

Computer-mediated discussion, self-efficacy and gender

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Abstract

In the context of hybrid instruction, this study was designed to explore whether gender has an influence on learners' preferences for synchronous or asynchronous modes of computer-mediated communication, and whether this decision impacts learners' self-efficacy (SE) towards knowledge acquisition. The participants were 180 teacher-education students (151 females and 29 males) enrolled in a hybrid (blend of traditional classroom instruction and online learning activities) foundations course at a United States research university with a proportionally high percentage of full-time commuters and/or distance enrollees. The findings showed that, regardless of gender, two-thirds of the participants preferred asynchronous modes over synchronous ones. In addition, gender was weakly related to the participants' SE in both modes. Linear regression indicated that SE, in turn, was weakly related to academic performance. The implications of these findings for instructional practice are discussed.

Introduction

As computers rose to be a cutting-edge technology in the 1980s, the Internet became the cutting-edge technology in the 1990s (Schumacher & Morahan-Martin, 2001), which led to the relatively new arena of online course delivery. Online learning is clearly different from traditional learning environments, which compels us to explore and examine learning strategies associated with this novel environment (Picciano, 2002; Wadsworth, Husman, Duggan & Pennington, 2007). Fundamentally, computer-mediated communication (CMC), either in hybrid instruction or online learning, offers great flexibility, particularly with regard to learner preferences for communication modes and learning activities. Hybrid instruction, or hybrid courses, refers to classes in which a blend of both traditional classroom instruction and online learning activities are utilised, including synchronous and asynchronous communication modes.

The quality of group discussion and interaction is pivotal to the success of online learning (Wang & Lin, 2007). Online discussion is typically text-based, and can be conducted asynchronously and/or synchronously. Asynchronous CMC creates an environment for discussion that removes some of the barriers to student participation, because the students can access their online classroom anytime and anywhere (Wu & Hiltz, 2004). Additionally, in the asynchronous format, the delayed communication typically utilises a discussion board, electronic mailing lists, blogs or even Wikipedia-type communication tools, whereas synchronous discussions require a chat room or instant messenger-type tool. In synchronous communication, students meet at the same time but not necessarily in the same place as other students. Other barriers overcome by the asynchronous format are distance and time, thus allowing students to learn from peers and their instructor. However, asynchronous discussion transpires slowly and requires commitment from all participants to attend often for short periods of time rather than one time for an extended period as in the synchronous mode, which is tantamount to live, virtual interaction, even though it is typically in text-based mode. The immediacy in this mode is valuable but, of course, requires participants to log on simultaneously. Synchronous communication also requires higher Internet bandwidth than asynchronous. The availability to choose communication modes seems to influence self-efficacy (SE) levels of learners which, in turn, can affect learning motivation (Brophy, 2004; Zimmerman, 2000).

Differential gender attitudes towards the use of computer technology have been discussed for years (eg, Anderson & Haddad, 2005; Bulter, Ryan & Chao, 2005; DeNeui & Dodge, 2006; Karma, 1994; Ory, Bullock & Burnaska, 1997; Wilson, Kickul & Marlino, 2007), and likewise have become a focus in teacher education (Sanders, 1997). In early days, females tended to express negative attitudes and less confidence towards technology use when engaged in computer-mediated learning environments (eg, Dambrot, 1985; Gutek & Bikson, 1985; Neuman, 1991). As computer technology became pervasive, one would think this gender gap might no longer exist. Interestingly, several current gender studies involving online learning show a reversal. In a large scale survey study, Bulter *et al* (2005) reported that females demonstrated greater career-related information technology (IT) skills than males on basic computer skills, spreadsheet programmes, database programs and website creation. In addition, not only did the female students in the study demonstrate greater IT skills than the males, but they placed higher value on those skills, demonstrated greater use of computer-mediated platforms (eg, Blackboard™) for learning and outperformed males in academic achievement in the online setting (DeNeui & Dodge, 2006). Yet, on the other hand, in the context of a master's-level Teaching English as a Second Language course, the gender issue was irrelevant in fostering interaction in threaded discussion (William & Humphrey, 2007).

The gender issue is shifting from a focus on broad-stroke, holistic differences to a more granular focus such as within specific domain knowledge acquisition and instructional methodology. Within learning, specific factors such as learning styles, learning delivery format, learner satisfaction and motivation may be related to gender. Lee (2002) iden-

tified three popular gender issues in the existing literature: (1) the dynamic of social interaction including its purposes and style, (2) motivation factors, and (3) expression frequency and style, discussion and feedback. Like Bulter *et al* (2005) and Campbell (1999), Lee found that the gender gap towards technology use was related to learning styles, which, in turn, are influenced by factors such as biology, historical inequalities, inconsistent political rights and problems of sociological constructions. In terms of online learning, gender is also related to reading and writing preferences which may suggest that females might find online discussions more motivating and enjoyable than males. On the other hand, if they are less confident about their use of computers, these factors may balance out (Wu & Hiltz, 2004). Females tend to think of computer-mediated conferencing as a place to post questions and consequently come to a consensus of understanding, while males deem the online conferencing tool more a place to post and obtain information (Tannen, 1990). Across the spectrum, from classroom face-to-face (FTF) instruction, to hybrid instruction to online environment, 'female students place emphasis on relationships, are empathetic in nature, and prefer to learn in an environment where cooperation is stressed rather than competition' (Blum, 1999, p. 51). This is consistent with Salter's (2003) finding that males and females differ significantly on the (Myer-Briggs Type Indicator) dimension of feeling-thinking in his study of how the factors of gender and learning style affect decision making and learning perception.

Social cognitive theory (SCT) (Bandura, 1982) is the overarching theoretical framework for the construct of SE (Bandura, 1986). Grounded in SCT, one promising area of research has focused on SE as a predictor of individual perceptions and use of computing technology. SE beliefs help determine how much effort people are likely to spend on a task and how long they would endure when encountering impediments. The social cognitive perspective holds that successful self-regulated learners possess higher levels of motivation (personal influences), apply more effective learning strategies (behavioural influences) and respond more appropriately to situational demands (environmental influences) (Pintrich & Schunk, 2002). Bandura (1986) outlined how one's efficacious beliefs are derived from four major sources of influence: (1) mastery experiences, (2) vicarious experiences, (3) social persuasion, and (4) reduction of one's reaction to stress, negative emotional predispositions and misinterpretations of physical states.

1. The foremost influential source is *mastery experiences*. According to Pintrich and Schunk (2002), the expectancy component may be conceptualised as one's belief to be capable of performing the task. Particularly, SE, defined as perceptions of capabilities to execute an action required to achieve a particular outcome (Bandura, 1986), has been reported to have influences on the choice of activity, the effort devoted and the willingness to persist in order to accomplish a task (Bandura, Barbaranelli, Caprara & Pastorelli, 1996; Zimmerman, 2000).
2. The second source is *vicarious experiences* provided by social models. People tend to perceive a higher probability of success when they see individuals similar to themselves succeeding in a particular task. Likewise, SE tends to be undermined significantly when learners see individuals similar to themselves fail at a related task.

3. *Social persuasion*, the third source, is another way to fortify one's perceived abilities or capabilities to improve performance and be successful. This source is related to environmental influences such as feedback and assessment from peers and/or instructors. Receiving immediate and plentiful feedback corrects misconceptions, provides clues for making progress (eg, Wang & Lin, 2007) and enhances motivation.
4. The fourth source is the *reduction of people's reaction to stress, negative emotional predispositions and misinterpretations of physical states*. This source is related primarily to behavioural influences such as metacognitive strategies and sophistication of decision making. Given an example on computer-supported collaborative learning, the more sophisticated the metacognitive strategies, the better the inquiry-based knowledge constructions (Salovaara & Jarvela, 2003).

Research model and questions

To gain insights into the effects of providing flexible learning environments, we investigated factors that may contribute to students' choice of online discussion mode, and the strength of the influence. Flexibility in this study refers to choice of online discussion mode— asynchronous versus synchronous—leading to the guiding question: Does the availability of choice influence learner SE levels which, in turn, may have an effect on learning achievement?

This study is based on an analytical path model (see Figure 1) by which SE influences academic performance (AP) by exploring the causal relationship among (1) gender, (2) types of discussion mode, (3) SE, and of primary importance, and (4) learning achievement, as measured by *Assessment of Cognitive Achievement (ACA)*.

Based on the model above, the following four research questions were posed.

- Q1. Does gender influence students' choice of text-based discussion modes?
- Q2. Does content-knowledge SE vary between two discussion modes?
- Q3. Is SE influenced by gender?
- Q4. Does magnitude of SE lead to differential learning?



Figure 1: Proposed research model of online discussion mode

Methodology

Participants and procedures

The participants were a convenience sample of 180 teacher-education students enrolled in a medium-size (approximately 22 000) 4-year public university in the United States. The university has a proportionally strong number of full-time commuter or distance enrollees (eg, 72% of the sample self-identified as full time). Eighty-five percent ($n = 151$) were female and 15% ($n = 29$) were male. The participants were randomly assigned to one of the 13 sections by a round-robin procedure. The unbalanced ratio of females to males is typical of teacher-education programs in the United States.

Thirteen sections of the hybrid course were utilised for the study. The course consisted of nine project-based modules, four of which utilised discussion threads, which served as the data source: (1) Learning Theories/Educational Psychology, (2) Problem-based learning (PBL) and Cooperative Learning, (3) Social and Ethical Issues, and (4) Information Literacy. Each discussion was based on four to five instructor-posted questions. The sections were essentially identical because the same syllabus, readings, assignments and hybrid delivery mode were universally used by all instructors.

Measures

The study utilised two measures: Self-Efficacy Questionnaire (SEQ) and ACA.

SEQ

The SEQ was developed by the researchers for the purpose of this study, based on Bandura's SE theory (Bandura, 1986; Fernandez-Ballesteros, Diez-Nicholas, Caprara, Barbaranelli & Bandura, 2002; Pajares, 2002). The SEQ was designed to investigate whether using different online text-based discussion modes results in varied levels of efficacy. Based on the course objectives, the questionnaire, consisting of 33 items (see Appendix A), was categorised into six subordinate skill domains: (1) Web activities, (2) information literacy, (3) learning theories, (4) PBL, (5) cooperative learning, and (6) online communications. In addition, the items were associated with either personal efficacy or individual social efficacy as identified by Fernandez-Ballesteros *et al* (2002). The participants rated their level of confidence on a 5-point Likert-type scale, ranging from *strongly not confident* (1) to *strongly confident* (5). Internal consistency of the SEQ overall is 0.96 with the subdomains returning (1) 0.86 for *Web activities*, (2) 0.91 for *Information literacy*, (3) 0.95 for *Learning theories*, (4) 0.91 for *PBL*, (5) 0.91 for *Cooperative learning*, and (6) 0.90 for *Online communications in general*.

ACA

The four discussion threads throughout the semester provided the content for the assessment but the actual assessment items were developed by the researchers based on Merrill's Performance-Content Matrix (1983), and were reviewed for content validity by selected course instructors who were subject-matter experts. The ACA was comprised of 32 questions in both open-ended and closed-ended formats and, for any given

objective, ranged from low level (*memorize-fact*) to high level (*apply-principle*). The weight of multiple-choice questions was based on its cognitive level (eg, 1 point for *Memorize-Fact*, 2 points for *Comprehend-Concept*, 3 points for *Apply-Concept*, and 4 points for *Apply-Principle*). Open-ended questions were assigned points based on the quality and level of the responses co-assessed by the researchers and the course instructors. The points derived from these assessments were summed to form a measure of AP.

Results

Gender and discussion modes

A two-way contingency table analysis (see Table 1) with crosstabs was conducted, which showed no significant difference between gender and choice of discussion modes (synchronous vs. asynchronous), $\chi^2(1, n = 178) = 0.32, p > 0.05$. To follow up, a one-sample chi-square test was performed to assess whether the participants choose one mode more or less than the other with significant results, $\chi^2(1, n = 178) = 23.10, p < 0.001$. A much larger proportion of the participants chose the asynchronous mode of discussion session over synchronous, indicating that the participants prefer the asynchronous format over the synchronous; yet, gender was not a factor influencing their decision.

Discussion modes and SE

As reported above, 65.2% of the sample chose the asynchronous mode for online discussion and 34.8% chose the synchronous mode. A Multivariate Analysis of Variance (MANOVA) was conducted to determine whether SE towards course content differed between synchronous discussion and asynchronous discussion. The results were significant: Wilks' $\Lambda = 0.93, F(1, 178) = 2.28, p < 0.05$ (see Table 2). As shown in Table 2, the participants in the synchronous mode felt more efficacious than those in the asynchronous mode, $M = 136.09$ versus $M = 135.60$, respectively.

To identify whether those differences were specific to particular subdomains, a follow-up analysis was conducted that revealed the difference was limited to only *Web activities*, $F(1, 178) = 5.30, p < 0.05$. The participants in the synchronous mode had

Table 1: Crosstabs on gender and discussion modes

		Discussion modes			
		Asynchronous	Synchronous	Total	
Gender	Female	Count	100	51	151
		% of total	66.2%	33.8%	100%
Male	Count	18	11	29	
	% of total	62.1%	37.9%	100%	
Total	Count	117	79	180	
	% of total	65.2%	34.8%	100%	

Table 2: Comparisons of discussion modes on the self-efficacy

Scale	Discussion modes	Mean	SD	F	p	η^2
Web activities	Asynchronous	20.77	3.35	5.30	0.02*	0.03
	Synchronous	21.94	2.55			
Information literacy	Asynchronous	22.40	2.93	0.66	0.42	0.00
	Synchronous	22.02	2.91			
Learning theory	Asynchronous	19.96	3.52	0.06	0.81	0.00
	Synchronous	20.09	3.32			
Problem-based learning	Asynchronous	20.82	3.07	0.00	0.98	0.00
	Synchronous	20.83	4.04			
Cooperative learning	Asynchronous	25.87	3.78	0.02	0.90	0.00
	Synchronous	25.78	4.65			
Online communications in general	Asynchronous	25.78	3.95	0.23	0.63	0.00
	Synchronous	25.43	5.71			

* $p < 0.05$.

SD, standard deviation.

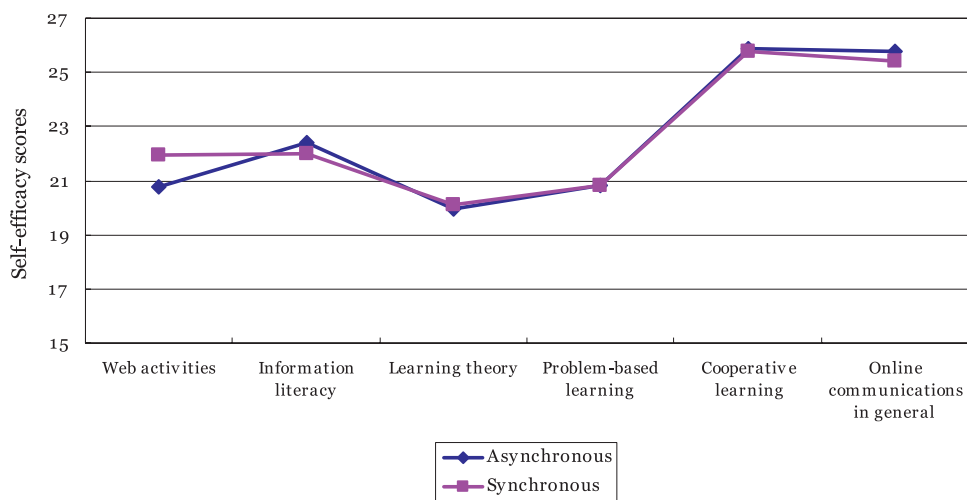


Figure 2: Disordinal interaction of self-efficacy by discussion modes

higher efficacy than those in the asynchronous mode, $M = 21.94$ versus $M = 20.77$, respectively. Figure 2 illustrates disordinal interaction of SE by the factor of discussion mode. Because the overall effect size was small, any implication should be made with caution.

Gender and SE

A MANOVA showed that SE differed between males and females: Wilks' $\Lambda = 0.91$, $F(1, 176) = 2.79$, $p < 0.05$ (See Table 3). Female participants exhibited higher efficacy than

Table 3: Gender comparisons on self-efficacy

Scale	Gender	Mean	SD	F	p	η^2
Web activities	Female	21.23	3.10	0.54	0.46	0.00
	Male	20.74	3.49			
Information literacy	Female	22.38	2.90	0.96	0.33	0.01
	Male	21.78	3.07			
Learning theory	Female	20.39	3.20	14.52	0.00***	0.08
	Male	17.81	3.45			
Problem-based learning	Female	21.04	3.33	3.61	0.06	0.02
	Male	19.70	3.56			
Cooperative learning	Female	26.09	4.12	3.13	0.08	0.02
	Male	24.59	3.58			
Online communications in general	Female	25.89	4.58	2.48	0.12	0.01
	Male	24.41	4.17			
Self-efficacy	Female	137.01	16.06	5.50	0.02*	0.03
	Male	129.04	17.46			

* $p < 0.05$; *** $p < 0.001$.
SD, standard deviation.

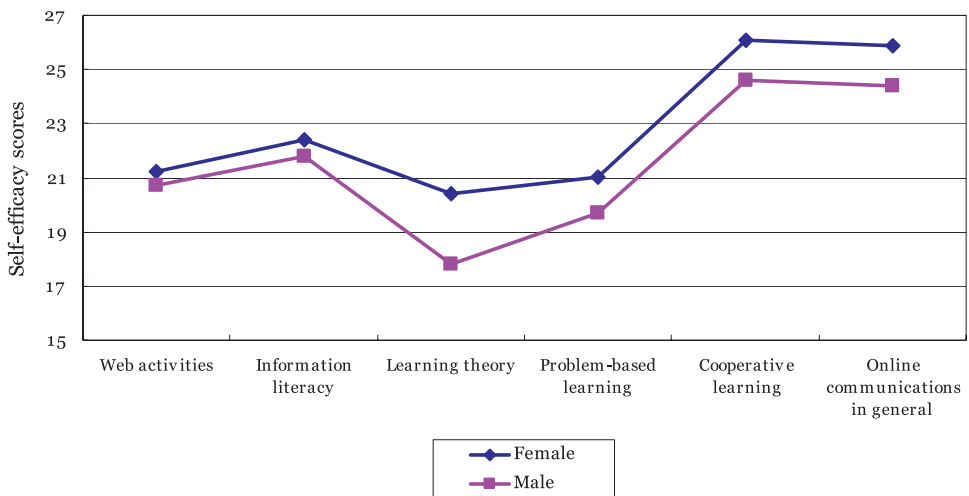


Figure 3: Ordinal interaction of self-efficacy by gender

males, $M = 137.01$ versus $M = 129.04$, respectively. Follow-up analyses determined that SE was significantly different only in *Learning theory*, $F(1, 176) = 14.52$, $p < 0.001$, with the female participants exhibiting significantly higher efficacy than the males, $M = 20.39$ versus $M = 17.81$, respectively. Figure 3 graphically depicts that females were more likely to feel more efficacious than males in general. Note that the overall effect size was small, so implications should be offered with caution.

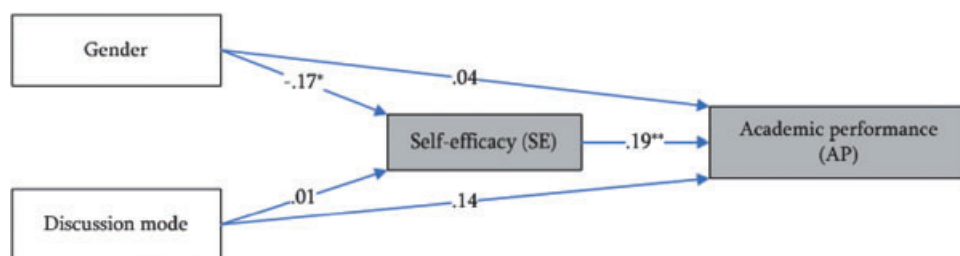


Figure 4: Regression coefficients of the model

*Significant at the 0.05 level.

**Significant at the 0.01 level.

SE and AP

A simple linear regression was used to determine whether AP correlated with SE and whether AP could be predicted by magnitude of SE. The correlation coefficient between the two variables was 0.18, and the value of R^2 is 0.03, which indicated only three percentage points of shared variance between the two variables. A conventional frame of reference to evaluate the magnitude of a correlation coefficient, suggested by Cohen (1988) in the absence of context, regards correlations of 0.5, 0.3 and 0.1 as large, moderate and small. Yet, Cohen and other researchers (eg. Chen & Popovich, 2002) pointed out that the size of a correlation coefficient varies based on context. In this scenario, an R^2 of 0.03 was considered a small association between AP and SE, $F(1, 178) = 5.62, p < 0.05$, which indicated that, while SE was a significant predictor of AP in this study, the value of the prediction was quite low and therefore perhaps of limited practicality. Mathematically, the linear association can be expressed in a regression equation as follows:

$$\text{Academic Performance} = 1.59 + 0.01 * \text{self-efficacy}$$

Based on these findings, we regressed AP on the other three variables (gender, self efficacy and discussion mode), and also regressed SE on gender and discussion mode. The results, illustrated in Figure 4, show that SE predicted AP, while SE was predicted by discussion mode and, to a lesser extent, gender. It was observed that AP was related to SE; yet, SE was also related to gender. The gender factor indirectly affected AP as a result of the transiting effect of SE.

Discussion

Attributes of computer-mediated discussion

Our results indicate that gender does not substantially influence participants' choice of asynchronous or synchronous discussion format for this sample of undergraduate teacher-education students in this particular academic endeavour. However, the finding remains noteworthy because knowledge of what does not influence student choice indicates that future research can focus on other potential factors that may be influential, such as the differential valuing of the dichotomous attributes of the two discussion

formats. For example, synchronous discussion is conducted in real time and therefore requires significantly more preparation in order for the session to be productive. In contrast, asynchronous discussion group members have the luxury of sufficient and flexible time to post, read, reflect upon and respond to the threads and refer to content as needed. These attributes may be related to situational characteristics, such as time management skills, perceived value of time flexibility, part time versus full time enrolment, and family obligations (Cross, 1981). Part-time students tend to possess multiple roles and family obligations, while full-time students tend to have more time available for coursework preparation and reflection.

Nonetheless, that some students prefer synchronous discussion is important. Given the fact that SE and achievement levels are very similar, providing the choice of discussion format enables students to learn in a manner consistent with their own preferences. Wang and Woo (2007) inferred that asynchronous online discussion may be more appropriate than face-to-face or synchronous discussion for groups whose members exhibit opposite characteristics such as introversion and extroversion, and submissiveness and dominance.

Efficacious beliefs towards use of CMC

Intuitively, stronger feelings of being capable of managing tasks lead to greater commitment and outcomes. Greater commitment and outcomes reciprocally build higher SE when similar tasks are encountered in the future. Pajares (1996) and Schunk (1996) are of the same mind that student SE is critical to academic success. SE beliefs account for '*thought patterns and emotional reaction*' (Pajares, 2002, p. 7). Pajares further explained that people with high SE are inclined to build a sense of serenity in their approach to more difficult tasks, whereas people with low SE, because of the accompanying stress, anxiety and a narrow vision, tend to undermine their confidence and morale because they perceive themselves incapable of performing a difficult task. Students who believe that they are capable of performing academic tasks use more cognitive and metacognitive strategies and persist longer than those who do not (Pintrich & Garcia, 1991). Concomitantly, SE beliefs can affect learners' manipulation and choice of learning environment (Zimmerman, 2000).

One of the strongest sources of SE is an individual's direct experiences with the same or a similar phenomenon (Bandura, 1982). Other sources of efficacy might be associated with one's family of origin and background variables such as gender, ethnicity, socio-economic status, the nature and quality of educational opportunities (Betz, 2004), and antecedent traits such as prior experiences and skills. Substantial empirical studies (eg, Fernandez-Ballesteros *et al.*, 2002; Kickul, Wilson & Marlino, 2004) provide support for the notion that perceived efficacy varies as a function of gender. For example, in their studies with adults, Wilson *et al.* (2007) found that gender differences are primarily observed in domains that are stereotypically allied with '*male*' skills such as business/entrepreneurial careers. Future research endeavours could look into causal relationships between one's efficacy beliefs and sophistication of decision making. It is our belief that higher student SE will lead to more sophisticated decisions during the journey.

To follow this line, our results show a distinguishing effect on the domains of *web activities* between the two discussion modes. We found that students were not acclimated to the discussion formats for the first discussion session, particularly the real-time mode. Moreover, the *web activities* session covers more theoretical and fundamental material than the other five topics, and therefore take comparably more effort to process and learn. As described earlier, asynchronous discussion provides a more flexible learning environment than synchronous, which leads to an inequity phenomenon of learning opportunities. Bates and Khasawneh (2007) note that the intertwined relationships among SE, prior experiences and potential outcomes related to online learning are far more complex than has typically been recognised in the research.

Implications of the study

As the use of computer technology to enhance learning continues to grow, it is important to try to learn how to create teaching/learning environments in which students will learn enthusiastically and persistently. This study provides implications regarding student choice of discussion mode as a desirable instructional practice. Taking time to read postings, reflecting, composing responses and refining writing seem so habitual and certain in asynchronous communication; yet, to engage these procedures in synchronous communication are impractical. A carefully designed course can provide such learner choice but the challenge remains in determining whether the learners make decisions that are consistent with their own preferences and result in enhanced learning.

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Appendix A

The SEQ use of online text-based discussion

This survey has 33 statements regarding the use of text-based communication tools to assist cognitive advancement as a result in effective learning, with respect to six skill domains: (1) Web activities (5 items), (2) Information literacy (5 items), (3) Learning theories (5 items), (4) Problem-based learning (5 items), (5) Cooperative learning (7 items), and (6) Online communications in general (6 items). After reading each statement, indicate the extent to which you feel confident or unconfident, by checking the button to the right of each sentence.

Because this course uses online text-based discussion (eg, asynchronous threaded blackboard discussion, synchronous chat sessions), your responses should reflect your level of confidence with the skill/activity described in each statement. Based on your perceptions, please respond to all the following questions by indicating your level of confidence with each statement on a 5-point scale, ranging from (1) *strongly not confident* to (5) *strongly confident*. For example:

I feel confident I can ...

Create web pages with Netscape Composer.

<i>Strongly Not Confident</i>	<i>Not Confident</i>	<i>Somewhat Confident</i>	<i>Confident</i>	<i>Strongly Confident</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

By checking 'somewhat confident', you indicate that you have some degree of confidence in creating web pages with Netscape Composer.

I feel confident I can ...**[Web activities]**

1. use the digital drop box in Blackboard(c) to send and retrieve files
2. use the discussion board in Blackboard to post information and attachments
3. use the threaded discussion feature in Blackboard to create 'grouped' postings
4. use the chat feature and archive in Blackboard
5. solve technical difficulties

[Information literacy]

6. utilize search engines for research and information obtaining
7. evaluate the content of the various websites
8. evaluate the accuracy of the various websites
9. identify biases of the various websites
10. evaluate currency of the various websites

[Learning Theory]

11. differentiate key principles and goals of instruction among the three major learning theories
12. give an instructional scenario to justify the use of Traditionalism in my classroom or a prospective classroom
13. give an instructional scenario to justify the use of Cognitivism in my classroom or a prospective classroom
14. give an instructional scenario to justify the use of Constructivism in my classroom or a prospective classroom
15. effectively use the major learning theories to design instruction.

[Problem-Based Learning]

16. think critically while interacting with other students on PBL during online discussions
17. differentiate between a PBL classroom and a 'traditional' classroom
18. develop enticing questions to engage students in a PBL structured activity
19. provide resources that facilitate research efforts in a PBL structured activity
20. integrate my content area SOLs in a PBL structured activity

[Cooperative Learning]

21. trust views and judgments proposed by my peers
22. establish a positive interdependence with my classmates
23. be an effective collaborator
24. prompt myself to generate discussion synergy
25. manage/resolve conflict among the group members
26. contribute to the collaborative efforts based on my prior knowledge
27. help facilitate learning in a collaborative setting with my own views and actions

[Online communications in general]

28. discuss course content frequently in text-based online forums
29. share my thoughts with my peers via online discussions
30. effectively utilize online discussion in conjunction with my life responsibilities
31. choose the online discussion mode (asynchronous vs. synchronous) that best matches my learning style
32. learn effectively via online discussion
33. benefit from my peers' contribution in online discussion

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