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Learning strategies in web-supported collaborative project

Lih-Juan ChanLin*

Department of Library & Information Science, Fu-Jen Catholic University, New Taipei City, Taiwan

Web-based learning promotes computer-mediated interaction and student-centred learning in most higher education institutions. To fulfil their academic requirements, students develop appropriate strategies to support learning. Purposes of this study were to: (1) examine the relationship between students study strategies (assessed by Learning and Study Strategies Inventory [LASSI]) with their learning outcomes and online interaction and (2) observe the development of strategies among students in the web-supported collaborative project. Both quantitative and qualitative data were gathered. The results of the study revealed that some LASSI constructs were significant in predicting students’ online learning achievement, including: anxiety, time management, use of support/material and test strategies \((p<.05)\). Students’ interaction significantly correlated with: attitude, motivation, information processing, selecting the main idea, use of support/material and test strategies \((p<.05)\). In addition to LASSI, strategies were identified in the study, including: task analysis, information utilisation, group coordination, self-review and task refinement.

Keywords: learning strategies; study strategies; cooperative learning; project-based learning; web-based learning; higher education

Introduction

Research has shown that students are more likely to succeed in college if they have mastered a strong repertoire of learning strategies (Alexander, Murphy, Woods, & Dubon, 1997; Liu, Lin, Jian, & Liou, 2012; Wadsworth, Husman, Duggan, & Pennington, 2007). In traditional classroom settings, learning strategies are defined as competence in acquiring, recording, organising, synthesising, remembering and using information; and they are among the skills that can be used by learners of all ages (Harvey, 1995; Proctor, Prevatt, Adams, Hurst, & Petscher, 2006). Learning strategies reflect an individual’s ability to use cognitive strategies effectively, consisting of a students’ perception of self-efficacy to set goals, maintain motivation and sustain a positive attitude toward learning. To be successful in their academic achievement, students have to be motivated to put effort into their studies and to use learning strategies and skills that support meaningful learning (Weinstein, Schulte, & Palmer, 1987).

Similar to traditional learning settings, in an e-learning environment, students must put effort into their studies and employ various learning strategies and skills that support meaningful learning (Mansour & Mupinga, 2007; Usta, 2011).

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Students’ use of various strategies for accomplishing online cooperative tasks is worth further examination in e-learning for promoting successful e-learning (Boyd, Boyd, & Boyd, 2000; Lightner, Bober, & Willi, 2007). Meaningful e-learning entails student active participation within a cooperative team approach project task, and application of collaboration, dialogue and reflection connected to learning context (Huang & ChanLin, 2007; Lofstrom & Nevgi, 2007; Williams, Morgan, & Cameron, 2011). The development of students’ learning strategies in self-regulation, problem solving and decision-making and evaluation of their own progress is the central focus for any educational innovations (Lightner et al., 2007).

In defining traditional learning strategies, Weinstein’s model of strategic learning has emerged as a useful way to identify and organise the skills necessary for academic success (Harvey, 1995; Proctor et al., 2006; Weinstein et al., 1987). This model has the learner at its core, focusing on self-concept, individual difference factors and learning history. Weinstein’s model of strategic learning encompasses a variety of activities, including time management, setting appropriate goals, selecting an appropriate note-taking strategy, concentrating, selecting main ideas, self-testing, organisation and managing anxiety (Proctor et al., 2006; Weinstein et al., 1987).

To provide diagnostic and prescriptive information for students wishing to expand their strategy knowledge base, the Learning and Study Strategies Inventory (LASSI) developed by Weinstein et al., (1987) has been widely used as a tool to record the multitude of areas of strategic learning among college students (e.g. Sizoo, Agrusa, & Iskat, 2005; Wadsworth et al., 2007). Expanding the use of LASSI in the e-learning environment might help understand students’ use of strategies appropriate to their achievement in online courses (Proctor et al., 2006).

Different from traditional face-to-face learning settings, e-learning environment requires students to devote more time and effort in the self-directed activities geared toward promoting academic achievement in specific online learning goals, including applying, synthesising and evaluating knowledge in order to contribute to the learning community (Rodriguez, Ortiz, & Dvorsky, 2006; Song & Hill, 2007). Since learning strategies encompass thoughts, behaviours, beliefs or emotions that facilitate the acquisition, understanding or transfer of new knowledge and skills (Weinstein, Husman, & Dierking, 2000), it is important for teachers to know what strategies are most effective in ensuring success in a particular course and how to incorporate these strategies into the course curriculum (Wadsworth et al., 2007).

Studies have indicated that appropriate learning experiences can foster students’ self-direction (e.g. Gazi, 2011; Vonderwell & Turner, 2005). An understanding of learner attributes and how these attributes impact what occurs in the online learning context are important (Song & Hill, 2007). Since online learning often situates control of implementation with the learners, students’ use of learning strategies and their capabilities to regulate their own learning processes are critical to learning achievement in online learning context (Garrison, 2003).

In the study, students’ use of learning skills to achieve online learning goals was explored. Numerous studies have demonstrated the link between study strategies and academic success in college students (Al-Hilawani & Sartawi, 1997; Larose & Roy, 1991; Proctor et al., 2006). In the online learning context, Loomis (2000) investigated the relationship between LASSI measures in individual strategy use and the performance of these measures; Wellman (2005) also examined the relationship between LASSI variables and learning. Wadsworth et al. (2007) used LASSI measures to identify LASSI variables that contributed to predict learning.
performance. This line of research may help identify areas that certain groups of students are likely to require assistance to develop appropriate strategies for online learning.

Specifically, this study examines the relationship between students’ online interaction and learning achievement with study strategies measured by the LASSI (Weinstein et al., 1987). An additional goal is to identify strategies that are not included in LASSI, but are pertinent to online learning.

Method

Participants and learning setting:
One hundred and eighteen subjects participating in the study were sophomore students enrolling ‘Media Services’ in the Department of Library and Information Science at Fu-Jen Catholic University. One part of the course was designed for asynchronous online learning covering various units related to ergonomic media services. The purpose of the course was to help students become acquainted with various ergonomics problems in the digital environment so that students would be more concerned with ergonomic issues for providing digital services in their future career.

The web-based learning lasted for 12 weeks. To fulfil the course requirement, students signed up with 3–4 persons a team, to accomplish a group project by the end of the course. They were encouraged to learn cooperatively with their peers and participate in various online activities. Students were requested to post messages on the group discussion forum for sharing project ideas and their learning reflections. The online lesson units provided subject content and resource links to help students access various web-based reading materials for their project task completion. The role of the instructor was to monitor and facilitate students’ learning, and to provide guidance and help when students encountered obstacles. Each student’s performance was assessed by their final group project grade using the following indications: content of the research project (20%), organisation (20%), appropriate use of references (20%), format of presentation (20%) and peer assessment of individual’s effort (20%)

Data collection and analysis

The learning system managed administrative tasks for students’ learning, including grading, announcement and communication. Thus, this setting provided a unique opportunity to examine the learning strategies students utilised in order to manage learning in an online environment. All student interactions with their peers and their instructor were documented for qualitative analysis.

On a quantitative basis, traditional measurement of LASSI was also used. The instrument has been translated into Mandarin, validated and widely used in Taiwan and as a standardised measure of learning strategies and skills among college students since 1992 (Lee, Chuang & Hong, 1992). Factor analysis of LASSI revealed following constructs: attitude (7 items) (Cronbach alpha = .68), motivation (7 items) (Cronbach alpha = .62), time management (9 items) (Cronbach alpha = .78), anxiety (8 items) (Cronbach alpha = .75), concentration (8 items) (Cronbach alpha = .72), information processing (9 items) (Cronbach alpha = .80), selecting the main idea

(6 items) (Cronbach alpha = .66), use of support/materials (7 items) (Cronbach alpha = .63), self-testing (9 items) (Cronbach alpha = .60) and test strategies (8 items) (Cronbach alpha = .76). Cronbach alpha for inter-item reliability in all items was .84. The accumulated variance reached 54.46.

**Results**

**Relationship of learning strategies and learning achievement**

LASSI used to examine students’ use of traditional learning strategies revealed that the mean scores (using five-point Likert Scale) of most constructs were above average (>3.0) (Table 1). Students’ learning outcomes measured by their final project score ranging from 66 to 92 (mean = 83.50 and CI.95 = [81.10; 84.50]) revealed that all students had achieved the learning objectives. A multiple regression analysis was conducted to examine the relationship between learning strategies using LASSI constructs and students’ project score. The analysis showed four LASSI constructs that predicted significantly the students’ project score, including: motivation, time management, anxiety, use of support/material and test strategies, \( R^2 = .507, F(10, 107) = 10.996, p = .000 \). Other LASSI constructs did not contribute significantly to the overall model in predicting students’ project score (\( p > .05 \)) (Table 2).

<table>
<thead>
<tr>
<th>Strategy measure</th>
<th>Construct mean</th>
<th>Item mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude (7 items)</td>
<td>20.10</td>
<td>2.87</td>
</tr>
<tr>
<td>Motivation (7 items)</td>
<td>22.00</td>
<td>3.14</td>
</tr>
<tr>
<td>Time management (9 items)</td>
<td>27.71</td>
<td>3.08</td>
</tr>
<tr>
<td>Anxiety (8 items)</td>
<td>24.58</td>
<td>3.07</td>
</tr>
<tr>
<td>Concentration (8 items)</td>
<td>24.98</td>
<td>3.12</td>
</tr>
<tr>
<td>Information processing (9 items)</td>
<td>30.69</td>
<td>3.41</td>
</tr>
<tr>
<td>Selecting the main idea (6 items)</td>
<td>19.53</td>
<td>3.26</td>
</tr>
<tr>
<td>Use of support/material (7 items)</td>
<td>24.02</td>
<td>3.43</td>
</tr>
<tr>
<td>Self-testing (9 items)</td>
<td>29.04</td>
<td>3.23</td>
</tr>
<tr>
<td>Test strategies (8 items)</td>
<td>23.13</td>
<td>2.89</td>
</tr>
</tbody>
</table>

**Table 2. Standardised coefficients for the multiple regression equation predicting project grade with LASSI constructs.**

<table>
<thead>
<tr>
<th>LASSI construct</th>
<th>Standard coefficient ( \beta )</th>
<th>( t )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>-.167</td>
<td>-1.63</td>
<td>.105</td>
</tr>
<tr>
<td>Motivation</td>
<td>.212</td>
<td>2.06</td>
<td>.042*</td>
</tr>
<tr>
<td>Time management</td>
<td>.274</td>
<td>2.195</td>
<td>.030*</td>
</tr>
<tr>
<td>Anxiety</td>
<td>-.240</td>
<td>-2.479</td>
<td>.015*</td>
</tr>
<tr>
<td>Concentration</td>
<td>.139</td>
<td>1.263</td>
<td>.209</td>
</tr>
<tr>
<td>Information processing</td>
<td>.007</td>
<td>.063</td>
<td>.950</td>
</tr>
<tr>
<td>Selecting the main idea</td>
<td>.037</td>
<td>.273</td>
<td>.785</td>
</tr>
<tr>
<td>Use of support/material</td>
<td>.222</td>
<td>2.305</td>
<td>.023*</td>
</tr>
<tr>
<td>Self-testing</td>
<td>-.029</td>
<td>-.275</td>
<td>.784</td>
</tr>
<tr>
<td>Test strategies</td>
<td>.508</td>
<td>3.762</td>
<td>.000***</td>
</tr>
</tbody>
</table>

Note: Model 1 – predicting project score with LASSI constructs: \( R^2 = .507, F(10, 107) = 10.996, p = .000; * p < .05; ** p < .01; *** p < .001.**
Relationship between online interaction and learning strategies

From students’ group discussion forums, a total of 9397 postings were gathered. Students’ total electronic postings in discussion forums ranged from 22 to 266 (79.38 ± 40.79). Students’ online interaction (in terms of number of postings) is significantly positive, however, low correlated with learning outcome (\( r = .22; p = .011 \)). To observe the relationship between students’ online interaction and various LASSI constructs, correlation analyses were conducted. According to Pearson correlation analysis, students’ postings were positively correlated with various LASSI constructs, including: attitude, motivation, information processing, selecting the main idea, use of support/material, self-testing and test strategies (\( p < .05 \)) (Table 3). These results reflected that online interaction from discussion forums might provide potential connection to understand further how students used self-directed or group-monitoring strategies to achieve the assigned project goal. In-depth analysis of examining strategy use in online group learning was performed.

<table>
<thead>
<tr>
<th>LASSI construct</th>
<th>( r )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>.210</td>
<td>.022*</td>
</tr>
<tr>
<td>Motivation</td>
<td>.424</td>
<td>.000**</td>
</tr>
<tr>
<td>Time management</td>
<td>.055</td>
<td>.533</td>
</tr>
<tr>
<td>Anxiety</td>
<td>.121</td>
<td>.193</td>
</tr>
<tr>
<td>Concentration</td>
<td>-.106</td>
<td>.256</td>
</tr>
<tr>
<td>Information processing</td>
<td>.264</td>
<td>.004**</td>
</tr>
<tr>
<td>Selecting the main idea</td>
<td>.287</td>
<td>.002**</td>
</tr>
<tr>
<td>Use of support/material</td>
<td>.196</td>
<td>.034*</td>
</tr>
<tr>
<td>Self-testing</td>
<td>.213</td>
<td>.021</td>
</tr>
<tr>
<td>Test strategies</td>
<td>.272</td>
<td>.003**</td>
</tr>
</tbody>
</table>

\*\( p < .05 \); \**\( p < .001 \).

Qualitative analysis of strategy use in accomplishing online task

Data from students’ discussion forums were analysed through content analysis of students’ postings. Specific strategy behaviours were summarised from grouping similar online reactions together. Induced from categorised phenomena, various strategies in achieving the project goal were observed from the content of postings. The analysed data of students’ use of strategies were summarised in various categories, including: task analysis, information utilisation, group coordination, self-review and task refinement with examples listed in Table 4. These strategies are briefly described below.

Task analysis

Students used task analysis strategies to identify what they had known, what needed to be learned and what were the tasks to be accomplished. Prior to starting a group project, students related new knowledge with previous experiences and confirmed what needed to be accomplished. Students used various strategies, such as confirm instruction received, confirm learning tasks to be accomplished, reflect on work experiences and relate personal life experiences with project tasks. These strategies
Table 4. Strategies used in online learning.

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Example (student id-group id-year-month-date)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task analysis</strong></td>
<td></td>
</tr>
<tr>
<td>Confirm instruction received</td>
<td>Are you saying that we should discuss the issues assigned for different time periods? (152-02-2007-10-21)</td>
</tr>
<tr>
<td>Confirm learning tasks to be accomplished</td>
<td>I have just checked the syllabus. This is what we need to work on this week (794-10-2007-11-25)</td>
</tr>
<tr>
<td>Reflect on work experiences</td>
<td>During the summer service camp, I experienced the same problem due to extensive computer usage for library</td>
</tr>
<tr>
<td></td>
<td>cataloging and classification (205-06-2007-10-08)</td>
</tr>
<tr>
<td>Conceptualise needed knowledge with practical</td>
<td>From my experience working with them, I conclude important concepts needed for providing library services</td>
</tr>
<tr>
<td>experience</td>
<td>(190-02-2007-12-13)</td>
</tr>
<tr>
<td>List personal tips</td>
<td>Here are my own tips for reminding myself ... (140-02-2007-11-18)</td>
</tr>
<tr>
<td>Relate personal life experiences with project</td>
<td>After reading this information, I know how to deal with the problems myself in the future (188-01-2007-12-04)</td>
</tr>
<tr>
<td>tasks</td>
<td>My previous work experiences were similar to this case (360-06-2007-10-11)</td>
</tr>
<tr>
<td>Link work experiences with project tasks</td>
<td>I am great at this area. I have studied a lot, and I am sure that I will do it well (619-05-2007-11-26)</td>
</tr>
<tr>
<td>Be aware of one’s own strengths</td>
<td>I am careless and frequently make mistakes (578-05-2007-10-15)</td>
</tr>
<tr>
<td>Be aware of one’s own weakness</td>
<td>I have not done a good job. I will do my best from now on (619-05-2007-12-30)</td>
</tr>
<tr>
<td>Attend to one’s own outcomes</td>
<td></td>
</tr>
<tr>
<td><strong>Information utilisation</strong></td>
<td></td>
</tr>
<tr>
<td>Search and select needed information</td>
<td>Here is the information about Neurology I identified from Science Online: … (720-07-2007-10-11)</td>
</tr>
<tr>
<td>Provide reading information to group members</td>
<td>… The above case was discovered in the 19 century (073-09-2007-10-26)</td>
</tr>
<tr>
<td>Identify main ideas from given information</td>
<td>The key point in the article is that the aging population will also benefit from accessibility design of the</td>
</tr>
<tr>
<td></td>
<td>computer and media center (073-09-2007-12-13)</td>
</tr>
<tr>
<td>Comment on information obtained</td>
<td>I would like to comment on one point from the information obtained. Besides definition, organization issues</td>
</tr>
<tr>
<td></td>
<td>need to be emphasized (732-07-2007-11-29)</td>
</tr>
<tr>
<td>Self-correct information provided previously</td>
<td>I need to correct my previous input. The correct website should be http: … (043-04-2007-11-22)</td>
</tr>
<tr>
<td>Self-check reliability of given information</td>
<td>The information I sent earlier might not be from a reliable source. The author’s name was not provided in</td>
</tr>
<tr>
<td></td>
<td>the paper. We need to look for other more reliable resources (794-10-2007-10-23)</td>
</tr>
</tbody>
</table>

(Continued)
<table>
<thead>
<tr>
<th>Strategies</th>
<th>Example (student id-group id-year-month-date)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remind others the use of reliable resources</td>
<td>Most of the information available online is from commercial websites. We should not rely too much on this type of resources (619-05-2007-11-27)</td>
</tr>
<tr>
<td>Question obtained information</td>
<td>Why are women more vulnerable? The results of studies might vary (188-01-2007-10-11)</td>
</tr>
<tr>
<td>Elaborate on given information</td>
<td>… From the website, several standards have been issued for prescribing work conditions (043-04-2007-11-29)</td>
</tr>
<tr>
<td>Criticise on specific information</td>
<td>I would like to address a point different from what you said. Although this is an important issue, no one really cared about its influences until 1984 (471-04-2007-11-29)</td>
</tr>
<tr>
<td>Identify key principles for organising information</td>
<td>When using the information, we need to select some print-based materials from more reliable resources (720-07-2007-12-23)</td>
</tr>
<tr>
<td>Group coordination</td>
<td>Initiate interaction Please read the information on the website: … and put your reflections here (504-01-2007-11-19)</td>
</tr>
<tr>
<td>Respond to others</td>
<td>I agree with you. Talk to you about the details later (774-04-2007-11-29)</td>
</tr>
<tr>
<td>Provide suggestions to help group interaction</td>
<td>Let’s set up a time to discuss it online (633-10-2007-11-28)</td>
</tr>
<tr>
<td>Maintain socialised connections</td>
<td>You teach me next time. Good stuff should be shared with friends (043-04-2007-10-27)</td>
</tr>
<tr>
<td>Learn by helping others learn</td>
<td>I suggest you use NDDS (National Document Delivery System) to get full-text articles (542-06-2007-10-15)</td>
</tr>
<tr>
<td>Praise group peers for their effort</td>
<td>You worked harder than the rest of us. We esteem you! (304-04-2007-12-18)</td>
</tr>
<tr>
<td>Praise competitive groups for their learning effort</td>
<td>Take a look at the other group. They have done a great job in putting the pieces together (528-03-2007-10-18)</td>
</tr>
<tr>
<td>Remind others about time and progress</td>
<td>Cheng-Yi, the teacher has already mentioned this. Please pay more attention (205-06-2007-10-08)</td>
</tr>
<tr>
<td>Be alert to team members’ slackness</td>
<td>You are far behind us. Please catch up with us! (401-08-2007-11-19)</td>
</tr>
<tr>
<td>Self-review</td>
<td>Self-review one’s own contribution I have contributed something to the final project. I shot a video for our project (255-06-2007-12-27)</td>
</tr>
<tr>
<td>Reflect on one’s own learning experiences</td>
<td>The use of various media is become popular in every field. Proper procedures can prevent some application problems (102-08-2008-01-05)</td>
</tr>
<tr>
<td>Remind oneself about time and progress</td>
<td>I have an assignment and a test on next Monday for other courses. Therefore, it</td>
</tr>
</tbody>
</table>
Table 4. (Continued)

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Example (student id-group id-year-month-date)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Express one’s own learning difficulties</td>
<td>is better for me to do it tomorrow (528-03-2008-01-04)</td>
</tr>
<tr>
<td>Self-review one’s own effort</td>
<td>The content is hard for me. I need to digest for a while before I can put it in the project (413-05-2008-01-04)</td>
</tr>
<tr>
<td>Take one’s responsibility seriously</td>
<td>I did my best to read the materials and summarized the key concepts from the information given (720-07-2007-12-13)</td>
</tr>
<tr>
<td>Be alert to one’s own slackness</td>
<td>Although I need to prepare assignment for other course, I will work on our group work first (619-05-2007-10-21)</td>
</tr>
<tr>
<td>Attend to online announcement</td>
<td>Hello everyone! I am here for discussing our final project. Since I haven’t done anything yet, I need to work harder from now on (774-04-2007-10-15)</td>
</tr>
<tr>
<td>Attend to course rules</td>
<td>Note the course announcement! All of our members should be online at a certain period of time to discuss the issue (528-03-2007-10-17)</td>
</tr>
<tr>
<td>Attend to grade and points obtained from project work</td>
<td>We have to follow the course rules, and finish our discussion before the deadline, 30 November (732-07-2007-11-26)</td>
</tr>
<tr>
<td>Task refinement</td>
<td>Vary from others’ opinions</td>
</tr>
<tr>
<td>Express agreement on specific issues</td>
<td>I don’t agree with you. Appropriate budget should be used according to the need of the majority of the people (035-09-2007-12-18)</td>
</tr>
<tr>
<td>Attend to grade and points obtained from project work</td>
<td>No problem. This should be it. After all, you got your points there. Those make sense to me (671-10-2007-11-28)</td>
</tr>
<tr>
<td>Attend to requirements for preparing the research project</td>
<td>I need to work harder. Otherwise, I might fail in this course (387-04-2007-11-24)</td>
</tr>
<tr>
<td>Attend to preparation of project components</td>
<td>The format of writing a research project is different from that of a text-book. Multiple references should be cited and correct format should be used for citing references (090-03-2007-12-19)</td>
</tr>
<tr>
<td>Review content of the project</td>
<td>I need to add some updated information in the paper to reflect the current situation (222-02-2007-11-13)</td>
</tr>
<tr>
<td>Identify problems and weakness of the project work</td>
<td>I think the part on library architecture should be deleted. It might not be relevant to the issue of our focus (117-03-2007-12-19)</td>
</tr>
<tr>
<td>(Continued)</td>
<td></td>
</tr>
</tbody>
</table>

L.-J. ChanLin

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were important in online course due to the lack of face-to-face interaction in classroom setting.

**Information utilisation**

To accomplish the research project, students needed to collect and process information they found themselves or obtained from group members. To utilise information for their project works, students used strategies such as search and select needed information, provide reading information to group members, comment on information obtained, self-correct information provided previously, elaborate on given information and criticise on specific information. Through the use of these strategies, students processed the information collaboratively to help themselves organise the content of the group project works.

**Group coordination**

From the online group learning experience, students integrated group-regulated strategies, such as initiate interaction, provide suggestion to help group interaction, learn by helping others learn, praise group peers for their effort and remind others about time and progress. These strategies help each group member monitor his/her and others’ progress. Unlike traditional learning strategies emphasising self-learning, students needed to learn as a team in order to accomplish a group project task. Since each member should contribute to the team, peer monitoring was important. Data revealed group-monitoring and group-regulation strategies used among team members to coordinate the team’s efforts.

**Self-review**

Students used self-review strategies to monitor their own learning in accordance with the course requirement. In addition, to contribute oneself in a group learning
setting, students developed self-review strategies to keep themselves productive in the team. Students used various strategies such as self-review one’s own contribution, reflect on oneself learning experiences, remind oneself about time and progress, express ones’ own learning difficulties and self-review one’s own effort. Self-review strategies not only allowed each individual to regulate his/her effort, but also permitted other group members to understand individuals’ difficulties.

Task refinement
To accomplish group project task, each group member should be expressive in presenting his/her ideas for refining the group work. Since students understood that they would be evaluated on a team basis, they were devoted to the group teamwork in accomplishing the research project. Various task strategies were observed among team members, such as vary from others’ opinions, express agreement on specific issues, attend to requirements for preparing the research project, attend to preparation of project components, identify problems and weakness of the project work, search ways of solving problems in the project work and adjust performance through comparison with others.

Discussion
In this study, three variables were investigated in relation to each other: study strategies, learning outcomes and number of online postings. This study might be useful as an initial attempt to enable understanding of relationships between students’ online dialogue, learning strategies and learning outcomes. However, there are many other factors influencing effective use of dialogues and expected learning outcomes (Huang, Huang, & Yu, 2011; Webb, Jones, Barker, & Schaik, 2004). These include dialogues in monitoring group progress and incentives for promoting self-monitoring process of group works. It was observed that the LASSI constructs: anxiety, time management, use of support/material and test strategies were significant in predicting students’ online learning achievement. Similar to Wellman’s findings (2005) that some LASSI constructs are significant in predicting online learning performance, results of this study indicated that students’ use of strategies in managing their time and anxiety, the use of supportive/material and test strategies were important indicators of predicting students’ outcome in accomplishing a project work.

In this study, it was observed that the number of students’ online postings was correlated with some LASSI constructs, including: attitude, motivation, information processing, selecting the main idea, use of support/material and test strategies. As noted, online strategies used among students are important for understanding their learning processes (Zimmerman, 2002). Further examination of the content of students’ postings in discussion forums, the study also inducted various strategies pertinent to the online collaborative learning context. However, future research effort in the analysis of e-learning work similar to Lee & Tsai (2011) will be emphasised. It will be more focused on the quality of dialogues that contribute to effective learning and collaborative knowledge exploration.

As addressed by other researchers, meaningful e-learning entails student active participation within a cooperative team approach project task, and application of collaboration and dialogue pertinent to the learning context foster students’
development of self-regulation strategies (ChanLin, 2009; Huang et al., 2007; Lofstrom & Nevgi, 2007; Lightner et al., 2007; Liu et al., 2012). The content analysis of students’ postings identified various strategy categories including: task analysis, information utilization, group coordination, self-review and task refinement. The use of these strategies might reflect some elements in traditional LASSI constructs. However, some of the strategies unique in online group learning settings were not included in LASSI constructs. For example, in processing online information, various strategies such as selecting, comparing, commenting and criticising on reading materials were observed. In addition, to work and coordinate with group members, students also frequently reminded themselves and others to accomplish the group project in accordance with class requirements. Other self-review strategies such as evaluating one’s own efforts and learning outcomes were also used. The findings of this research imply several facets of online learning strategy that can be explored in future research.

Conclusion
This study examined the use of learning strategies among college students in a web-based setting. LASSI measures used in this study revealed that various constructs were significant indicators for learning achievement in terms of students’ project and final grades. However, strategies in collaborative learning and social engagement in online interactions among students might need to be further explored and included in LASSI constructs to cope with the change of technological learning world.

This study also noted that the role of interaction and collaborative effort among students helped self-regulate learning progress and monitored task for achieving their academic goals. Since this research is preliminary, further investigations on study of the development of learning strategies in online learning are needed.

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