Computers & Education 51 (2008) 1589–1598

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

The role of feedback and self-efficacy on web-based learning: The social cognitive perspective

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ARTICLE INFO

Article history:
Received 24 May 2007
Received in revised form 11 March 2008
Accepted 11 March 2008

Keywords:
Peer feedback
Self-efficacy
Self-regulated learning
Social cognitive theory
Web-based learning
Interactive learning environments
Learning strategies

ABSTRACT

The social cognitive perspective of self-regulated learning suggests that effective learning is determined by the interactions among personal, behavioral, and environmental influences; particularly, high self-regulated learners hold higher motivation (personal), apply better learning strategies (behavioral) and respond to environmental demand more appropriately (environmental). The study thus uses the social cognitive perspective to explore the role of self-efficacy (personal), student feedback behavior, use of learning strategies (behavioral), performance and receiving feedback (environmental) in Web-based learning. There were 76 university students participated in this study. Both quantitative and qualitative methods were applied for data analysis. The results supported that self-efficacy predicted student use of learning strategies and related to elaborated feedback behavior (personal → behavioral). High self-efficacy students applied more high-level learning strategies, such as elaborative strategy and critical thinking. Students who provided elaborated feedback also had higher self-efficacy than those who did not. Moreover, receiving elaborative feedback significantly promoted student self-efficacy (environmental → personal), while receiving knowledge of correct response improved student performance. However, the results indicated that feedback behaviors did not predict academic performance, which may be interfered by modeling effects.

1. Introduction

Recently, Web-based learning has gained more attention in education because it provides students with greater access to information and greater opportunities to work collaboratively with peers without the limitations of time and distance (Palmieri, 1997). However, although Web-based environment provides students with more flexibility to learn, research shows that students who are accustomed to the traditional didactic teaching may have problems to adapt to Web-based learning (McCormack & Jones, 1998). Researchers also identify that learners tend to lack focus, willingness to participate and confidence in Web-based learning (Boechler, 2001; Hansan, 2003). Thus, researchers are attempting to understand how to promote learner motivation and to facilitate learning behaviors in the Web-based learning environment. One important theory that has been noted is the social cognitive theory (Bandura, 1986).

Research has placed emphasis on social cognitive theory in order to understand the relationships between personal, behavioral, and environmental influences (Bandura, 1986, 1997), which help to promote students practices and skills of self-regulated learning (Wang & Lin, 2007a). A recent study proposed a number of significant factors involved in such influences for a social cognitive model of self-regulated learning in the Web-based environment (Wang & Lin, 2007a). However,

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doi:10.1016/j.compedu.2008.03.004

research using the social cognitive model on Web-based learning seldom examines the reciprocal interaction between personal, behavioral, and environmental influences (Compeau & Higgins, 1995; Compeau, Higgins, & Huff, 1999; Wang & Lin, 2007a). This study thus examines reciprocal interactions among these influences in order to better understand students' self-regulated learning in the Web-based environment.

Social cognitive theory suggests that successful self-regulated learners have higher motivation (personal influences), employ better learning strategies (behavioral influences), and respond more appropriately to situational demands (environmental influences) (Pintrich & Schunk, 2002; Wang & Lin, 2007a). The social cognitive perspective on self-regulation plays a very important role in academic learning. According to Wang and Lin (2007a), teachers who recognize the possible reciprocal interactions of these influences will be able to manipulate environmental influences, student perception, and learning behaviors to facilitate student learning. As Bandura (1997) suggested, the relative importance of personal, behavioral and environmental influences would vary for different activities and under different circumstances. The impacts of these influence in Web-based learning needs to be further examined. This study thus investigates the role of self-efficacy (personal), learning strategies, providing feedback (behavioral), performance and receiving feedback (environmental) in the social cognitive model to understand their influences in the Web-based learning environment (see Fig. 1).

2. Personal influence: self-efficacy

The effects of motivation or personal beliefs about learning have been the subject of intense investigation in educational settings, but have rarely been studied in the context of Web-based learning (Tobias, 2006; Yang & Tsai, in press). Some researchers, however, suggest that motivation is even more important in Internet environment (Sankaran & Bui, 2001; Shih & Camon, 2001; Tobias, 2006). For example, research suggests that motivation is the most important student attribute significantly related to Web-based performance (Sankaran & Bui, 2001; Shih & Camon, 2001).

Specifically, research suggests that self-efficacy, or students' beliefs regarding their capability to execute actions necessary to achieve designated outcomes (Bandura, 1986), has a stronger effect on academic performance than other motivational beliefs (Lent, Brown, & Larkin, 1987; Pintrich & De Groot, 1990; Pintrich & Schunk, 1996, 2002). Self-efficacy also has been found to have critical effects on various types of academic learning (Bandura, 1996, 1997, 2000; Gibson, Randel, & Earley, 2000; Joo, Bong, & Choi, 2000; Linnenbrink & Pintrich, 2002; Little & Madigan, 1997; Pajares & Kranzler, 1995; Pajares & Miller, 1995; Pintrich & Schunk, 2002). Recent studies show that self-efficacy is strongly related to Web-based learning and performance (Bolt, Killough, & Koh, 2001; Compeau & Higgins, 1995; Joo et al., 2000; Tsai & Tsai, 2003). For example, research demonstrates that students' self-efficacy in using the internet significantly impacts their Web-based performance (Joo et al., 2000). Tsai and Tsai (2003) also indicate that students with higher internet self-efficacy perform better than those with lower internet self-efficacy in the Web-based learning task.

Research also indicates that self-efficacy has significant influences on self-management behaviors and self-regulated learning processes, such as self-observation, self-judgment and self-reaction (Dembo, 2000; Pintrich & Schunk, 2002; Schunk, 1990, 2001). Research in general suggests that effective self-regulation is based on students' sense of self-efficacy for self-regulating their learning and performing well (Pintrich & Schunk, 2002; Schunk, 1994). In other words, self-efficacy plays important roles in self-regulated learning behaviors. In addition to self-regulated behaviors, research also shows that self-efficacy has a strong influence on effort and task persistence, particularly in the face of the difficulty (Pintrich & Schunk, 2002; Schunk, 1995). In a review of distance learner persistence studies, Gibson (1998) identifies self-efficacy as a key variable. Aside from its effects on persistence and quantity of effort, self-efficacy has also been positively correlated to quality of effort, such as in the use of deeper processing strategies (Pintrich & Schrauben, 1992; Pintrich & Schunk, 2002). A study of internet searching strategies suggested that high internet self-efficacy students apply better information searching strategies than low internet self-efficacy students in a Web-based learning task (Tsai & Tsai, 2003). The aforementioned studies indi-

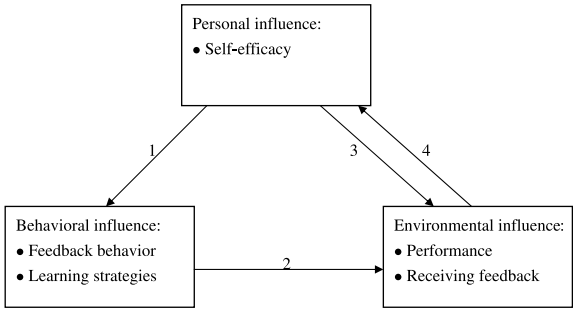

Fig. 1. The personal, behavioral, and environmental influences of the social cognitive model. *Note*: Arrow 1 hypothesizes that self-efficacy should have positive influences on feedback behavior and learning strategies. Arrow 2 hypothesizes that feedback behavior and learning strategies should have significant influences on performance. Arrow 3 hypothesizes that self-efficacy should have significant impacts on performance. Arrow 4 hypothesizes that receiving feedback should have positive impacts on self-efficacy.

cate that self-efficacy is strongly related to student learning behaviors. To date, self-efficacy has been shown to have significant effects on both traditional and Web-based learning and performance. The present study thus utilizes self-efficacy as the personal influence in our social cognitive model in order to understand its importance for behavioral influences such as feedback behaviors as well as learning strategies, and for environmental influence, such as achievement, which is evaluated by peers or teachers as a source of environmental influences in the academic context.

3. Behavioral influence: learning strategies and feedback behaviors

Research generally supports the notion that learners tend to provide feedback resulting in more effective learning (Bangert-Drowns, Kulick, Kulick, & Morgan, 1991; Bulter & Winne, 1995). In a study on the use of peer feedback in the process of writing research papers, peer feedback providers reported their understanding and learning improved during the feedback process (Reese-Durham, 2005). Moreover, research indicates that peer reviewers who provide high quality of feedback demonstrate better assignment scores (Liu, Lin, Chiu, & Yuan, 2001).

Three types of feedback are often used to assess feedback information: knowledge of results (KR), knowledge of correct response (KCR), and elaborated feedback (EF). According to Dempsey, Driscoll, and Swindell (1993), knowledge of results (KR) or simple verification feedback, merely verifies learners' responses as correct or incorrect, such as "You are right." Furthermore, knowledge of correct response (KCR) informs the learner the content of correct answers. Moreover, elaborated feedback (EF) explains why the learners' responses or answers are correct or incorrect, or provides relevant information to inspire learners to reason or judge correct responses or results. Bangert-Drowns et al. (1991) suggest that elaborated feedback is crucial in developing deeper conceptual understanding, and helpful in applying rules in more complicated situations. Elaborated feedback and knowledge of correct responses are generally considered as better student feedback behaviors than knowledge of result feedback (KR). This study thus investigates the role of these feedback behaviors in the Web-based learning environment.

In addition to feedback behaviors, research suggests that student use of learning strategies plays an important role in self-regulated learning processes and distant learning (Dembo, Junge, & Lynch, 2006; Pintrich, 2000). For example, rehearsal strategies involve repeating information to keep the contents in working memory, while elaboration strategies build internal connections between learned information in order to help learners store information to long-term memory (Dembo, 1995; Weinstein & Mayer, 1986); both are strongly related to academic achievement (Pintrich & DeGroot, 1990; Pintrich & Schrauben, 1992; Weinstein, 1986). Moreover, Dembo (1994) suggests that critical thinking, which involving analyzing arguments, judging source credibility, and choosing an appropriate course of action, is also important for learning. Elliot, McGregor, and Gable (1999) add that whereas memorization and rehearsal are considered surface level strategies, elaboration and critical thinking constitute deeper level cognitive strategies.

The selection of appropriate learning strategies is critical for learning and performance (Pintrich, 2000). Research shows that deeper level strategies are important in inquiry-based knowledge constructions in computer-supported collaborative learning (CSCL) (Salovaara & Jarvela, 2003). This study therefore explores the role of the use of learning strategies on students' Web-based achievement. It is also worth pointing out that in a review of studies of computer-based instruction (CBI) feedback, Dempsey et al. (1993) found that individuals who generate feedback metacognitively have significantly enhanced higher-level learning; in other words, feedback behaviors are probably related to the use of learning strategies. This study thus explores the relationship between students' feedback behaviors and their uses of learning strategies in Web-based learning.

4. Environmental influence: receiving feedback

Research suggests that feedback is one of the most significant sources of information helping individual students to correct misconceptions, reconstruct knowledge, support metacognitive processes, improve academic achievement, and enhance motivation (Clark & Dwyer, 1998; Foote, 1999; Warden, 2000; Zimmerman & Martinez-Pons, 1992). Although feedback sources include self, technological devices, and other people, Johnson and Johnson (1993) identify receiving feedback from other people as the most powerful. Previous studies corroborate the importance of receiving feedback for effective learning (Bangert-Drowns et al., 1991; Crooks, 1988; Kulik & Kulik, 1988). In a study of the effects of feedback in an adaptive CBI environment, the results show that the groups who received KCR feedback achieved the same performance but spent significantly less time than during other feedback types such as elaborated feedback and try-again feedback (Dempsey, Driscoll, & Litchfield, 1993). In other words, KCR feedback is more efficient than other types of feedback. However, Bangert-Drowns et al. (1991) declare that elaborated feedback should have critical effects "if the learners attend to it mindfully" (p. 48). As Tseng and Tsai (2007) suggested, different types of feedback may lead to various learning outcomes. Therefore, this study explores the role of receiving feedback, such as KR, KCR and elaborated feedback on student Web-based academic performance.

Researchers suggest that feedback can impact learners' motivation and self-esteem (Dempsey et al., 1993). In particular, feedback signifies progress (e.g. "You're doing better at this task" enhances self-efficacy) (Pintrich & Schunk, 2002). Feedback that emphasizes mastery, self-improvement, and achievement should therefore have positive effects on learners' self-efficacy (Pintrich & Schunk, 2002). One recent study investigated the effects of elaborated feedback, KR, and KCR on learners

motivation, and the results showed that elaborated feedback is related to positive motivation (Narciss & Huth, 2006). The present study further examines the role of receiving elaborative feedback, KR, and KCR on students' self-efficacy.

Therefore, this study investigates the following research questions:

1. Does students' self-efficacy predict their learning behaviors (e.g. learning strategies, feedback behaviors) and performance in a Web-based learning environment?
2. Do students' learning behaviors (feedback behaviors, learning strategies) predict their academic performance? What are the relationships between students' uses of learning strategies and their feedback behaviors?
3. Does the feedback received by students significantly relate to their academic performance and self-efficacy?

5. Measures

5.1. Questionnaire

The questionnaires consisted of the scales of "self-efficacy" and "cognitive strategies" using a 7-point Liker scale ranging from (1) "not at all true of me" to (7) "very true of me". These scales were derived from Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich, Smith, Garcia, and McKeachie (1991). Since this study was conducted with students in Taiwan, the authors used the Chinese version of MSLQ translated by Wang and Lin (2000), which has been proved very reliable with α of .91. The self-efficacy scale consisted of eight items (α = .90) (for example, "I am certain I can understand the most difficult material presented in the readings for this course"). The cognitive strategy scale consisted of four subscales, such as rehearse strategy (α = .70) (3 items, e.g. "When I study for this class, I practice saying the material to myself over and over."), elaboration strategy (α = .83) (4 items, e.g. "I try to relate ideas in this subject to those in other courses whenever possible"), and critical thinking (α = .77) (3 items, e.g. "When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence.").

5.2. The networked system

This study used the networked portfolio system (NetPorts, Fig. 2) which was proven highly reliable (Liu, Lin, & Yuan, 2001; Wang & Lin, 2007a, 2007b). The system server utilizes Windows 2000 as its operating system and SQL Server 7.0 as its database. The NetPorts system provided an online questionnaire module to collect students' data, and also allowed online submission of students' work. Students are able to submit homework, process peer assessments, and view peer feedback through the system. After a student submitted his/her work, the system automatically sent the work to a peer. After this work was given feedback, the system informed the submitting student of the anonymous peer reviewer's feedback. The system was also designed with a system management module that allows teachers to easily monitor student progress. For example, teachers can easily keep track of and modify assignment due dates, as well as monitor student homework and feedback.

6. Participants

Seventy-six students participated in this study. The selected participants were students who enrolled in a mandatory course at the teacher education center of a research university in Northern Taiwan. The teacher education center offers the course to students with different majors who consider teaching a future career option. These participants were from about 23 different majors, such as Mathematics, Chemistry, language, Music, etc.

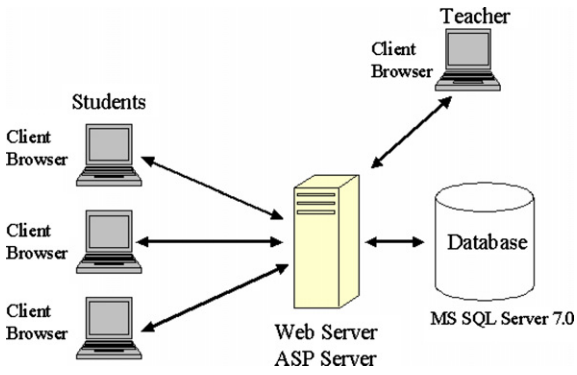

Fig. 2. NetPorts configuration.

7. Task

The "Educational Psychology" course was aimed at improving students' understanding of both theoretical and practical issues in educational psychology. One of the course assignments was a case study, in which a student lacked motivation to learn and subsequently experienced learning difficulties. These participants were asked both to identify the case student learning problems (e.g. lack of self-efficacy, inadequate attribution) and to provide strategies to solve the problems and improve learning. The purpose of this task was to encourage preservice teacher participants to apply theory to solve practical classroom problems.

8. Procedures

The teacher assigned the homework to students in the fourth week of the semester. Students were asked to finish the assignment within one week. After finishing their assignment, students were asked to fill out the questionnaires and uploaded their homework through the NetPorts system. The NetPorts system then automatically sent each student's homework to an anonymous peer reviewer who did not know the author of the homework. Every reviewer was allotted two weeks to give and upload feedback on homework to the NetPorts system. The feedback was also sent to the author through the NetPorts system. Students were further asked to revise their homework based on feedback provided by the anonymous reviewer. Prior to uploading their homework, students were finally asked to fill out the self-efficacy questionnaire again through the NetPorts system, allowing the researchers to examine the difference between student self-efficacy before and after receiving peer feedback. One issue to be noted was that the feedback process in this study was under anonymous review, which provided more reliable information and eased of the students' pressure of criticizing peers' work, as research suggested (Hanrahan & Isaacs, 2001; Topping, Smith, Swanson, & Elliot, 2000). Particularly, Asian students were more concerned with their relationship with others due to Asian collective culture, and thus might not provide authentic critiques or feedback to their classmates. Therefore, anonymous review process was employed in order to acquire a more reliable peer feedback in this study.

9. Data analysis

This study used both quantitative and qualitative methods of data analysis.

9.1. Quantitative methods

Several statistical methods were used to analyze the data. An item analysis was conducted to determine item reliability in the questionnaires, and correlation analysis was used to test inter-rater reliability. Moreover, the regression was used to assess the predictability of self-efficacy on learning strategies; learning behaviors (e.g. strategies, and feedback) on performance; receiving feedback on performance and self-efficacy. Furthermore, since there is a significant difference in both self-efficacy and achievement between the top 30% and bottom 30%, *t*-tests were uses to analyze the differences of the uses of learning strategies, feedback behaviors between these groups.

9.2. Qualitative methods

Content analysis was used to analyze participants' assignments and feedback. Three graduate students majoring in Education served as raters. The instructor and three raters discussed the case student learning situations, identified the learning problems, and provided the strategies to solve the problems and improve learning. In order to enhance inter-rater reliability, the raters first jointly analyzed both 12 participants' assignments and feedback, and then analyzed the other 64 participants' assignments and feedback independently. For both assignment and feedback analysis, three raters analyzed the content based on participants' paragraphs which were stored in the NetPorts system. Each paragraph could cover one or more ideas, and each idea served as an analysis unit; if one paragraph conveyed two ideas, two separate analytical units were counted, while two continuous paragraphs expressed the same idea were treated as a single analytical unit.

The three raters first analyzed the participants' assignments, in which they need to identify case student learning problems, and also provide the strategies to solve the problems. The instructor discussed with three raters and decided the rubric for class assignment, based on course instruction. The case student learning problems consisted of lack of motivation (e.g. low self-efficacy, high anxiety, inappropriate attribution, low intrinsic motivation) and inappropriate use of learning strategies. Strategies for solving case student learning problems were focused on how to promote motivational beliefs and to improve learning strategies. Students score from their ideas in either identifying the learning problems or providing strategies to solve the problems, based on the predefined rubric. Each idea in accord with rubric would be counted as one point. For example, "setting the specific goal could promote self-efficacy" would be counted as one point. Students who identified the learning problems and provided all the possible strategies to solve the problems would attain high scores of their assignments. The inter-rater consistency for both original and revised assignment scores was calculated by the Pearson product

moment correlation, and all correlations were over .80, which indicated that the content analysis for students' assignment scores was reliable.

For feedback analysis, every idea unit was evaluated and categorized according to Dempsey et al.'s (1993) definitions for KR, KCR, and EF. The feedback that merely designated answers as correct or incorrect was deemed knowledge of results (KR) (e.g. "Your answer is right"). Feedback that provided correct answers to questions was regarded as knowledge of correct response (KCR) (e.g. "You should set the specific goal for raising his self-efficacy"). Elaborated feedback (EF) was that which identified correct or incorrect answers, but also provided more information to help develop higher-level thinking (e.g. "Vicarious experience is good for promoting self-efficacy, what kinds of vicarious experiences may have the best effects in raising self-efficacy?"). The Pearson product moment correlations for inter-rater consistency on students' feedback were over .78. This demonstrated that content analysis was also reliable for students' feedback.

10. Results

The tests of internal consistency on the scales of self-efficacy, rehearsal strategies, elaborative strategies, and critical thinking strategies were performed. The reliability results and descriptive statistics for the scales of self-efficacy, rehearse, elaborative, and critical thinking strategies were shown in Table 1. The reliability test indicated that these scales were reliable with an alpha of .891 for self-efficacy of original assignment, .901 for self-efficacy of revised assignment, .704 for rehearsal strategies, .823 for elaborative strategies, and .767 for critical thinking strategies. The descriptive statistics for KR, KCR, EF, and assignment scores were displayed in Table 2. The results indicated that knowledge of results (KR) and knowledge of correct response (KCR) were significantly greater than elaborated feedback (EF), and that there was also a significant difference between original and revised assignment scores.

1. Does students' self-efficacy predict their learning behaviors (e.g. feedback behaviors, learning strategies) and performance in a Web-based learning environment?
   For the role of self-efficacy on feedback behaviors, the regression results indicated that self-efficacy did not significantly predict student feedback behaviors, such as providing knowledge of results feedback ($\beta = .038$, $T = .329$, $p > .05$), correct response feedback ($\beta = -.002$, $T = -.018$, $p > .05$), and elaborated feedback ($\beta = .131$, $T = 1.133$, $p > .05$). However, the t-test indicated that students who provided high cognitive level of feedback (i.e. elaboration feedback) had higher self-efficacy than those who did not ($t(74) = 2.82$, $p < .01$). On the other hand, students who provided knowledge of results feedback ($t(74) = -1.38$, $p > .05$) or correct response feedback ($t(74) = -.44$, $p > .05$) did not differ significantly in self-efficacy from those who did not.
   For the role of self-efficacy on the uses of learning strategies, the regression analysis showed that students who had higher self-efficacy tended to use more learning strategies, such as rehearsal ($\beta = .604$, $T = 6.527$, $p < .01$), elaboration ($\beta = .711$, $T = 8.694$, $p < .01$), and critical thinking skills ($\beta = .632$, $T = 7.017$, $p < .01$). The t-test further indicated that there was a significant difference in using higher-level learning strategies, such as elaboration and critical thinking skills, between students whose self-efficacy was in the top 30% and in the bottom 30% ($t(43) = -8.68$, $p < .01$). The results also demonstrated that the top 30% self-efficacy students used significantly more high-level learning strategies than low-level cognitive strategies (e.g. rehearse) ($t(21) = 3.58$, $p < .01$).
   For the role of self-efficacy on students' performance, the results showed that students' self-efficacy beliefs were not significantly related to both their original ($\beta = -.185$, $T = -1.621$, $p > .05$) and revised assignment scores ($\beta = -.072$, $T = -.623$, $p > .05$).

Table 1
Summary table of descriptive statistics and reliability of scales of self-efficacy, rehearse, elaboration, and organization strategies

	Mean	SD	α
Self-efficacy (for original assignment)	5.195	0.813	.891
Self-efficacy (for revised assignment)	5.180	0.933	.901
Rehearse strategy	4.796	0.941	.704
Elaboration strategy	5.526	0.876	.823
Critical thinking strategy	4.800	1.093	.767

Table 2
Summary table of descriptive statistics, and tests of significance of feedback and assignment scores

	Mean	SD	t
KR	1.143	0.746	4.09**
EF	0.644	0.890	
KCR	1.385	1.315	3.82**
Original assignment	10.28	3.163	−3.60**
Revised assignment	10.77	3.262	

KR: knowledge of results; EF: elaborated feedback; KCR: knowledge of correct response.
** $p < .01$.

Table 3
The correlations between strategy use and providing feedback

	Rehearse strategy	Elaboration strategy	Critical thinking strategy
Knowledge of results	.244*	.225	.254*
Knowledge of correct response	.003	.002	.041
Elaboration feedback	.177	.225	.241*

* $p < .05$.

Table 4
The regression results for receiving feedback on students' improved achievement and increased self-efficacy

	Improved achievement			Increased self-efficacy		
	β	t	Sig.	β	t	Sig.
KR	.196	1.719	n.s.	.131	1.141	n.s.
KCR	.374	3.464	$p < .01$	−.004	−.034	n.s.
EF	−.141	−1.223	n.s.	.287	2.576	$p < .05$

KR: knowledge of results; KCR: knowledge of correct response; EF: elaborated feedback.

2. Do students' learning behaviors (feedback behaviors, learning strategies) predict their academic performance? What are the relationships between students' uses of learning strategies and feedback behaviors?
   The regression results showed that knowledge of results (KR) ($\beta = -.62$, $T = -.524$, $p > .05$), knowledge of correct response (KCR) ($\beta = .02$, $T = .015$, $p > .05$), and elaborated feedback ($\beta = .128$, $T = 1.081$, $p > .05$) did not predict student assignment performance. To further examine the roles of feedback behaviors on students' achievement, the t-test results also indicated no difference in using knowledge of results ($t(41) = .561$, $p > .05$), knowledge of correct response ($t(41) = 1.097$, $p > .05$), and elaborated feedback ($t(41) = -1.709$, $p > .05$) between students' achievement in the top 30% and in the bottom 30% average score of two assignment performance (original assignment and revised assignment).
   For the role of learning strategies on achievement, the regression results indicated that student use of rehearses strategies ($\beta = .152$, $T = .886$, $p > .05$), elaborated strategies ($\beta = .046$, $T = .248$, $p > .05$), and critical thinking skills ($\beta = -.133$, $T = -.770$, $p > .05$) did not predict student academic achievement. To further examine the impact of cognitive strategies on students' achievement, the t-test results also indicated no difference in using rehearse strategies ($t(41) = -.831$, $p > .05$), elaborated strategies ($t(41) = -.788$, $p > .05$), and critical strategies ($t(41) = -.310$, $p > .05$) between students' achievement in the top 30% and in the bottom 30% of average score of two assignment performance (original assignment and revised assignment).
   For the relationship between strategy use and feedback behavior, the correlation results (shown in Table 3) indicated that students who used more rehearse strategies were more likely to only provide knowledge of result feedback ($r = .244$, $p < .05$). In addition, the results showed that students using more critical thinking strategies provided more knowledge of result feedback ($r = .254$, $p < .05$) and elaborated feedback ($r = .241$, $p < .05$). In other words, whereas students who used more rehearse strategies tended to only provide more knowledge of result feedback, students who applied more critical thinking strategies not only provided knowledge of result feedback, but also provided more elaboration feedback. In addition, the results showed that elaboration feedback only correlated to critical thinking strategies significantly ($r = .241$, $p < .05$). In other words, students who provided more elaborated feedback also used more critical thinking strategies.
3. Does the feedback received by students relate to their academic performance and self-efficacy?
   In general, the pair t-test results indicated that students had significantly better scores of revised assignment than original assignment after receiving feedback ($t(75) = -3.60$, $p < .05$). This suggests that students improve their performance after receiving peer feedback. More specifically, the regression results demonstrated that knowledge of correct response (KCR) ($\beta = .374$, $T = 3.464$, $p < .01$) significantly predicted students improved performance, while knowledge of results (KR) ($\beta = .196$, $T = 1.719$, $p > .01$) and elaborated feedback ($\beta = -.141$, $T = -1.223$, $p > .01$) did not (see Table 4).
   For the role of receiving feedback on students' self-efficacy, the results showed that receiving elaborative feedback (EF) was significantly related to the difference between students' self-efficacy of original assignment and self-efficacy of revised assignment ($\beta = .287$, $T = 2.576$, $p < .05$). That is, students who received more elaborated feedback significantly increased their self-efficacy. The t-test results further validated the point that students receiving elaborative feedback significantly increased their self-efficacy as compared to those who did not receive elaborative feedback ($t(74) = -2.416$, $p < .05$).

11. Conclusion and discussion

For the role of self-efficacy in behavioral influences, the results of this study indicated that self-efficacy was significantly related to students' elaborated feedback behaviors and use of learning strategies. Students who provided elaborated feedback had higher efficacy in comparison to those who did not. In addition, high efficacy students used more high-level cognitive strategies, such as elaboration and critical thinking strategies, as compared to low self-efficacy students. The results

also supported the notion that high efficacy students used more high-level cognitive strategies than low-level cognitive strategies.

However, the results indicated that self-efficacy was not related to student academic performance, which is inconsistent with most studies (Pintrich & Schunk, 2002). As Bandura (1986) suggested, students acquire self-efficacy from their previous performance, vicarious experience, verbal persuasion, and physical characteristics. Particularly, previous performance experiences play the most important role in student judgment of self-efficacy (Pintrich & Schunk, 2002). As previously noted, the "Educational Psychology" course is an introductory class at the teacher education center and thus all the students from other academic domains may not have had enough performance experience or information to judge their efficacy in education domain. As Schunk, Pintrich, and Meece (2007) suggested, self-efficacy is a domain specific construct. Students who lack performance information or experience in the academic domain may lead to inaccurate estimations of self-efficacy. The lack of performance experience in assessing self-efficacy in the domain might help to explain why self-efficacy did not predict student achievement in this study.

Self-efficacy, the key variable in self-regulated learning for personal influences, was significantly related to feedback behaviors and high-level learning strategies. To promote effective learning behaviors, some suggestions for raising efficacy beliefs have been made (Pintrich & Schunk, 2002; Wang & Lin, 2007b). For example, in summarizing Pintrich & Schunk's (2002) review of the roles of goal setting on self-efficacy, Wang and Lin (2007b) stated that specific and proximal (close-at-hand) goals are more likely to enhance self-efficacy, since progress is easier to estimate; moderately difficult goals which convey more clear information about students' capabilities are also effective in enhancing self-efficacy.

In addition to goal setting, research suggests that vicarious experience has critical effects on self-efficacy (Bandura, 1986). Observing others' success, rewards, or failures makes observers to believe that they are very likely to experience similar outcomes when acting out the same behaviors (Pintrich & Schunk, 2002). Indeed, observing similar peers complete a task successfully generates a sense of self-efficacy that helps to improve performance (Wang & Lin, 2007b). Particularly, the more similar individuals' capability and background are, the stronger the effects of vicarious experience (Schunk et al., 2007). This lends support to why the peer model exerts greater influence in student learning than the adult model (Schunk & Hanson, 1985). Verbal persuasion is also effective for raising self-efficacy, but the persuasive message should be consistent with the learners' actual academic achievement. According to Schunk et al., (2007), students who have self-efficacy slightly over their actual skills should be most adaptive for their learning. Because self-efficacy is strongly related to students' learning behaviors, teachers can apply these strategies to raise students' self-efficacy, and possibly have direct or indirect effects on student academic achievement (Pintrich & Schrauben, 1992).

The study results also indicated that behavioral influences, such as learning strategies and feedback behaviors, did not predict student academic achievement; this is also inconsistent with previous studies (Pintrich & DeGroot, 1990; Pintrich & Schrauben, 1992; Weinstein, 1986). After careful examination of the cognitive strategy items in the questionnaire, the authors found that most items were concerned with students' use of cognitive strategies for the "Educational Psychology" course rather than with the networked assignments applied in this study. As a result, the use of cognitive strategies for course learning cannot effectively predict their networked assignment scores. The results further showed that feedback behavior did not significantly relate to student academic achievement. Students who provided better quality of feedback did not have better performance. Some students' feedback stated that they learned more from reviewing their peers' assignments; that is, it seems that modeling effects might have influenced student achievement. Students should benefit from reviewing high quality peer assignments. Thus, the effects of feedback behaviors on achievement might be affected by other factors, such as modeling effects. A Web-based study also shows similar results that students benefit from reviewing other peers' assignments (Liu et al., 2001).

The results indicated that student performance improved significantly after receiving feedback. Particularly, receiving knowledge of correct response (KCR) improved student academic performance. In other words, students who received more knowledge of correct response (KCR) significantly enhanced their Web-based performance. However, receiving elaborated feedback did not significantly improve student academic performance. A review of Dempsey et al. (1993) on feedback studies suggested that in almost all cases there is little difference in performance between KCR and any elaborated form of feedback, but due to its brevity, KCR feedback was more efficient than elaborated form of feedback. Indeed, knowledge of correct responses (KCR) was sufficient for students to correct their errors, which improved their performance scores. Accordingly, the meta-analysis conducted by Bangert-Drowns et al. (1991) suggested that students were most interested in the correct answer, instead of the reasons for the correct answer, and thus they did not mindfully attend to more detailed explanation of responses (elaborated feedback). This might explain why KCR significantly improved student Web-based performance, while elaborated feedback did not have such influence in this study. It is probably particularly true for Taiwanese college students, who have been accustomed to focus on correct answers when preparing for National Entrance Examination while they studied at high schools.

For the influence of receiving feedback on self-efficacy, the results showed that students who received more elaborated feedback significantly raised their self-efficacy, while students receiving knowledge of results (KR) or knowledge of correct response (KCR) did not significantly increase their self-efficacy. Indeed, even the KCR could improve students' academic performance, but it was not able to increase individuals' self-efficacy, which is the belief that they are capable of performing the actions to achieve the designed goals. As mentioned, for students who attend to the feedback mindfully, elaborated feedback is very helpful in developing deeper conceptual understanding (Bangert-Drowns et al., 1991), which in turn makes them to believe that they have the capability or skills to execute the actions toward the goals so as to enhance self-efficacy.

The results of the study also demonstrated that self-efficacy significantly predicted student use of cognitive strategies and related to student feedback behavior (personal → behavioral); receiving elaborated feedback significantly enhanced student self-efficacy (environmental → personal). However, behavioral influences such as feedback behavior and use of cognitive strategies on academic performance (environmental influence) were not supported in this study. As noted above, modeling effects may have interfered with the effects of feedback behavior on performance, hence, future studies might take this variable into account in order to better understand the influence of feedback behavior.

This study examined the social cognitive model of self-regulated learning in the Web-based learning environment. Although the model was not fully supported by this study, it was consistent with Bandura's (1997) views of social cognitive theory, that is, although personal, behavioral, and environmental influences may operate as reciprocal interacting determinants, these influences are not of equal strength. For example, this study suggested that self-efficacy (personal) plays important roles in learning behaviors (behavioral), such as providing elaborated feedback or applying learning strategies, while these behaviors (behavioral) cannot significantly predict students' performance (environmental). In addition, the results also indicated receiving better quality feedback (environmental) promoted students' performance and self-efficacy (personal). As Pintrich and Schunk (2002) suggested, the directions among personal, behavioral, and environmental influences are not always the same; generally, one or two influences may predominate. Indeed, our results indicated that personal (self-efficacy) and environmental (receiving feedback) influences played more important roles in Web-based learning in our model. Even though our model was not fully supported by the results, the social cognitive emphasis on interaction between personal, behavioral, and environmental influences clearly helps teachers to facilitate student learning. For the influences of motivation in learning, as Wang and Lin (2007a) stated, in real learning contexts, students may have knowledge of cognitive or metacognitive strategies, but lack the motivation to use these strategies. From the vantage point of the social cognitive perspective, however, teachers should focus more on promoting students' motivational beliefs (e.g. self-efficacy) in order to improve their learning (Wang & Lin, 2007a). This study further suggested that teachers could provide students with high quality of feedback, which in turn helps to promote students' self-efficacy. Our model also supported Bandura's (1997) views of social cognitive model: "it is possible to gain an understanding of how different segment of reciprocal causation operation without having. . .to assess every possible interactant at the same time" (p. 6).

In this study, students were only given feedback from one of their peers. To better understand the effects of feedback in learning, future studies may be designed to enable students to receive more feedback, or receive feedback from different peers. In addition, although our study was conducted under anonymous review process due to the pressure of criticizing other's work in Asian collective culture, the comparison between the impacts of anonymous and non-anonymous feedback process on self-efficacy should be an important issue to clarify in future research. Finally, further research on other personal, behavioral, and environmental factors will certainly contribute to an even greater understanding of the social cognitive model of self-regulated learning in Web-based environments.

Acknowledgement

The authors would like to thank the National Science Council, Taiwan, ROC under Contract No. NSC 94-2520-S-011-001 and NSC 95-2520-S-011-001.

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