Factors affecting metacognition of undergraduate nursing students in a blended learning environment

Li-Ling Hsu RN EdD
Professor, Graduate Institute of Health Allied Education, National Taipei University of Health and Nursing, Taipei, Taiwan

Suh-Ing Hsieh RN PhD
Associate Professor, Nursing Department, Chang Gung University of Science and Technology, Taoyuan, Taiwan

Accepted for publication January 2013

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This paper is a report of a study to examine the influence of demographic, learning involvement and learning performance variables on metacognition of undergraduate nursing students in a blended learning environment. A cross-sectional, correlational survey design was adopted. Ninety-nine students invited to participate in the study were enrolled in a professional nursing ethics course at a public nursing college. The blended learning intervention is basically an assimilation of classroom learning and online learning. Simple linear regression showed significant associations between frequency of online dialogues, the Case Analysis Attitude Scale scores, the Case Analysis Self Evaluation Scale scores, the Blended Learning Satisfaction Scale scores, and Metacognition Scale scores. Multiple linear regression indicated that frequency of online dialogues, the Case Analysis Self Evaluation Scale and the Blended Learning Satisfaction Scale were significant independent predictors of metacognition. Overall, the model accounted for almost half of the variance in metacognition.

The blended learning module developed in this study proved successful in the end as a catalyst for the exercising of metacognitive abilities by the sample of nursing students. Learners are able to develop metacognitive ability in comprehension, argumentation, reasoning and various forms of higher order thinking through the blended learning process.

Key words: baccalaureate nursing student, blended learning, cognition, metacognition.

INTRODUCTION

The development of metacognition has attracted increasing attention in educational and psychological research during the last three decades. Cognitive psychologists have described metacognition as the executive control system of the person mind and as higher order thinking that supervise a person’s thoughts, knowledge and actions. Metacognitive abilities are considered crucial and closely related to one’s learning performance. Empirical studies have suggested that enhancing students’ metacognition can result in improvements in their learning. Students with good metacognition demonstrate better academic performance compared with students with poor metacognition. Today, most professional...
organizations regard the baccalaureate level as the required level of nursing education for professional nursing practice. Undergraduate nursing students might have yet to develop strong enough metacognitive qualities in terms of reflection, self-knowledge of personal strengths and weaknesses, learning strategies and self-monitoring learning.

The use of blended learning is growing rapidly because instructors believe that diverse delivery methods might significantly enhance learning outcomes as well as increase student satisfaction with the learning experience. In other words, the use of effective learning strategies is conducive to the development of metacognitive ability. Metacognition is the integrative element between knowledge and cognition. Metacognition is an active process of knowing, or being acutely aware of one’s cognitive state with the ability to complete a given task. Psychologists and educators recognize the need to guide students to solve complex problems and have proceeded to enhance students’ abilities in this area.

Ireland, Johnson, Adams, Eboh and Mowatt conducted an opinion survey of participants in a blended learning course in nursing and midwifery education. The module was rated by all 36 participants as useful, although their opinions on the online discussion part of the module were mixed. However, in a blended learning environment, online discussion is more likely seen as a useful way to access knowledge. This kind of flexibility makes it easier to differentiate instruction for among education providers or professionally qualified nurses, satisfying the needs of a diverse population of learners. The promises of blended learning are extensive: increased learning, increased learning responsibility, collaboration and higher quality learning. So described face-to-face discussion as important for sharing ideas and working collaboratively and provided a more robust educational experience than either traditional or fully online learning.

Several studies found that students preferred a mixed course structure and that hybrid courses affected students’ learning positively, enhanced quality time for higher learning activities and discussions as well as allowing more time for practical or ‘hands-on’ nursing education. In addition, Liu and Yin suggested that insufficient computer skills might reduce the effectiveness of online learning. These problems as well as issues associated with technical difficulties can be a source of tremendous frustration for students. Blended learning is one of various methods being used to deliver meaningful learning experiences. Very few studies demonstrate how metacognition is affected by other factors as theoretical models in studies usually conceptualize it as a predictor. Blended learning incorporates face-to-face and online learning technologies. Although there has been little effort to examine metacognition as a learning outcome, there is little evidence to suggest how learning factors influences metacognition. This paper was a report of a study to examine the influence of demographic, learning involvement and learning performance variables on metacognitive abilities of undergraduate nursing students in a blended learning environment.

METHODS

Study design

A cross-sectional, correlational survey design was adopted. Ninety-nine students invited to participate in the study were enrolled in a professional nursing ethics course in the fall semester of 2009 at a public nursing college in Taiwan. This research study was approved by the college’s Institutional Research Committee. The participants were asked to complete four Likert-type scales: Case Analysis Attitude Scale (CAAS), Case Analysis Self Evaluation Scale (CASES), Blended Learning Satisfaction Scale (BLSS) and Metacognition Scale (MS).

Setting and samples

This study was conducted in a college of nursing in northern Taiwan. A purposive sampling approach was used to select two classes of students from a total of six classes. Participants must meet the following inclusion criteria: enrollment in the course ‘Professional Nursing Ethics’ in the fall 2009 semester. There were no estimators of effect size proposed in existing literature. Therefore, a priori power analysis was conducted using G*Power 3.1 (Heinrich-Heine-University, Dusseldorf, Germany) with an alpha level of 0.05, power established at 0.80 and an effect size of 0.15. The optimal sample size calculated using G*Power 3.1 turned out to be 103. However, Field prescribed a minimum of ten observations for each predictor in a model. The final model of multiple linear regression consisted of seven predictors. Therefore, the sample size of 99 senior undergraduate nursing students was considered greater than the requirement of the number of participants ($n = 70$). Participation rate in the study was 100%. Using a purposive sampling method,
two classes of students out of the total six were selected. The participation rate and the completion rate (100%) are good indicators of acceptability.

The appropriate institutional review board approved this study. Consent to participate was implied by voluntary completion and return of the questionnaires. Participants were informed that failure to participate would not affect their grades in the course. Moreover, participants were reassured that their responses would be kept confidential and their identities would not be revealed on research reports and publications related to the study.

### Measures

The blended learning intervention in this study was basically an assimilation of classroom learning and online learning. In the online learning section, participants were introduced to an Internet interface through which they watched video scenarios of ethical dilemma and exchanged views regarding the videos via an online chat room. The scenarios were as follows:

- **Scenario 1**: A head nurse at a hospital is asked by the family of a patient to feed the patient ‘magic water’ (water containing ashes of burned writing, believed by some to possess medicinal qualities).
- **Scenario 2**: A doctor is requested by the family of a patient to make all efforts to cure the patient who slipped into serious coma, but he feels the family should be thinking about having the organs of the patient donated.
- **Scenario 3**: A head nurse at a hospital is asked by the family of a patient not to tell the patient the truth about his or her condition.

As demonstrated in Figure 1, framework of this study consisted of 10 independent variables and one dependent variable. The independent variables were two dummies of age, previous school attended, work experience in months, time spent using the Internet in minutes, frequency of online dialogues, the CAAS score, two dummies of the CASES score and the BLSS score. The dependent variable was the total metacognition score. A series of questionnaire surveys were conducted in the following order:

A brief demographic questionnaire was administered to obtain demographic information on participants’ age, education, marital status, gender, work experience (including place of work and positions held), previous experience with ethical education, computer literacy and experience with the Internet.

The CAAS was administered to assess attitudes towards ethical dilemma analysis. It was developed by the researcher based on nursing students’ learning commitment in case analysis. The content validity of the CAAS was 0.71. This five-point Likert scale was used to allow participants to express how much they agree or disagree with eight statements, on a continuum from strongly agree to strongly disagree. Possible total score ranges from 8 to 40 where higher scores indicate better attitudes towards ethical case analysis. The internal consistency of the CAAS in this population was 0.85.

The CASES was administered to assess the ability to analyse ethical dilemma. The CASES was designed by the researcher as a measurement of students’ thinking, reasoning and decision-making abilities in case analysis. The CASES had a content validity index of 0.75. The 11 items were responded on a five-point Likert scale (ranging from never to always). The possible total score ranges from 11 to 55 where higher scores indicate better case-analysis ability. The Cronbach’s alpha of the CASES was 0.92.

The BLSS was administered to assess participants’ perception towards blended learning. The BLSS was designed on the basis of a blended learning pilot project. The content validity index of the BLSS was 0.81. The 18 items were responded on a five-point Likert scale (ranging from strongly disagree to strongly agree), yielding a possible total score of 18–90 where higher scores indicate a higher level of satisfaction with blended learning experience. The Cronbach’s alpha of the BLSS for this study was 0.91.

And finally, the MS was administered to assess participants’ metacognitive abilities. Metacognition refers to an individual’s knowledge, awareness and command of thinking and learning strategies. Metacognitive abilities are closely related to learning performance.

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study by the researcher reduced the original 40 items to 28 items. Five factors were retained with 53.09% of the variance explained: self-monitoring, self-modification, self-awareness, effective learning and problem solving. The 28 items were responded on a five-point Likert scale (ranging from never to always), yielding a possible total score of 28–140 where higher scores indicate greater metacognitive abilities. The content validity index of the MS was 0.82. The resultant MS achieved good internal consistency reliability, with a Cronbach’s alpha coefficient of 0.95 and the coefficient of the five factors ranged from 0.73–0.90.

Data collection procedures
Data were collected in the period from September 2009 to January 2010 using the demographic questionnaire, the CAAS, the CASES, the BLSS and the MS.

Data analysis
Data were analysed using SPSS 15.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to illustrate participant characteristics and test relationships among the variables. Variables of age and the CASES were not normally distributed; thus, cut-offs for three equal groups were used to create dummy variables by frequencies. After checking assumptions of linear regression, simple linear regressions were conducted with predictors of demographic characteristics, learning involvement and learning performance. A variable with a $P$ value of $\leq 0.20$ was included in three categories of independent variables and incorporated into the multiple linear regression. The model of multiple linear regression was used to determine which of the key variables of interest had significant correlations with metacognition. A two-sided $P$ value of $< 0.05$ was considered to be statistically significant.

RESULTS
As noted in Tables 1 and 2, a total of 99 female senior undergraduate nursing students taking the course ‘Professional Nursing Ethics’ at a nursing college in northern Taiwan participated in this study. Their ages range from 22 to 30. Mean work experience was 10.62 (standard deviation (SD) = 16.04) months. The average time spent using the Internet is 4.03 h per day (SD = 0.84). The average frequency of online chat is 8.92 times (SD = 7.33), and the range of frequency of online chat is 0–32.

| Table 1 Demographic characteristics of the sample ($n = 99$) |
|------------------|------------------|
| Variable          | $n$ (%)          |
| Age in years      |                  |
| Range             | 22–30            |
| Mean (SD)         | 22.96 (1.67)     |
| Previous school attended |          |
| Private           | 50 (51)          |
| Public            | 48 (49)          |
| Work experience   |                  |
| None              | 21 (21.2)        |
| Medical related   | 51 (51.5)        |
| Other             | 27 (27.3)        |
| Work place        |                  |
| Hospital          | 14 (17.9)        |
| Clinic            | 27 (34.6)        |
| Residential apartment | 8 (10.3)  |
| Nursing home      | 2 (2.6)          |
| Non-medical place | 27 (34.6)        |
| Position held     |                  |
| OPD staff         | 3 (3.8)          |
| Nurse             | 38 (48.8)        |
| Nursing aids      | 10 (12.8)        |
| Other             | 27 (34.6)        |
| Work experience in months |            |
| Range             | 0–84             |
| Mean (SD)         | 10.62 (16.04)    |
| Scores of ethics  |                  |
| Range             | 69–92            |
| Mean (SD)         | 80.83 (5.15)     |

OPD, outpatient department.

The CAAS mean score and the CASES mean score were 34.06 (SD = 4.26) and 43.15 (SD = 5.57), respectively. The BLSS mean score was 64.20 (SD = 9.83), and the MS mean score was 94.92 (SD = 13.63).

The results of the simple and multiple linear regression analyses are shown in Table 3. Simple linear regressions showed significant associations between frequency of online chats ($P = 0.001$), attitude towards case analysis ($P < 0.001$), self-evaluation of case analysis ($P = 0.006$ or $P < 0.001$), and level of satisfaction with blended learning, and metacognitive qualities among the sample. A one-time or one-point increase in frequency of online chat or total BLSS score leads to a 0.60 or 0.64 units increase in total metacognition score. Compared with participants who achieved a total CASES score of 22–42 points, participants who achieved a total CASES score of 43–44 or
45–55 points managed to increase their total MS score by 7.45 points and 18.38 points, respectively.

However, predictors of age, frequency of online chat, attitude towards case analysis, self-evaluation of case analysis and satisfaction level of blended learning were statistically significant ($F_{(7, 88)} = 11.68, P < 0.0001$) in the model of multiple linear regression. Frequency of online chat ($P = 0.02$), self-evaluation of case analysis ($P = 0.04$ for 43–44 vs. 22–42 or $P = 0.001$ for 45–55 vs. 22–42) and level of satisfaction with blended learning ($P = 0.01$) were significant independent predictors of total metacognition score after adjusting age and attitude towards case analysis. In other words, a one-unit increase in the frequency of online chat or BLSS score would lead to a 0.35 or 0.31 increase in MS score after controlling other variables in the model. The higher the CASES score, the higher the MS score. The multiple regression model could account for 48% of the variance in metacognition ($R^2 = 0.48$; adjusted $R^2 = 0.44$).

### DISCUSSION

This study aims to construct demographic predictors, learning involvement predictors and learning performance predictors with regard to metacognition by examining the blended learning experience among a group of nursing students attending the course ‘Professional Nursing Ethics’ (which involved classroom discussions and online discussions). Findings attest to a positive correlation between the sample’s frequency of online chat and their metacognitive qualities ($P < 0.02$).

The findings concurred with those of Lim and Morris in that a strong positive correlation was observed between learning involvement and various types of learning motivation.8 Choi, Land and Turgeon argued that learners might be more prepared to ask elaborate questions if generic and domain-specific questions were given as part of instructions.31 In this study, the sample of nursing students watched videos showing ethical dilemma scenarios. Then they were instructed to reflect on the ethical issues presented in the videos both individually and in small groups and indicate their choice of action with regard to resolving the dilemma in an online questionnaire. The effectiveness of scenario instruction as the means of developing critical analysis and problem-solving skills in learners is supported by Blankson and Kyei-Blankson,32 who noted the value of idea exchange and active learning entailed by scenario instruction. In addition, reflection can be the act of thinking before, during or after an event. The purpose of reflection is to learn from experiences. Reflection is an integral element of metacognition as it is the means by which one monitors thinking processes.33 Reflections are an important process in metacognition, which is crucial to self-regulated learning.34 In this study, using ethical scenarios can promote students’ reflection in the learning process.

Studies on the subject of metacognition established its strong positive correlation with learning and problem-solving capacities.35 In this study, CASES scores might be regarded as an indicator for metacognitive powers as the majority of those who are good at case analysis registered high scores in CASES. A study described that highly metacognitive learners tend to be more flexible and persevering in problem solving and also are in the habit of consciously applying intellectual skills.36

Several studies have indicated that blended learning modules, practiced by college faculties, contribute to better learning performance in students.37,38
introduction of new technologies including the Internet has revolutionized traditional-style education and opened up new possibilities in the form of online education, thereby necessitating development of brand-new teaching and learning strategies more suited for online education. Both in this study and in the one conducted by Colesca, Dobrica and Alpopi, the sample of students displayed a high level of satisfaction with online learning resources they encountered in the blended learning experience. Learners placed in hypermedia learning environments described the experience as helpful in that they found it easier to acquire course-related knowledge and construct a proper framework for new knowledge in the same area, thereby getting closer to their learning objectives. Ireland et al. also observed that a group of students attending nursing courses had identified their blended learning experience as generally positive, noting the value of blended learning as a more convenient access to knowledge.

In this study, blended learning was made possible through a combination of lecture, video watching, online discussion, and small group discussion. Garrison and Kanuka identified blended learning as one of the key factors leading to critical thinking and higher order learning development in students. As suggested in this study, a blended learning environment provides a venue for learners to actively make use of their metacognitive powers by organizing, planning, monitoring and evaluating their learning. In addition, the video scenarios acted as meaningful contexts for the application of knowledge and problem-solving skills. The usefulness of multimedia as a learning aid is also reflected in a similar study by Cooner. Other studies also demonstrated that learners favoured real-life case study for being relevant and down-to-earth.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Bivariate analysis</th>
<th>Multivariate analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beta (SE)</td>
<td>Std beta</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>23 y/o vs. 22 y/o†</td>
<td>1.06 (3.66)</td>
</tr>
<tr>
<td>Frequency of online chats</td>
<td>0.60 (0.17)</td>
<td>0.33</td>
</tr>
<tr>
<td>Attitude towards case analysis</td>
<td>1.54 (0.27)</td>
<td>0.50</td>
</tr>
<tr>
<td>Self-evaluation of case analysis</td>
<td>7.45 (2.66)</td>
<td>0.26</td>
</tr>
<tr>
<td>43–44 vs. 22–42†</td>
<td>18.38 (2.72)</td>
<td>0.63</td>
</tr>
<tr>
<td>45–55 vs. 22–42†</td>
<td>0.64 (0.12)</td>
<td>0.48</td>
</tr>
<tr>
<td>Satisfaction level of blended learning</td>
<td>0.31 (0.12)</td>
<td>0.23</td>
</tr>
</tbody>
</table>

Note: †22 y/o = the referent group; †22–42 points = the referent group. Bold values indicate significant P values (< 0.05). Std beta, standardized coefficients; y/o, years old.

A number of existing studies, such as the one conducted by Zulkiply, Kabir and Ghani, noted a strong positive correlation between a person’s metacognitive powers, positive learning behaviour and learning performance. Highly metacognitive learners tend to reflect, understand and manage their learning better and therefore tend to return better learning performance. Undoubtedly, technology plays a major role in the future of blended learning. An example would be using websites to support interactive, multimedia learning. In addition, Thompson and Ku pointed out that Taiwanese students were traditionally less outspoken and less inclined to actively participate in classroom discussions and would feel more comfortable expressing themselves online. Wang and Reeves also highlighted the importance of taking cultural factors into account in planning instructional design of a course.
LIMITATIONS
There are several limitations in this study. The fact that the target population all came from the same college might have resulted in the presence of institutional characteristics in the findings. They might not be representative of BSN in general and further research might be conducted to involve a larger group of participants and a greater variety of settings. In addition, the study might have benefitted from an inclusion of objective assessment of the participants’ performance to be compared against the participants’ self-assessment.

CONCLUSION
Nursing students are challenged to think and learn in a way that will prepare them for clinical practice in a complex health-care environment. This study examined the influence of demographic, learning involvement and learning performance variables on metacognition of nursing students in a blended learning environment. By giving learners a greater level of independence and control over their learning, blended learning also facilitates metacognitive skill development and collaborative learning.

In this study, the participants had a chance to draw on their training and education to exchange views on ethical dilemmas through the use of a convenient tool in the form of an online interface. Ku and Ho observed that metacognitive strategies are thought to invoke behaviours that enable students to supervise and control their thinking processes. An important purpose of this study is to encourage nursing students to practice decision making over ethical dilemmas that might arise in the workplace by applying ethical principles to resolve hypothetical ethical dilemma scenarios. Learners are able to develop metacognitive ability in comprehension, argumentation, reasoning and various forms of higher order thinking through the blended learning process. This is consistent with the study of Delialioglu and Yildirim, which proved that a mixture of instructivist and constructivist elements could facilitate group discussion, critical thinking, individualized learning and activity-based learning for learners. This study leaves room for future studies examining more closely the effects of learner-centred or constructivist approaches to blended learning and for a longitudinal examination of students’ metacognition in a blended learning environment.

ACKNOWLEDGEMENT
This research project was sponsored by the National Science Council (NSC 96–2520-S-227-001-MY3) in Taiwan.

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