The Relationship Between Engineering Students' Self-Directed Learning Abilities And Online Learning Performances: A Pilot Study

Pao-Nan Chou, National University of Tainan, Taiwan

ABSTRACT

This study aimed to explore engineering students' self-directed learning abilities in an online learning environment. The research centered on the correlation relationship between students' self-directed learning abilities and learning outcomes. The instructional activity in one experimental study was to simulate an online learning task in the real-world online courses. The results of the study showed that a significant, positive relationship existed between engineering students' self-directed learning abilities and online learning performances. High level of self-directed students performed better in the criterion test.

Keywords: Self-Directed Learning Ability; Experimental Study; Online Learning Environment

INTRODUCTION

Self-directed learning ability is often regarded as a valuable skill in workplaces and school settings (Murane & Levy, 1996; Rees & Bary, 2006). People with a high level of self-directed learning ability are self-motivated learners who can employ any learning resources to solve problems in learning tasks (Brockett & Hiemstra, 1991; Candy, 1991). Regardless of the types of learning environments, highly self-directed learners are good at problem-solving in terms of knowledge acquisition and management (Merriam & Caffarella, 1991; Gibbons, 2002).

Previous studies have shown that self-directed learning is a strong factor for influencing students' learning outcomes in traditional learning settings or distance learning environments (Long, 1991). However, in the existing literature, little empirical evidence explains how engineering students' self-directed learning abilities relate to learning achievements, regardless of learning settings. Litzinger et al. (2005) and Stewart (2007) were pioneers who explored the relationship between engineering students' self-directed learning abilities and academic performances. In Litzinger et al.'s study, engineering undergraduate students' self-directed learning abilities significantly correlated to their grade point average. In Stewart's study, the link between students' self-directed learning abilities and learning outcomes is positive related.

Although a significant relationship existed between students' self-directed learning abilities and learning outcomes in Litzinger et al. and Stewart's studies, the learning settings still occurred in the traditional classrooms. Whether or not applying self-directed learning to online engineering education may yield different findings is worthy of an extensive investigation for follow-up studies.

The purpose of the study was to explore engineering students' self-directed learning abilities in an online learning environment. The research centered on the correlation relationship between students' self-directed learning abilities and learning outcomes. One hypothesis was proposed:

Hypothesis: No significant relationship exists between engineering students' self-directed learning abilities and online learning outcomes.

LITERATURE REVIEW

The following theoretical discussions, which are partial results of our previous research (Chou & Chen, 2008), are summarized and listed:

Instruments for Measuring Students' Self-Directed Learning Abilities

One of the instruments used for measuring self-directed learning ability, Self-Directed Learning Readiness Scale (SDLRS), was the product of Guglielmino's doctoral dissertation (Guglielmino, 1977). The SDLRS uses a 58-item 5-point Likert scale. Through factor analysis, the scale includes eight factors: openness to learning opportunities, self-concept as an effective learner, initiative and independence in learning, informed acceptance of responsibility for one's own learning, love of learning, creativity, positive orientation to the future, and ability to use basic study and problem-solving skills. Higher scores occurring from using the scale represent higher readiness for self-directed learning. Nowadays, a number of studies have supported the reliability and validity of the scale (Hsu & Shiue, 2005).

Another instrument for assessing self-directed learning ability, developed by Oddi's doctoral dissertation, is the Oddi Continuing Learning Inventory (OCLI) (Oddi, 1984, 1986). The OCLI is a 24-item 7-point Likert scale and contains three domains established by factor analysis: proactive/reactive learning drive, cognitive openness/defensiveness, and commitment/aversion to learning. Higher scores in the scale indicate having greater characteristics of a self-directed continuing learner. In this scale, the reliability coefficient also achieves a higher level (more than 0.8). However, factor analysis conducted by a recent study suggested that Oddi's three domains should be extended to four domains. The new four factors created are: learning with others, learner motivation/self-efficacy/autonomy, ability to be self-regulating, and reading avidity (Harvey et al., 2006).

In addition to the two measurements described earlier, the Bartlett-Kotrlik Inventory of Self Learning (BKISL) has been newly developed (Bartlett & Kotrlik, 1999). This measurement is a 49-item 7-point Likert scale and contains 11 factors. According to the developers, social and environment variables, which are not included in the SDLRS or OCLI, were added to the scale. The developers also reported the measurement had high estimates for internal consistency. However, no further studies reported BKISL's validity and reliability.

Self-directed Learning Ability and Learning Performance in Online Courses

By searching online education database, a review of the existing literature only identifies three case studies exploring the relationship between students' self-directed learning abilities and learning performances in online courses. These three studies neither focused on a cause and effect relationship, nor used engineering students as targeted research subjects. No consistent findings occur in the three case studies. The three case studies are:

Case Study 1

Pachnowski and Jurczyk (2000) employed the SDLRS to investigate the factors correlated with academic performance in a web-based learning environment. In this study, the academic performance, defined as a final course grade, consisted of students' technical skills and attitudes according to the course instructor's standards. The SDLRS was distributed to 17 online learners during the online course. The result of the study showed no significant relationship between students' self-directed learning abilities and academic performances.

Case Study 2

Doherty (2000) attempted to find the existence of a relationship between self-directed learning and academic performance as defined by a final course grade. The study subjects were 147 college students who enrolled in online courses. The SDLRS was used to assess students' self-directed learning abilities. The result of the study showed that students' self-directed learning abilities did not relate to their academic performances.

Case Study 3

In Corbeil's (2003) study, the instrument for measuring students' self-directed learning abilities is the OCLI. 98 graduate-level online learners participated in this semester-long study. The academic performance measure was the final grade for the course. The result of the study showed a significantly positive relationship existed between students' self-directed learning abilities and academic performances.

RESEARCH DESIGN

The purpose of the current study is to investigate the correlative relationship between engineering students' self-directed learning abilities and learning outcomes. A research assumption is that students who score higher in a self-directed learning measurement might perform better in an online learning activity. The details of the research design are:

Research Method

This study adopted the true experimental design (Campbell & Stanley, 1963) which greatly decreases the effect of extraneous factors, such as participants' backgrounds.

Subjects

Forty-eight undergraduate students majoring in electronic engineering from a technological university in Taiwan participated in the study. The participants consist of randomly selected students from eight classes in the department of electronic engineering.

Self-directed Measurement

In this study, the SDLRS was utilized to measure students' self-directed learning ability because the SDLRS is a widely accepted measurement to assess self-directed learning ability when compared to other two available related instruments (Merriam & Caffarella, 1991). Overall scores in the SDLRS range from 58 to 290. In this study, a reliability analysis of this measurement showed that Cronbach's Alpha value was 0.83, which indicated the SDLRS was a reliable measurement. A sample of questions in the measurement is:

- I can learn things on my own better than most people.
- I can think of many different ways to learn about a new topic.
- Learning how to learn is important to me.
- If there is something I want to learn, I can figure out a way to learn it.
- Difficult study doesn't bother me if I'm interested in something.

Online Learning Activity

A science learning website (20 web pages), which imparts knowledge about the structure of the human body, was created. The rationale for using this instruction is that learning contents are not related to participants' courses of study, thereby, avoiding potential threats to internal validity in the study's experimental design (Campbell & Stanley, 1963). In order to confirm the validity of learning contents, the learning website underwent a review by professional instructional designers.

Learning Outcome

A criterion test containing 60 multiple-choice test items was used to measure students' online learning performances. This test assesses students' three cognitive learning outcomes: factual, conceptual, and principle/rule knowledge (Dwyer, 2007). The test's contents substantively relate to the knowledge students received in the online learning activity. In this study, a reliability analysis showed that Cronbach's Alpha for the test was 0.92.

Research Procedure

Before the study, participants responded to an SDLRS questionnaire. Subsequently, when arriving in the computer lab, students received random assignments to computer terminals from which they would complete the online learning activity. Instructions required students to read all learning contents in a one-hour session. Immediately upon completion of the instructional presentation, students received an online criterion test described earlier.

Data Analysis

After data collection, Pearson Product-Moment Correlation, whose purpose is to test the relationship between two independent variables (Huck, 2008), was used to analyze the relationship between self-directed learning and learning performance. The significant level was set to 0.05.

RESULTS

Table 1 reports a summary of descriptive statistics regarding SDLRS scores and students' learning outcomes. On average, students obtained 200.56 points (Standard Deviation =15.04) in the SDLRS measurement and 37.17 points (S.D. =11.27) in the criterion test.

Table 1: Overall Summary for SDLRS and Criterion Test (n=48)

Type of measurement	Minimum	Maximum	Mean	S.D.
SDLRS[1]	165	229	200.56	15.04
Criterion Test[2]	11	60	37.17	11.27

1: Score ranges from 58 to 290
2: Score ranges from 0 to 60

Table 2 shows the result of Pearson product-moment correlation. The significant value ($p=0.00 < 0.01$) and correlation coefficient ($r=0.6$) indicates that a significant, positive relationship exists between the SDLRS and the criterion test. Since the coefficient is higher than 0.5, the correlation level tends to be medium-high according to accepted statistical standards (Huck, 2008).

Table 2: Correlation Result

	Criterion Test
SDLRS Coefficient	0.6
P value	0.00*
Number	48

*Significant level below 0.01

Based on the findings presented above, the first research null hypothesis was rejected. In other words, the results of the first study showed that a significant, positive relationship existed between engineering students' self-directed learning abilities and online learning performances. Students who obtained higher scores in the SDLRS measurement performed better in the criterion test. This research result is consistent with Corbeil's (2003) study.

CONCLUSION

The ultimate goal of the instructional activity in the study was to simulate an online learning task in the real-world online courses. High level of self-directed student participants tended to perform better in this instructional activity. However, since the current study occurred in a laboratory setting, one experimental study will be implemented in a natural setting. The effect of students' self-directed learning abilities on learning performances in a real online course will be explored during this time.

AUTHOR INFORMATION

Pao-Nan Chou is an assistant professor at the Department of Education at the National University of Tainan, Taiwan. He received his BS in Electronic Engineering and Computing Education and MS in Technological and Vocational Education from the National Taipei University of Technology, Taiwan. He also received his MEd and PhD in Instructional Systems from Pennsylvania State University, USA. His research interests include e-learning and engineering education. E-mail: pnchou@mail.nutn.edu.tw.

REFERENCES

1. Bartlett, J. E., & Kotrlik, J. W. (1999). Development of a self-directed learning instrument for use in work environments. *Journal of Vocational Educational Research*, *24* (4), 185-208.
2. Brockett, R. G., & Hiemstra, R. (1991). *Self-direction in adult learning: Perspectives on theory, research, and practice.* London: Routledge.
3. Candy, P. C. (1991). *Self-direction for lifelong learning: A comprehensive guide to theory and practice*. San Francisco, CA: Jossey-Bass.
4. Campbell, D. T., & Stanley J. C. (1963). *Experimental and quasi-experimental designs for research*, Chicago: Rand McNally.
5. Corbel, J. R. (2003). Online technologies self-efficacy, self-directed learning readiness, and locus of control of learners in a graduate-level web-based distance education program unpublished doctoral dissertation. The University of Houston, Houston, TX.
6. Chou, P.-N, & Chen, W.-F. (2008). Exploratory study of the relationship between self-directed learning and academic performance in a web-based learning environment. *Online Journal of Distance Learning Administration, 11*(1), 15-26.
7. Doherty, P. B. (2000). Success factors among community college students in an online learning environment. Unpublished doctoral dissertation. The Nova Southeastern University, Fort Lauderdale-Davie, FL.
8. Dwyer, F. M. (2007). The program of systematic evaluation (PSE): Evaluating the effects of multimedia instruction 1965-2007. *Educational Technology, 47*(5), 41-45.
9. Gibbons, M. (2002). *The self-directed learning handbook: Challenging adolescent students to excel*. San Francisco, CA: Jossey-Bass.
10. Guglielmino, L. M. (1977). Development of the self-directed learning readiness scale. Unpublished doctoral dissertation. The University of Georgia, Atherns, GA.
11. Harvey, B. J., Rothman, A. I., & Fredker, R. C. (2006). A confirmatory factor analysis of the ODDI continuing learning inventory (OCLI). *Adult Education Quarterly, 56* (3), 188-200.
12. Hsu, Y. C., & Shiue, Y. M. (2005). The effect of self-directed learning readiness on achievement comparing face-to-face and two-way distance learning instruction. *International Journal of Instructional Media, 32* (2), 143-155.
13. Huck, S. W. (2008). *Reading statistics and research.* 5th ed. New York: Addison Wesley Longman.
14. Litzinger, T. A., Wise, J. C., & Lee, S. H. (2005). Self-directed learning readiness among engineering undergraduate students. *Journal of Engineering Education*, *94*(2), 215-221.
15. Long H. B. (1991). College students' self-directed learning readiness and educational achievement, In H. B. Long & Associates, eds. *Self-directed learning: Consensus and conflict*. Oklahoma, OK: Oklahoma Research Center for Continuing Professional and Higher Education of The University of Oklahoma, 107-122.
16. McCune, S. L., & Guglielmino L. M. (1991). The validity generalization of Guglielmino's self-directed learning readiness scale, In H. B. Long & Associates, eds. *Self-directed learning: Consensus and conflict*. Oklahoma, OK: Oklahoma Research Center for Continuing Professional and Higher Education of The University of Oklahoma, 147-155.
17. Merriam, S. B., & Caffarella, R. S. (1991). *Learning in adulthood: A comprehensive guide*. San Francisco, CA: Jossey-Bass, Pfeiffer.
18. Murane, R. J., & Levy, F. (1996). *Teaching the new basic skills*. New York: Free Press.
19. Oddi, L. F. (1984). Development of an instrument to measure self-directed continuing learning. Unpublished doctoral dissertation. The Northern Illinois University, DeKalb, IL.

20. Oddi, L. F. (1986). Development and validation of an instrument to identify self-directed continuing learners. *Adult Education Quarterly, 36*, 97-107.
21. Pachnowski, L. M., & Jurczyk, J. P. (2000). Correlating self-directed learning with distance learning success. Paper presented at The Annual Meeting of The Eastern Educational Research Association, Clearwater, FL. (ERIC Document No. ED441000)
22. Rees, M., & Bary, R. (2006). Is self-directed learning the key skill for tomorrow's engineers? *European Journal of Engineering Education, 31*(1), 73-81.
23. Stewart, R. A. (2007). Investigating the link between self-directed learning readiness and project-based learning outcome: The case of international masters students in an engineering management course. *European Journal of Engineering Education, 32* (4), 453-465.

