MOOCs and online courses share similar digital architecture and mechanisms of work (Willis, 2013), students possessing high-efficacy levels in online learning might likely overcome motivational problems or frustrations and attempt to complete registered MOOCs. In the present study, students' MOOC self-efficacy refers to the students' beliefs in their abilities to carry out a specific learning task in the context of a MOOC delivered in English.

The current study contributes to an emerging field of self-efficacy research exploring students' self-efficacy in a MOOC environment. While a limited number of researchers (e.g., Rabin et al., 2020; Sujatha & Kavitha, 2018) have considered relationships between MOOC self-efficacy and other variables, none, to my knowledge, compared the MOOC self-efficacy beliefs of students in a developed country to those of students in a developing country. Thus, the first aim of this study was to compare the MOOC self-efficacy levels of engineering students at a university in Taiwan and Vietnam. Both countries are in Asia where English is not the native language. On the other hand, MOOC education has developed fast in Taiwan (Yang et al., 2017) but is still very much in its infancy in Vietnam (Dang et al., 2017; Pham et al., 2021). The socio-economic context differs between the two countries. As self-efficacy is developed through a reciprocal relationship between personal factors, behavior, and environmental factors (Bandura, 1997), it was hypothesized that the MOOC self-efficacy beliefs of Taiwanese and Vietnamese students would differ.

Further to the above aim, it is also important to explore what factors influenced students' self-efficacy beliefs in both countries. Limited research has been examining students' MOOC self-efficacy. Likewise, self-efficacy's practical and psychological implications may impact students' adoption, perceptions of MOOCs' effectiveness, satisfaction, and retention in a MOOC environment (Rodriguez & Armellini, 2017). At the same time, owing to the malleability nature of self-efficacy beliefs (Bandura, 1997), commentary and research around the impact of different factors on self-efficacy beliefs have yielded mixed results, and additional research is needed (Klassen et al., 2011). Therefore, the second aim of the current study was to explore factors influencing the

MOOC self-efficacy of students in the two countries. It was anticipated that factors such as students' English proficiency levels and other variables would predict their self-efficacy beliefs.

The paper strengthens and extends prior self-efficacy research. It underlines the malleability of self-efficacy beliefs in a MOOC environment and explores if there are any factors influencing MOOC self-efficacy that are out of Bandura's classification of sources of self-efficacy information (1997). The study compares students' self-efficacy levels in two countries with different socio-economic statuses and MOOCs conditions. Understanding the similarities and differences sheds light on how to increase the participation, engagement, and completion of MOOCs of Asian students who are less researched in self-efficacy literature than those in Western countries.

In this paper, the researcher starts with a brief description of self-efficacy, its formation, and factors affecting self-efficacy beliefs. Next, a review of how other researchers have explored self-efficacy in a MOOC environment is given. Because the self-efficacy literature in MOOC contexts is scarce, the researcher includes studies investigating self-efficacy in online learning in the review. Subsequently, the method used to draw inferences from data is presented. The results of the study are discussed concerning the aims of the study and the results of prior self-efficacy research. Finally, the implications and limitations of the findings are analyzed.

2. Literature review

2.1. Self-efficacy

Self-efficacy, a key concept of Social Cognitive Theory (Bandura, 1997), focuses on people's evaluation of their future-oriented capability to complete specific tasks (Klassen et al., 2011). The self-perception of competence significantly influences people's motivation, effort, and preservation in coping with challenges. In essence, people who display a strong sense of self-efficacy will likely face challenging tasks and perceive them as meaningful. Others with a low sense of self-efficacy may find the tasks discouraging and give up easily. It is important to note that when making judgments of self-efficacy beliefs, individuals do not attempt to assess their actual abilities. Instead, self-perception of competence is gauged. Besides, self-efficacy is a "forward-looking capability" (Klassen et al., 2011), not a perception of current abilities.

According to Bandura (1997), individuals construct their self-efficacy based on self-efficacy information coming from sources: mastery experiences (e.g., past performances), vicarious experiences (e.g., observation of other people doing the same tasks), social persuasion (e.g., verbal and non-verbal comments from important people), and physiological and affective states (e.g., tiredness or happiness). Individuals internalize these types of information to build their self-efficacy. The differences in self-efficacy levels are attributed to the availability of sources of self-efficacy information and environmental and personal factors (Bandura, 1997; Phan, 2020).

Self-efficacy is domain-, task- and context-specific (Bandura, 2006). Consistent with this perspective, a MOOC student may judge his or her ability to do the same task differently in different situations. Changes in external factors (e.g., task difficulty, resources) and internal factors (e.g., physical condition, affective mood, preparation) can

lead to fluctuations in the student's self-efficacy in doing a specific task. In addition, self-efficacy beliefs function differently in MOOC students with different backgrounds or settings. Self-efficacious students in a physical classroom may not be confident when learning a MOOC. Students in a developed country may display a higher sense of MOOC self-efficacy than those in a developing country, owing to educational and financial differences. Grounded on Bandura's self-efficacy perspective (2006) and Social Cognitive Theory (1997), this research compares the MOOC self-efficacy levels of engineering students in two settings and explores what predicts their self-efficacy levels.

2.2. Students' MOOC self-efficacy

Most studies in the self-efficacy literature have researched face-to-face learning environments (Kao et al., 2014). Although the number of self-efficacy articles published yearly is growing, little is known about students' self-efficacy in a MOOC platform (Liang et al., 2014). A selective review of relevant studies is reported as follows.

There have been three main research directions in the reviewed articles. Some scholars (e.g., Rabin et al., 2020; Sujatha & Kavitha, 2018) have examined the role of self-efficacy as a factor affecting students' behaviors in MOOCs. In essence, researchers have agreed that self-efficacy is one important factor that impacts students' MOOC behaviors. Learner retention, completion, satisfaction, or persistence in MOOCs are positively or negatively predicted by their self-efficacy beliefs. For example, Rabin et al. (2020) used pre- and post-questionnaires sent online via email to identify the barriers and barriers' predictors to MOOC satisfaction of 542 participants. The researchers identified three barriers: lack of interestingness (i.e., relevance), lack of time (i.e., bad planning), and lack of knowledge (i.e., technical problems). Self-efficacy was reported to negatively predict participants' perceived lack of knowledge/technical problems, which affected their satisfaction with the MOOC.

Another group of researchers (e.g., Ghazali et al., 2020; Lee et al., 2020) has investigated the relationship between MOOC self-efficacy and other constructs, such as students' use of self-regulated learning strategies and meaningful learning. Researchers agreed that there was a positive correlation between self-efficacy and other constructs. For example, Ghazali et al. (2020) studied the influence of Malaysian undergraduates' MOOC efficacy on meaningful learning. The authors sent a questionnaire consisting of 52 items measuring self-efficacy and five measuring meaningful learning to 603 respondents. The self-efficacy construct was categorized into four dimensions: information searching, making queries, MOOC learning, and MOOC usability. Findings revealed that the students' self-efficacy significantly influenced meaningful learning experiences in the MOOC.

Only one study has explored factors affecting MOOC students' self-efficacy in my review. The study conducted by Branson (2017) examined whether learners' demographic characteristics predicted their academic MOOC self-efficacy and influenced the relationship between academic self-efficacy and MOOC completion rates. The author used a 7-point Likert scale consisting of eight question items to measure the students' self-efficacy for learning and performance and a second follow-up survey with one question item to collect the students' MOOC completion rates. Findings indicated no significant correlations between independent variables (i.e., age, gender, race, reasons for taking the MOOC, ethnicity, enrolment status, MOOC experience, and educational level) and academic MOOC self-efficacy. Learners' demographic characteristics did not

influence the relationship between learners' self-efficacy and MOOC completion rates. Academic self-efficacy was not a predictor of MOOC completion rates in this study.

Due to a serious lack of studies investigating factors affecting MOOC students' self-efficacy, research on factors affecting self-efficacy in online learning has been included to broaden the literature. It is important to note that MOOCs and traditional online learning have differences and similarities. The open nature of MOOCs requires MOOC learners to be more autonomous than those in traditional online courses. Due to its massive nature, the lack of social interaction and support in a MOOC seems to be more serious (Lee et al., 2020). However, online learning and MOOCs have similar digital architecture and mechanisms of work (Willis, 2013). Hence, the results of prior research on factors affecting online self-efficacy are relevant to the current discussion.

Many researchers listed factors influencing self-efficacy in the online learning environment that are consistent with Bandura's classification of four sources of self-efficacy information (1997). For example, previous online learning and experience (mastery experiences) such as computer knowledge (Jashapara & Tai, 2011), digital literacy (Prior et al., 2016), and the number of completed online courses (Shen et al., 2013) are the most powerful factor mediating self-efficacy. Instructor feedback (Wang et al., 2013), reward (Liou et al., 2016), group potency (Chu & Chu, 2010), and family support (Chu, 2010) (social persuasion) can improve or lower students' self-efficacy beliefs. Online interactions and communication with peers, learning materials, and instructors can provide students with opportunities to receive feedback and recognition (social persuasion) and foster opportunities to learn from others (vicarious experiences) (Shen, 2015; Zhang et al., 2012). High or low anxiety levels (physiological and affective states) can increase or decline participants' self-efficacy in online learning (Bervell & Umar, 2018; Mamolo, 2022).

However, other researchers have found other factors inconsistent with Bandura's (1997) classification. For example, motivation and attitudes can enhance students' self-efficacy beliefs abundantly or dampen them (Hong et al., 2017; Wang et al., 2013). The facilitating role of social and cultural settings (Chiu & Tsai, 2013) can be an indirect but influential way of raising students' online self-efficacy. Students' gender, nationality (Alonso-Mencía et al., 2021), and personality (Chiu & Tsai, 2013) also contribute to self-efficacy in online learning.

2.3. Methodology issues of existing literature

Many quantitative studies in the review have methodology issues. For example, most of the items in Sujatha and Kavitha's (2018) self-efficacy construct do not follow the conceptual clarity and measurement fidelity suggested by Social Cognitive Theory (Wyatt, 2014). Self-efficacy needs to be specifically measured rather than generally. Self-efficacy is a judgment of future ability, not current capability. However, the instrument in some studies included items that required participants to judge their general self-efficacy, not their perceived capabilities to perform a task in a MOOC environment (e.g., "*I do not seem capable of dealing with most problems that come up in life*"). Some items measured learners' intention to carry out a task (e.g., "*I give up on things before completing them*"), or self-competence (e.g., "*I feel insecure about my ability to do things*") instead of self-efficacy, a judgment of "forward-looking capability" (Klassen et al., 2011) which is task- and situation-specific (Bandura, 1997). Rabin et al. (2020) and Branson (2017) used eight question items taken from the Motivated Strategies for Learning Questionnaire (Pintrich

et al., 1991) without modifying them to better fit with the MOOC environment. The original questionnaire was designed to measure students' self-efficacy for learning and performance, not self-efficacy in a MOOC environment. MOOC self-efficacy is not the same as general self-efficacy owing to the task- and context-specific nature of self-efficacy. In addition, the scale included some items measuring task outcomes (e.g., "*I expect to do well in this class*") which are not in line with the properties of self-efficacy (Wyatt, 2014).

In addition, all MOOC self-efficacy studies in my review are quantitative, and students' self-reports on Likert-scale items are used to measure self-efficacy. Questionnaires have limitations in describing the complexity of different sources of self-efficacy information (Usher et al., 2015). Likert-scale items do not provide an in-depth understanding of the influences of context on students' construction of self-efficacy beliefs (Wheatley, 2005). Many self-efficacy researchers (e.g., Wyatt, 2014) have called for a mixed-methods design, arguing that the qualitative phase may reveal underlying cognitions.

The review above has demonstrated that investigating factors influencing MOOC self-efficacy is an important but neglected issue. No researchers compare MOOC students' self-efficacy in different settings, groups, locations, and cultures. Prior studies have noted the emergence of new sources that were not identified by Bandura (1997). Educators and teachers have not yet understood the MOOC self-efficacy beliefs of students in Asian countries. Researchers have called for a combination of qualitative and quantitative methods to understand self-efficacy beliefs better. The discussion above draws attention to the need to conduct research that uses a scale suggested by Bandura (1997) and incorporates a meaningful qualitative component to compare the MOOC self-efficacy levels of students and examine factors influencing their self-efficacy.

3. Method

The researcher used a mixed-method design in the current study to make use of complementary data sources and strengthen the robustness of the data (Hesse-Biber & Leavy, 2006). The combination of quantitative and qualitative data provides multiple viewpoints to address the research questions, taking the aforementioned limitations of quantitative research into account. Engaging in focus group discussions, members co-construct meaning and knowledge through productive interactions (Tuckett & Stewart, 2004). It was hoped that the discussions would help the researcher understand the participants' inner world, which questionnaire items failed to capture (Cameron, 2010). The online questionnaire and focus group discussions helped to converge and corroborate research findings. First, questionnaires were delivered to 222 students in both settings. Quantitative data were analyzed, and the results were used to shape the qualitative questions and sample. The qualitative data in the second phase were a follow-up on the findings from quantitative data. The researcher selected participants for the discussions based on identifying participants who scored high and low in the survey. Focus group discussions were used to confirm factors affecting self-efficacy and levels of self-efficacy beliefs identified in the first phase. In addition, focus group discussions probed the emergence of new sources of self-efficacy information, reasons for the perceived self-efficacy levels, and insights into the impact of different factors.

3.1. Participants

There were 222 engineering students from Vietnam and Taiwan participating in the present study. Table 1 shows the demographic information of the participants.

Table 1
Description of participants

Demographic variables	Category	Frequency	%
University name	IUH	100	45.0
	NIU	122	55.0
Age	Under 20	102	45.9
	20 – 30	110	49.5
	Above 30	10	4.5
Year of study	Freshman	79	35.6
	Sophomore	87	39.2
	Junior	28	12.6
	Senior	13	5.9
	Master's Degree	15	6.8
English proficiency level	Beginner	95	42.8
	Elementary	55	24.8
	Low Intermediate	37	12.2
	Intermediate	45	20.3
Number of prior MOOCs	None	194	87.4
	One	14	6.3
	More than one	14	6.3
Number of prior online courses	None	131	59.0
	One	42	18.9
	More than one	49	22.1
Total		222	

3.2. Instruments

3.2.1. The questionnaire

The questionnaire used in this study consists of two sections. The first section with six question items elicits respondents' demographic information including university name, age, years of study, current English language proficiency level, number of prior MOOCs, and number of prior online courses. The questionnaire aimed to examine the students' self-efficacy levels in two locations and factors predicting their self-efficacy levels. The second section with 30 question items was adapted from the Online Learning Self-efficacy Scale (Zimmerman & Kulikowich, 2016). The original 6-point Likert scale consists of 22 items divided into three factors, namely learning in the online environment (10 items), time management (5 items), and technology use (7 items). In my study, the 11-point Likert scale was divided into three dimensions with 10 question items evaluating self-efficacy in technology use, 5 evaluating self-efficacy in time management, and 15 evaluating English self-efficacy. I modified the 22 items of the Online Learning Self-Efficacy Scale to fit my research purposes better. Some items were removed

(e.g., "*complete a group project entirely online*"). New items were added (e.g., "*do oral presentations* and *understand videos' contents*"). Original items were modified (e.g., "*online course materials*" were changed to "MOOC *materials*").

Students were asked to select a number from 0 to 10 to indicate their confidence that they could complete certain tasks in an engineering MOOC delivered in English. Anchors were provided at single unit intervals with 0 responding to "cannot do at all", 5 responding to "moderately certain can do", and 10 responding to "highly certain can do". According to Kan (2009) and Weil et al. (2013), respondents can make more nuanced and reliable ratings of the strength of their capabilities to accomplish given tasks since the 11-point scale provides a range of alternatives with intermediate steps ranging from 0 to 10. Students who gain higher scores on the scale display greater self-efficacy beliefs.

Before being distributed to students in Vietnam and Taiwan, to have participants' full understanding of the question items and to collect statistically reliable data, the questionnaire was translated into Vietnamese and Chinese by the author and a Chinese language expert. Back translation was used to ensure translation accuracy. The Vietnamese and Taiwanese versions of the questionnaire were discussed among the author and other researchers, two experts in Vietnamese and Chinese, and a technical assistant. Because the questionnaire would be delivered online, its two versions were tried out with small samples of students to minimize technical difficulties and meaning ambiguity. The questionnaire was then finalized. A convenient sampling method was used in the present study for the quantitative phase. A total of 100 Vietnamese and 122 Taiwanese students completed the questionnaire online. Quantitative data were analyzed using SPSS 20.0 for Windows.

In this study, a reliability test was run, and Cronbach's alpha value for the self-efficacy in technology use subscale, the self-efficacy in time management subscale, and the English self-efficacy subscale was .960, .938, and .968, respectively. A KMO value of .958 was found and Bartlett's test was significant ($p < .001$). Further inspection revealed that item 36 was cross-loaded, and a difference of 0.005 was found between loadings. The item was deleted and the analysis was repeated with twenty-nine question items. The new factor loading distributions ranged from .603 and .816. A new version of the questionnaire was created with three dimensions: the 11-item English self-efficacy subscale, the 10-item self-efficacy in technology use subscale, and the 8-item self-efficacy in independent learning subscale.

3.2.2. Focus group discussions

In the present study, students interested in the subsequent focus discussion left their contact information in the questionnaire. The researcher selected participants according to their scores in the survey. There were 18 Taiwanese and 12 Vietnamese students joining the focus group discussions. Two 60-minute discussions with two groups of Taiwanese students (nine students per group) and two 45 minute-discussions with two groups of Vietnamese students (six students per group) were conducted online. All discussions were audio-recorded. The researcher used a semi-structured set of questions to interview the students in their first language. Questions in the focus group discussions aimed to confirm quantitative results and seek explanations and new findings. Examples of the questions are: "*Do you have any technical difficulties when learning a MOOC?*", "*How do you feel if you are required to deliver an oral presentation in English?*" and

"*What has caused your low levels of confidence?*" All interviews were fully transcribed. Participants' privacy was protected by using pseudonyms.

The thematic analysis method suggested by Braun and Clarke (2006) was used to analyze qualitative data. The researcher had the research questions in mind while looking for codes and themes. All data were transcribed and the researcher read each transcript several times to get familiar with its contents. Keywords, phrases, and sentences were underlined and grouped into sub-categories. Data from the first focus group discussion were tabulated and all data across the data set were coded. Data were reviewed constantly to look for new codes or to reduce overlapping or redundant codes. Codes were collated into themes. Themes were defined and named to tell the entire story of the analysis. Table 2 provides some examples of how codes were generated in the present study.

Table 2
Example of coding hierarchy

Codes	Excerpts
Age	*"I'm getting old. Young people will learn technology faster than I…" [S4TwFG2].*
English proficiency levels	*"I will feel least confident in reading English materials or understanding videos. I may have difficulty looking up new words in the dictionary or understanding the instructors." [S1VietFG1].*
Prior technical learning experience	*"I can't manage my time effectively… I need someone to remind me to finish my assignments. I need someone beside me to push me." [S1TwFG2].*
Self-regulation	*"To submit assignments on time, I will schedule a plan so that I can hand in my tasks before deadlines." [S5TwFG2].*

4. Results

4.1. Quantitative data

An independent t-test was run to compare the MOOC self-efficacy levels of the students in Taiwan and Vietnam. Self-efficacy was assessed in the three dimensions of the scale. Table 3 shows no significant differences ($p > 0.05$) concerning the three dimensions. Students in both universities gave the lowest ratings to the English self-efficacy subscale and the highest to the self-efficacy in the independent learning subscale. Mean scores range from 5.24 to 6.44. Data suggest that participants in both universities felt moderately self-efficacious in all dimensions of the MOOC self-efficacy scale.

Table 3
Independent samples *t*-test

	University	*N*	Mean	*p*
Self-efficacy in technology use	IUH	100	5.98	.959
	NIU	122	5.96	
Self-efficacy in independent learning	IUH	100	6.21	.416
	NIU	122	6.44	
English self-efficacy	IUH	100	5.24	.109
	NIU	122	5.70	

An examination of the scores of each item on three subscales in Table 4 shows that Vietnamese students gave the highest rating to item 18 while the task with the highest mean for Taiwanese students was item 37. Participants in the two sites were least confident in their abilities to deliver an oral presentation in English (item 31). In terms of the first subscale, Vietnamese and Taiwanese students were least confident in creating a new thread in the discussion forum (item 13). Regarding the second subscale, the Vietnamese dataset shows that the scores on item 22 were slightly higher than the rest of the items. The task with the lowest mean rating for Vietnamese students was item 24. Meanwhile, Taiwanese participants had the lowest score with respect to the ability to focus on schoolwork (Item 21). Regarding the last domain, Taiwanese students gave slightly higher scores on most of the items on the scale than their counterparts except for items 31 and 34. However, the differences were not significant.

Table 4
Mean scores on the three subscales

	Mean IUH (N = 100)	Mean NIU (N = 122)
Self-efficacy in technology use		
9. Navigate MOOC materials.	6.32	5.84
10. Find the course syllabus online.	6.10	6.34
11. View MOOC materials.	5.81	6.11
12. Search the Internet to find answers to MOOC-related questions.	6.13	6.00
13. Create a new thread in the discussion forum.	5.09	5.37
14. Post a reply to others' messages in the discussion forum.	5.38	5.25
15. Do an online quiz.	6.08	5.80
16. Submit assignments to the MOOC platform.	5.85	6.19
17. Seek technical support in case of technical difficulties using the given contact details.	6.22	6.14
18. Learn to use a new type of technology.	6.87	6.65
Self-efficacy in independent learning		
19. Complete all assignments on time.	6.40	6.62
20. Meet deadlines with very few reminders.	6.31	6.56
21. Focus on schoolwork when faced with distractions.	6.07	6.07
22. Develop and follow a plan for completing all required work on time.	6.49	6.37
23. Manage time effectively.	6.44	6.25
24. Learn without being in a physical room with the instructor.	5.75	6.20
25. Learn without being in a physical room with other students.	5.91	6.66
37. Complete the course without dropping out.	6.38	6.83
English Self-efficacy		
26. Understand videos' contents.	5.05	6.12
27. Understand reading materials.	5.11	6.05
28. Understand task requirements.	5.00	6.30
29. Take notes from videos effectively.	5.95	5.98
30. Communicate with others effectively in the discussion forum.	5.12	5.15
31. Do oral presentations.	4.13	4.04
32. Read more materials to understand the lessons in depth.	5.08	5.55
33. Complete all assignments without copying ideas from other students or the Internet.	5.36	6.22
34. Complete all assignments with a good grade.	5.42	5.02
35. Evaluate classmates' assignments according to the criteria provided by the instructors.	5.70	6.10
38. Explain the knowledge learned from the course to others.	5.75	6.25

A regression analysis model was run to understand which demographic variables predicted students' MOOC self-efficacy. The demographic variables included participants' levels of English proficiency, age, the number of prior MOOCs and online courses, and years of study.

4.1.1. Self-efficacy in technology use

Table 5 shows that participants' age, the number of prior MOOCs, and levels of English proficiency significantly predicted their self-efficacy in technology use. Of the three factors, age influenced self-efficacy the most, followed by English proficiency levels and the number of prior MOOCs. As participants' age increased, their self-efficacy decreased. The higher their English proficiency levels were, the higher their self-efficacy levels became. The higher number of MOOCs the students experienced, the more self-efficacious they were.

Table 5
Multiple regression analysis results for factors affecting self-efficacy in technology use

Variable	B	SE	*β*	*t*	*p*
Constant	5.119	.546		9.382	.000
Age	- .806	.336	- .250	- 2.401	.017
Number of online courses	.133	.104	.086	1.281	.202
Number of MOOCs	.447	.216	.142	2.069	.040
Years of study	.364	.207	.188	1.757	.080
Levels of English proficiency	.254	.100	.165	2.533	.012

Note. $R_{adj}^2 = .073$, $F = 4.457$, $p = .001 < .05$

4.1.2. Self-efficacy in independent learning

Table 6 shows that the number of prior online courses and MOOCs, levels of English proficiency, years of study, and age did not significantly predict participants' self-efficacy in independent learning.

Table 6
Multiple regression analysis results for factors affecting self-efficacy in independent learning

Variable	B	SE	*β*	*t*	*p*
Constant	5.599	.504		11.114	.000
Age	- .450	.310	- .155	- 1.451	.148
Number of online courses	.129	.096	.093	1.350	.179
Number of MOOCs	.304	.199	.107	1.525	.129
Years of study	.230	.191	.132	1.205	.230
Levels of English proficiency	.157	.093	.113	1.692	.092

Note. $R_{adj}^2 = .028$, $F = 2.289$, $p = .047 < .05$

4.1.3. English self-efficacy

Table 7 shows that English proficiency is a significant predictor of students' English self-efficacy ($p = .003 < .05$). Other factors did not predict English self-efficacy ($p > .05$).

Table 7
Multiple regression analysis results for factors affecting English self-efficacy

Variable	B	SE	*β*	*t*	*p*
Constant	5.181	.526		9.842	.000
Age	- .606	.324	- .197	- 1.870	.063
Number of online courses	- .057	.100	- .039	- .571	.568
Number of MOOCs	.267	.208	.089	1.283	.201
Years of study	.188	.200	.102	.942	.347
Levels of English proficiency	.295	.097	.201	3.047	.003

Note. $R_{adj}^2 = .050$, $F = 3.316$, $p = .007 < .05$

4.2. Qualitative data

When asked to compare self-efficacy levels across three dimensions, thirty students from two universities reported their lowest levels of English self-efficacy. Delivering a presentation in English was considered one of the biggest challenges that lowered their self-efficacy. Reading English materials, understanding videos' content, taking notes from the videos, and communicating with other learners in the forum in English were also perceived as barriers. Reasons for the inefficacy included lack of vocabulary, poor pronunciation, poor grammar, limited English comprehension, and inaccurate language use. For example, some participants said:

> *"I will feel least confident in reading English materials or understanding the videos. I may have a hard time looking up new words in the dictionary or understanding the instructors. The course will have professional terms, which I may struggle to find their correct meanings." [S1VietFG1].*

> *"I think most engineering students pronounce English inaccurately… People may not understand my pronunciation… It's hard for people to catch my ideas. I will have the most difficulty with giving an oral presentation." [S7TwFG2].*

Regarding self-efficacy in technology use, the qualitative data supported quantitative data and made underlying reasons visible to the researcher. Students' prior technical learning experience appeared to influence the participants' self-efficacy positively. Most participants in both sites felt more self-efficacious to use technology than learning independently or using English. They said:

> *"I took some computer courses in senior high school and already experienced in finding information on the Internet. I don't worry about any technical issues or using MOOC platforms." [S5TwFG1].*

> *"I took three MOOCs as suggested by my lecturers, so I'm familiar with common technical issues." [S2VietFG2].*

However, two NIU students aged above 30 reported that using technology was a matter of concern. Age and low English proficiency levels were considered barriers to their self-efficacy.

> *"I'm not very quick to use technology. At my age, it's not easy." [S6TwFG2].*

> *"I'm getting old. Young people will learn technology faster than I… Besides, people's English proficiency levels must be high enough to use technology well. My English is not good… I will need to ask my classmates for instructions or contact a technician if I have any technical questions." [S4TwFG2].*

Regarding students' self-efficacy in independent learning, quantitative data showed no relationship between students' self-efficacy levels and their demographic variables. However, in the focus group discussions, the ability to develop a learning plan appeared to influence the self-efficacy of most participants. Some students felt quite self-efficacious. For example:

> *"I don't have much trouble in balancing between work and study… I will arrange my tasks in priority order… I will reschedule my plan based on this list if unexpected things happen." [S2VietFG1].*

> *"To submit the assignments on time, I will schedule a plan to do them so that I can hand in my tasks before deadlines." [S5TwFG2].*

In contrast, some Vietnamese participants displayed low levels of self-efficacy when learning without their instructors or peers.

> *"I can't manage my time effectively… I need someone to remind me to finish my assignments. I need someone to push me." [S1TwFG2].*

> *"If I learn alone, not with a lecturer in the class, not with any peers or any other classmates… that will be a problem… and a challenge for me." [S3VietFG1].*

5. Discussion

One of the purposes of the study is to compare the self-efficacy levels of students in the two sites. Data show no significant differences in the MOOC self-efficacy levels of the students. Both students in Taiwan and Vietnam were moderately self-efficacious in three dimensions of the MOOC self-efficacy scale. The finding did not support our hypothesis that Taiwanese students would show greater MOOC self-efficacy than their counterparts. The finding that there were no significant differences in the MOOC self-efficacy levels of the students in the two sites was consistent with what Basol and Karatuna (2017) and Connor (2021) found out. For example, in Connor's study, the perceived self-efficacy in mathematics was the same for students in rural and metropolitan schools. The culture and organization of the schools, together with the teaching practice of the teachers, predicted the students' self-efficacy. However, some other researchers reported differences in the self-efficacy levels of participants in their studies. For example, Shneor et al. (2013) found that Turkish students displayed higher self-efficacy levels than Norwegian students. The researchers argued that the distinct cultures led to differences in students' self-efficacy levels. Different findings in different settings confirm the task- and context-specific nature of self-efficacy (Shen et al., 2013). Since there is a dearth of MOOC self-efficacy research, future MOOC researchers should conduct research in different contexts

to compare the self-efficacy levels for validation and figure out what contributes to the low or high levels of self-efficacy in each context.

In my study, it appears that the differences in environmental factors in the two sites, that is, different socio-economic contexts and MOOC education situations, did not affect self-efficacy or lead to differences in self-efficacy levels. No student in the two countries mentioned the influence of such factors in focus group discussions. Quantitative and qualitative data showed that the drivers of students' self-efficacy beliefs were personal factors: English proficiency levels, the number of attended MOOCs, self-regulation, and age. Years of study and the number of attended online courses did not predict students' MOOC self-efficacy in the two countries. There was support for the significant role of personal factors in influencing self-efficacy in the literature on online learning self-efficacy. For example, Choi et al. (2007) found out that students' attitudes toward learning and flow experiences had a significant impact on students' technology self-efficacy. In the study of Jashapara and Tai (2011), personal innovativeness with IT, computer playfulness, and computer experience significantly affected e-learning self-efficacy. In the following sections of this paper, the significant role of personal factors in mediating subscales of MOOC self-efficacy will be discussed in more detail. Suggestions to improve students' self-efficacy beliefs will also be given.

Quantitative data showed that students' perceptions of English proficiency levels influenced their English self-efficacy and self-efficacy in technology use. Qualitative data made clear that the perceived lack of vocabulary, poor pronunciation, poor grammar, limited English comprehension, and inaccurate use of the target language were barriers to the students' self-efficacy beliefs. The literature has confirmed a significant relationship between English proficiency levels and English self-efficacy (Zhu & Gong, 2020), and between self-reported English scores and online learning self-efficacy (Ramsin & Mayall, 2019). Students with higher English proficiency levels scored higher in the surveys. In MOOC education, English has been found to hinder MOOC adaptation (Rabin et al., 2020) and lower students' self-efficacy in learning MOOCs lectured in English in countries where English is not a native language (Liu, 2017). Therefore, it would be helpful if MOOC developers in Taiwan and Vietnam provide target learners with a clearer description of the required level of English proficiency, which can help future MOOC learners' who are non-native English speakers choose suitable courses. Other efforts to improve the students' self-efficacy may include English placement tests administered at the beginning of the courses to determine existing knowledge and skills (Uchidiuno et al., 2016). For engineering students enrolling in MOOCs to acquire English in a unique learning area like the students in my study, English keywords appearing on the lecturing videos and English transcripts may make MOOCs more accessible (Eriksson et al., 2017), thereby improving the self-efficacy of the students.

Quantitative data in this research indicated that the number of attended MOOCs influenced how self-efficacious the students were in technology use. Qualitative findings confirmed quantitative data and suggested the link between the students' experience in online courses and/or MOOCs and their self-efficacy in technology use. The higher number of MOOCs and/or online courses the students attended, the more self-efficacious they were. The findings were consistent with those in some prior studies (e.g., Jan, 2015; Jashapara & Tai, 2011; Zimmerman & Kulikowich, 2016), which reported a positive relationship between prior experience and online self-efficacy. For example, Taipjutorus (2014) reported that prior learning experiences and computer skills significantly correlated with the online learning self-efficacy of 75 university students in New Zealand.

Qualitative data confirmed that daily computer usage and skills positively influenced the confidence of the participants to succeed in online learning, and students with more online learning experiences appeared to be more self-efficacious. However, some researchers (e.g., Luu & Pham, 2022) did not find a relationship between the number of prior online courses and online learning self-efficacy. Because the present study is the first attempt to investigate factors affecting the MOOC self-efficacy of engineering students, future research is needed to understand more about the impact of prior MOOCs on MOOC self-efficacy to validate this association. In my study, students at the two universities were moderately self-efficacious in technology use. In order to increase the participants' self-efficacy, online orientations at the beginning of MOOCs, as suggested by Cho and Byun (2017), to familiarize the students with the technical requirements of the platform and/or the provision of "personalized, tailor-made assistance tools" (Rabin et al., 2020) may be effective at increasing the students' self-efficacy.

In this paper, Taiwanese students' self-efficacy in technology use was also dependent on age. Age is a demographic factor that is inconsistent with Bandura's classification of sources of self-efficacy information (1997). Quantitative data did not indicate the relationship between age and self-efficacy in technology use; however, qualitative data showed the influence of age. The students' confidence to learn the MOOC was lowered by their perceptions of old age. Several researchers, such as Henderikx et al. (2021), found that age was a barrier to students' MOOC learning achievement. In self-efficacy literature, it is questionable whether age can facilitate or hinder learners' online self-efficacy (Jan, 2015; Taipjutorus, 2014). Due to the limited number of studies examining age as one of the predictors of MOOC self-efficacy and the limited number of participants' age groups in the present study, further research investigating the issue in depth would be desirable.

Regarding self-efficacy in independent learning, some students in the two countries gave lower ratings to the items that gauged their abilities to learn without peers or the instructor or the ability to focus on schoolwork when faced with distractions. Qualitative data in the present study confirmed that students' abilities to develop a learning plan influenced their self-efficacy. Zimmerman (2002) defined self-regulated learning as the ability to self-generate "thoughts, feelings, and actions that are planned and cyclically adapted towards the attainment of personal goals". Highly self-regulated students seemed more confident than those with difficulty regulating their learning process. Previous research showed that students' online self-regulatory learning behaviors could influence their technology self-efficacy and learning achievements (Wang et al., 2013). This ability is particularly important in MOOCs since immediate support and guidance will be absent when the learners experience these self-paced courses (Henderikx et al., 2021). Therefore, introductory sessions of MOOCs in which learners are encouraged to set goals or sub-goals for their learning process at the beginning of the courses might be beneficial to the students' self-regulating skills and self-efficacy. Besides, MOOC developers may want to design learning activities in such a way that helps learners manage and achieve their learning goals at certain points in time.

6. Limitations and conclusion

Most previous studies have investigated learners' self-efficacy in face-to-face learning environments, while few have delved into that of MOOC learners (Kao et al., 2014). Most MOOC self-efficacy studies use a quantitative approach but surveys do not follow

the conceptual clarity and measurement fidelity suggested by Social Cognitive Theory (Bandura, 2001). Researchers have called for the incorporation of a qualitative element in a mixed methods design to grasp the domain-, task-, and context-specific nature of self-efficacy beliefs (Wyatt, 2014). In addition, no comparative research has touched upon the MOOC self-efficacy of students in developed and developing countries to explore similarities and differences. In an attempt to fill in these research gaps, this paper, using a scale suggested by Bandura (1997) and focus group discussions, compared the self-efficacy levels of engineering students in two universities in Taiwan and Vietnam and examined factors predicting their self-efficacy. The study contributes to the existing literature by widening the understanding of MOOC self-efficacy in Asian countries. There were no differences in the self-efficacy levels of engineering students in Taiwan and Vietnam. The students in the two countries were moderately self-efficacious in all three dimensions. The study highlights the significant role of personal factors in influencing self-efficacy. The number of prior MOOCs, English proficiency levels, and self-regulation influenced the students' self-efficacy beliefs in the two universities. The perceptions of old age negatively impacted the self-efficacy of Taiwanese students. Self-regulation and age were the factors that do not fall into Bandura's (1997) categories. The study lends support to the existence of other sources outside Bandura's (1997) four sources of self-efficacy information (Alonso-Mencía et al., 2021; Chiu & Tsai, 2013).

The study has some practical implications for MOOC developers and teachers. Almost all MOOCs are delivered in English, but students in non-native English-speaking countries, like the Vietnamese and Taiwanese students in my study, display a low sense of English self-efficacy. Methods to strengthen their English self-efficacy include the administration of English placement tests at the beginning of MOOCs, the provision of English keywords or transcripts of video lectures, and a clear description of the required level of English proficiency. In addition, to help students who are unconfident in technology use, online orientations of the requirements of the MOOC platform and the use of personalized assistant tools (Rabin et al., 2020) may be practical. Next, introductory sessions of MOOCs in which students are invited to set goals or sub-goals for their learning process at the beginning of the MOOCs might be helpful to students who have difficulty self-regulating their learning skills. Designing learning activities in a way that helps these students manage and achieve their learning goals at a certain point in time might also be beneficial.

My study is not without limitations. The students may not have remembered the correct number of MOOCs or online courses they attended or may have judged their English proficiency levels inaccurately. Besides, most students in the present study were undergraduate engineering students. A few of them were aged above 30. Future research should include graduate or postgraduate students and different age groups to increase the generalizability of the results. More participants from other developed and developing countries are preferable in future studies. Researchers might want to replicate the same study with participants from underdeveloped and developing countries to test the variability of the results and increase their accuracy. In my study, Social Cognitive Theory and its subset, self-efficacy theory, were used to explore self-efficacy. Personal factors influenced students' self-efficacy beliefs in the present study. Connor (2021) suggested the alignment of Social Cognitive Theory within Bronfenbrenner's (1981) ecological systems, arguing that: "Ultimately agency must be owned by the individual, but the proxy influences within the micro-, meso- and exo-systems are crucial in its development and sustainment." It is recommended that future researchers study the

impacts of various ecological systems on self-efficacy through the lens of Bronfenbrenner (1981). Due to a serious lack of studies examining MOOC self-efficacy, future research on this topic is desirable to yield more inclusive and meaningful findings.

Author Statement

The author declares that there is no conflict of interest.

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