Computers in Human Behavior 29 (2013) 323–328

Contents lists available at SciVerse ScienceDirect

Computers in Human Behavior

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

Making on-line logistics training sustainable through e-learning

Yen-Chun Jim Wu [a,*], Shihping Kevin Huang [b]

[a] Dept. of Business Management, National Sun Yat-Sen University, 70, Lienhai Road, Kaohsiung 80424, Taiwan
[b] Institute of Management of Technology, National Chiao Tung University, Ta Hsueh Road, Hsinchu 30010, Taiwan

ARTICLE INFO

Article history:
Available online 15 August 2012

Keywords:
e-Learning
Self-learning
Training
Logistics
Capability
Motivation

ABSTRACT

The purpose of this study is to investigate the possibility of using an online logistics certification learning environment as a training tool to equip future logisticians with required logistics skills. This study incorporates an online logistics certification website that was constructed for college students to familiarize themselves with the certification. In addition, this study also performed comparison tests on students before and after their interaction with the web-based learning environment system to ascertain the system's effectiveness. Our findings suggest that such a system might motivate students to familiarize themselves with logistics-related certification information and can enhance students' professional capabilities. In addition, the web-based learning environment might possibly motivate students to join logistics related industries in the future.

1. Introduction

The effectiveness of web-based learning environments (WLEs) has been under debate by many scholars (Hu & Gramling, 2009; Johnson, Hornik, & Salas, 2008; Piccoli, Ahmad, & Ives, 2001; Sitzmann, Kraiger, Stewart, & Wisher, 2006; Swan, 2003). A web-based learning environment is an open system which facilitates interactions among participants (Piccoli et al., 2001). The use of technology as a mediation in support of conventional classroom-based learning environments is one of the main traits of WLE. Students are allowed to enter a self-contained internet-based learning environment at their own convenience (Piccoli et al., 2001). Students also enjoy a high degree of learner control with little to no supervision under WLE (Hu & Gramling, 2009). In this research, WLE is defined as the use of internet to deliver a wide range of resources to students that enhance their knowledge and performance (Liaw, Huang, & Chen, 2007, p. 1067). The benefits of WLE have been thoroughly described in previous research (Allan, 2007; Johnson et al., 2008; Piccoli et al., 2001; Sitzmann et al., 2006). The most outstanding of these benefits include improvements in student attitude, student learning experience, teacher–student interaction, and individual student's learning flexibility. WLE is a breakaway from the confinement of conventional classroom-based learning environment in terms of time and space by allowing more learner control. However, some scholars point out the problems associated with learner control, such as less time spent on the task, poor learning strategy, low self-motivation, and discomfort with individual learning (Hu & Gramling, 2009). Furthermore, learner achievement in WLE is also questioned (Swan, 2003). Some studies have suggested that there is no significant difference between WLE and classroom-based environment (Piccoli et al., 2001; Swan, 2003). Technology alone does not change the learning outcome (Clark, 1994). Indeed, WLE requires a more proactive and dynamic learning effort from students. The effectiveness of WLE is dependent upon several factors, such as learner characteristics, instructional structure, and interaction (Liaw et al., 2007). In addition, knowledge type also affects the learning outcome of WLE. Sitzmann et al. (2006) reveal that WLE is more effective than conventional classroom-based learning when knowledge is declarative. Declarative knowledge refers to students' memory of the facts and principles taught in training which affect the students' application of knowledge (Sitzmann et al., 2006). Furthermore, the effectiveness can also be examined from various perspectives such as performance, self-efficacy, and satisfaction (Piccoli et al., 2001). In this study, WLE acts as an enhancement tool which facilitates classroom-based learning. Learning outcome is measured by the improvement of students' performance, self-efficacy and motivation to enroll in a logistics certification exam.

Many scholars are suspicious about the effectiveness of WLE (Clark, 1994; Johnson et al., 2008; Sulcic & Lesjak, 2009). On the other hand, proponents believe that WLE improves student's performance, self-efficacy, and satisfaction (Chou & Liu, 2005). At the same time some scholars suggest the mediating variables, such as student characteristics and course design, determine the effectiveness of WLE (Liaw et al., 2007; Piccoli et al., 2001). Meanwhile, the blended approach, which combines elements of WLE and conventional classroom environment, has emerged as an alternative

* Corresponding author. Tel.: +886 7 5251005; fax: +886 7 5254698.
E-mail addresses: wuyenchun@gmail.com (Y.-C.J. Wu), kevin1003@ gmail.com (S.K. Huang).

0747-5632/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.chb.2012.07.027

view (Wu & Hwang, 2010). WLE is treated as a supplement to the face-to-face learning environment in the blended approach. The blended approach provides a balance between the regular face-to-face environment and WLE. The major similarity in studies measuring the effectiveness of WLE is the sample basis. The sample is usually based on the effectiveness of a single WLE course against another conventional course (Johnson et al., 2008; Sulcic & Lesjak, 2009). This course-based sample, however, is too narrow and lacking a holistic view. In some cases, effectiveness can also be measured by a student's ability to advance their careers after the course's completion (Lohman & Dingerson, 2005). This study examines the supplementary role of WLE as a blended approach. The effectiveness of WLE is assessed from the academic program perspective instead of on a single-course comparison basis. We will also analyze the effectiveness of WLE in advancing career plans for students who enrolled in the logistics management program.

Bridging the gap between students' capabilities and industry requirements is one of the most important missions for college education. Over the past decades, logistics management, logistics engineering, and supply chain management (SCM)-related programs have been established in order to fulfill the growing need for logistics professionals sought by the industry (Wu, 2006). Logisticians need to possess a diverse set of skills in order to deal with the ever-changing, competitive industry dynamics (Marien & Evenson, 1986). However, one of the major challenges facing the industry is the lack of well-trained logisticians (Gammelgaard & Larson, 2001; Pohlen, 2011). Consequently, detecting the need of the industry has become a priority in college logistics course design (Ozment & Keller, 2011; Wu, 2007). Lancioni, Forman, and Smith (2001) reveal that, although logistics and supply chain related programs have been growing eminently at most college campuses in developed countries, firms still have to retrain their newly hired logistics staffs. There is still a significant gap between the industry requirements and college curriculum; college logistics training simply cannot satisfy industry needs.

Taiwan plays a critical role is the global information technology (IT) supply chain. At the same time, Taiwan also gradually assumes the logistics responsibilities for its Western clients. Promoting Taiwan to become the global logistics hub has turned into a national economic policy priority. However, the logistics industry in Taiwan has failed to attract more fresh talent to the industry with the absence of a national-level logistics management certification. As asserted by Erridge and Perry (1993), a national qualification system is effective in creating a network of fresh workforce entrants who lack formal qualification and training. Establishing a national-level logistics management certification is one of the most cost-effective ways of sustaining a stable supply of human resources for the industry.

On the other hand, China, as a late entrant in logistics, has been facing various problems, such as the lack of logistics infrastructure, a disorganized distribution network, local protectionism, a lack of capable third party logistics suppliers, and cash flow and accounts payable problems (Easton, 2002; Easton & Zhang, 2002; Jiang & Prater, 2002; Luo & Findlay, 2002). China has been trying to improve its basic logistics infrastructure in order to satisfy its distribution and logistics demand. At the same time, China has also established a national logistics certification exam. The first nation-wide logistics certification exam took place in 2004. Unlike other certification systems, the Chinese certification is officially recognized and implemented by the government. It demonstrates the government's active role in improving its logistics-related institutions.

The objective of certification and qualification training is to provide membership in a professional body and indicate the professional capabilities of the participants (Monks, 1993). There is little policy guidance related to the logistics certification and implementation in Taiwan. Stock (2001) analyzes 317 thesis titles from American PhD dissertations compiled by the *Dissertation Abstracts* database and found that there is not a single thesis related to a logistics certification. Industry professionals, government authorities and university associates in Taiwan all recognize the importance of building a certification system that reflects the specific need of the local logistics industry. Taiwan is in the early stages of using the certification system from the Chartered Institute of Logistics and Transport (CILT) in the United Kingdom. However, since little has been done so far to investigate the possibility of using a self-learning logistics certification system to achieve the objective in an effective and efficient manner, the purpose of this study is to use graduating college students in Taiwan as a case to explore such a possibility. After all, research has shown that multimedia repetition, such as internet instruction, combined with instructor-led guidance can improve students' learning results (Mahdizadeh, Biemans, & Mulder, 2008; Shim, Shropshire, Park, Harris, & Campbell, 2007). The use of an electronic learning tool over the internet is an effective way to stimulate a student's learning experience (Lupo & Erlich, 2001; Wright & Li, 2011). Students as a group create an academic support community to facilitate the learning process (Allan, 2007; Hew, 2011). Collaborative activities in an online virtual environment have a positive impact on motivating students' learning processes (Biasutti, 2011; EL-Deghaidy & Nouby, 2008).

This study performs a learning effect comparison between pre-test and post-test scores for the aforementioned self-learning system. Our findings suggest that a self-learning logistics certification system can motivate students to familiarize themselves with logistics-related certification information and can enhance their professional capabilities. In addition, the self-learning system is a mechanism that motivates students to join the logistics industry after their graduation. This study concludes with practical suggestions of how to establish an effective online self-learning information system. This study can be divided into two sections. The first section explains the research method, design, and implementation processes. The last section analyzes the result of the students' questionnaires after their interaction with the self-learning system.

2. Hypothesis

The online self-learning logistics certification exam is designed to test students' comprehensive knowledge of the subject which is difficult to deliver in a single class. The role of WLE as a blended approach for facilitating students' understanding of logistics is unique from the conventional approaches, which either focus on WLE or on a face-to-face environment, but do not combine the two. The hypotheses of this study include:

H1. Students' interactions in the WLE will positively influence their test scores.

H2. Students' interactions in the WLE will positively influence their logistics related knowledge.

H3. Students' interactions in the WLE will positively motivate their intentions to take a certification exam in the future.

3. Research method and sample collection

One of the objectives of this research is to build a logistics certification information website as the basis for the student self-learning system. This research spent 2 years on the construction of the website. In the first part, the primary task was to collect

information on the logistics certification and teaching materials from various countries such as China, the United Kingdom, the United States, certain members of the European Union, Japan, and Australia. In addition, this study also invited forty college students majoring in logistics to participate in the actual test.

The most commonly observed online learning application patterns include the discussion- and interaction-based "Bulletin Board System" (BBS), chat areas, online teaching and online testing applications. This logistics certification information website consists of eight modules: member login, simulation test, chapter test, learning tutorial, personal testing record, test result tutorial, teaching material, and foreign certification information. The first six modules are treated as online testing content. The last two modules introduce the background information on various foreign logistics certification systems and their related teaching materials. This logistics certification information website uses the Windows 2000 server platform, SQL database server, and Active Serve Page as the software language. The WLE is intended to be incorporated into students' regular curriculum activities as a supplemental learning tool, which allows users to proceed through their regular curriculum based upon the conventional face-to-face learning environment while integrating their interactions with the WLE.

For the study of the online self-learning system detailed herein, students were asked to participate in the eight modules of the WLE on a regular basis during a 6-month period. The students were encouraged to engage in as many modules as possible. Students maintained full learner control in terms of access time and location, and their online activities were continuously monitored by instructors. The students were also asked to post their questions online in either the BBS or the public chat areas to which every participant had access for engaging in discussions. The online questions were answered accordingly by instructors.

One of the major objectives of this study is to investigate the effectiveness of WLE as a blended approach for students who have already taken comprehensive courses on the target subject. Students should therefore have the basic knowledge of the subject matter from their conventional face-to-face environment instruction before participating in the WLE; in this study, college graduates in logistics management were invited to participate as volunteers in this online self-learning system. The fundamental, driving question behind this research is: What is the impact of WLE as a blended approach on the learning effect for students who have taken related courses on the subject before? The independent variable in this case is the students' experience with the WLE. The dependent variable is the learning effect. This study identifies three learning effect measurements: students' usability, use of WLE, and WLE performance. Initially, this study managed to attract a total of 40 participants, consisting of 20 students from the 2-year college program and 20 students from the 4-year college program. Every student was required to participate in the entire testing process. Each student was first given an account and a password and was required to complete the self-testing process within a week as a pre-test. The results of the pre-test were used as an indicator of student's prior knowledge of the logistics subject matter based on their training in the conventional face-to-face classroom environment. The post-test was conducted in May of 2007 to measure the effectiveness of students' interactions with WLE. By the end, only 22 students, 14 students from the 4-year college program and 8 students from the 2-year college program, managed to complete the entire process. The main sections of the questionnaire are as follows:

1. Students' sectional post-test results.
2. Students' average hours spent on the self-learning system.
3. Students' knowledge of the logistics certification information before and after the self-learning system.
4. Students' evaluation of the effectiveness of the self-learning system.
5. Students' logistics certification related test plans, if any, in the next 2 years.
6. Students' opinions on the strengths and weaknesses of the self-learning system.

4. Result

The objective of this section is to provide the overall results analysis. Participants were asked to take an online certification exam 6 months after their initial engagement with the WLE. The results were compiled and collected by the authors. Table 1 reveals the comparison of students' test scores before and after their full participation in the online self-learning system. Based on the table, it shows that the post-test score (44.27) is significantly higher than that of the pre-test (32.5). It is statistically significant with $p < 0.001$ (2-tailed) (also see Tables 2 and 3). The improvement in each of the categories is also significant with $p < 0.01$. The single-choice and multiple-choice questions have made the most visible progress with $p < 0.001$. This research also required participating students to be assessed on their logistics-related certification knowledge before and after their interaction with the online self-learning system. Their assessment is based on the 7-point Likert scale: 1 for no prior knowledge about the logistics certification content, 4 for average knowledge of the logistics certification content, and 7 for full knowledge of the logistics certification content. Based on the result, participating students' knowledge of the subject has grown from almost no prior knowledge on the logistics-related certification (mean = 2) to a good understanding of the logistics related certification (mean = 4.68). The improvement in students' knowledge about the logistics-related certification is statistically significant with $p < 0.001$.

The above assessment indicates the positive impact of the online self-learning system on the participating students. In addition to the impact assessment, this research also tried to examine the correlation between the time spent on the online self-learning sys-

Table 1
Descriptive statistics.

	N	Minimum	Maximum	Mean	S.D.
Pre-test score	22	19	46	32.5	6.315
Post-test score	22	32	62	44.27	6.998
Study time	22	0.5	3	1.38	0.688
Website effect	22	4	7	5.45	1.224
Plan to take certification test	22	0	1	0.59	0.503
Valid N (listwise)	22				

Table 2
t-Test for paired samples.

		Mean	*N*	S.D.	S.E. mean
Pair 1	Pre-test score	32.5	22	6.315	1.346
	Post-test score	44.27	22	6.998	1.492
Pair 2	Pre-test true and false	15.14	22	2.981	0.636
	Post-test true and false	18.27	22	2.995	0.639
Pair 3	Pre-test single choice	10.95	22	3.062	0.653
	Post-test single choice	15.77	22	2.544	0.542
Pair 4	Pre-test multiple choice	6.41	22	3.686	0.786
	Post-test multiple choice	10.23	22	3.449	0.735
Pair 5	Pre-test certification familiarization	2	22	1.309	0.279
	Post-test certification familiarization	4.68	22	0.839	0.179

Table 3
Paired differences.

		Mean	S.D.	S.E. mean	95% Confidence interval of the difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Pre and post test score	−11.8	7.904	1.685	−15.277	−8.268	−6.99	21	0
Pair 2	Pre and post test true and false	−3.136	4.155	0.886	−4.979	−1.294	−3.54	21	0.002
Pair 3	Pre and post test single choice	−4.818	3.172	0.676	−6.224	−3.412	−7.12	21	0
Pair 4	Pre and post test multiple choice	−3.818	3.634	0.775	−5.429	−2.207	−4.93	21	0
Pair 5	Pre and post test certification familiarization	−2.682	0.894	0.191	−3.078	−2.286	−14.1	21	0

Table 4
Correlation analysis.

		Study time	Website effect	Pre and post difference
Study time	Pearson correlation Sig. (2-tailed) N	1	.494*	0.252
			0.019	0.257
		22	22	22
Website effect	Pearson correlation Sig. (2-tailed) N	.494*	1	0.203
		0.019		0.364
		22	22	22
Pre and post difference	Pearson correlation Sig. (2-tailed) N	0.252	0.203	1
		0.257	0.364	
		22	22	22

* $p < 0.1$

tem and the extent of its impact upon students' scores. Table 4 shows the positive correlation between students' time spent on the self-learning system and the extent of its impact on their pre- and post-test assessments. In other words, the more time a student spends on the online self-learning system the greater the positive effect upon his or her assessment.

In addition to the above analyses, this research also conducted a simple *t*-test to assess the inter-group differences within the participating student body in Table 5. The performance of the 4-year college program students proved significantly better than that of the 2-year college program students, with the exception of multiple choice questions. As for the rest of the questions, there was a

Table 5
Student group's *t*-test.

	Program type	*N*	Mean	S.D.	S.E. mean
Pre-test true and false	2-year college program	8	13.38	3.503	1.238
	4-year college program	14	16.14	2.179	0.582
Pre-test single choice	2-year college program	8	9.25	2.659	0.94
	4-year college program	14	11.93	2.921	0.781
Pre-test multiple choice	2-year college program	8	6.13	2.475	0.875
	4-year college program	14	6.57	4.309	1.152
Post-test true and false	2-year college program	8	18.13	2.167	0.766
	4-year college program	14	18.36	3.455	0.923
Post-test single choice	2-year college program	8	15.25	2.712	0.959
	4-year college program	14	16.07	2.495	0.667
Post-test multiple choice	2-year college program	8	8.25	3.615	1.278
	4-year college program	14	11.36	2.898	0.775
Study time	2-year college program	8	1.375	0.69437	0.2455
	4-year college program	14	1.375	0.71219	0.19034
Pre-test certification familiarization	2-year college program	8	1.63	1.188	0.42
	4-year college program	14	2.21	1.369	0.366
Post-test certification familiarization	2-year college program	8	4.75	0.886	0.313
	4-year college program	14	4.64	0.842	0.225
Website effect	2-year college program	8	5.38	1.061	0.375
	4-year college program	14	5.5	1.345	0.359
Plan to take certification test	2-year college program	8	0.75	0.463	0.164
	4-year college program	14	0.5	0.519	0.139
Pre-test score	2-year college program	8	28.75	5.471	1.934
	4-year college program	14	34.64	5.891	1.575
Post-test score	2-year college program	8	41.63	6.589	2.329
	4-year college program	14	45.79	6.996	1.87
Pre and post test difference	2-year college program	8	12.88	6.221	2.199
	4-year college program	14	11.14	8.883	2.374
Pre and post test familiarization	2-year college program	8	3.13	0.641	0.227
	4-year college program	14	2.43	0.938	0.251

Table 6
Levene's test for equality of variances.

	F	Sig.	*t*	df	Sig. (2-tailed)	Mean difference	S.E. difference	95% Confidence interval of the difference	
								Lower	Upper
Pre-test true and false	0.754	0.396	−2.299	20	0.032	−2.768	1.204	−5.279	−0.256
			−2.023	10.17	0.07	−2.768	1.368	−5.81	0.274
Pre-test single choice	0.241	0.649	−2.134	20	0.045	−2.679	1.255	−5.297	−0.06
			−2.192	15.909	0.044	−2.679	1.222	−5.27	−0.087
Pre-test multiple choice	3.683	0.069	−0.267	20	0.792	−0.446	1.671	−3.932	3.039
			−0.309	19.978	0.761	−0.446	1.446	−3.464	2.571
Post-test true and false	1.645	0.214	−0.171	20	0.866	−0.232	1.359	−3.067	2.603
			−0.193	19.711	0.849	−0.232	1.2	−2.738	2.273
Post-test single choice	0.008	0.929	−0.72	20	0.48	−0.821	1.14	−3.2	1.558
			−0.703	13.683	0.494	−0.821	1.168	−3.332	1.689
Post-test multiple choice	1.046	0.319	−2.213	20	0.039	−3.017	1.404	−6.036	−0.178
			−2.079	12.2	0.059	−3.017	1.495	−6.358	0.144
Study time	0.003	0.958	0	20	1	0	0.3129	−0.6527	0.6527
			0	15.022	1	0	0.31064	−0.66203	0.66203
Pre-test certification familiarization	1.748	0.201	−1.016	20	0.322	−0.589	0.58	−1.799	0.62
			−1.058	16.53	0.305	−0.589	0.557	−1.767	0.588
Post-test certification familiarization	0.009	0.925	0.282	20	0.781	0.107	0.38	−0.686	0.9
			0.278	14.064	0.785	0.107	0.386	−0.72	0.934
Website effect	2.544	0.126	−0.225	20	0.824	−0.125	0.555	−1.283	1.033
			−0.241	17.714	0.813	−0.125	0.519	−1.217	0.967
Plan to take certification test	4.424	0.053	1.128	20	0.273	0.25	0.222	−0.212	0.712
			1.165	16.171	0.261	0.25	0.215	−0.204	0.704
Pre-test score	0.145	0.708	−2.313	20	0.031	−5.893	2.547	−11.207	−0.579
			−2.363	15.651	0.031	−5.893	2.494	−11.19	−0.596
Post-test score	0.104	0.75	−1.369	20	0.186	−4.161	3.039	−10.5	2.178
			−1.393	15.469	0.183	−4.161	2.987	−10.511	2.179
Pre and post test difference	0.546	0.469	0.485	20	0.633	1.732	3.569	−5.712	9.176
			0.535	18.957	0.599	1.732	3.236	−5.042	8.507
Pre and post test familiarization	1.386	0.253	1.858	20	0.078	0.696	0.375	−0.085	1.478
			2.061	19.161	0.053	0.696	0.338	−0.01	1.403

significant difference with $p < 0.05$. A point worth noting is that the 2-year college program students have improved drastically in the post-test score. The gap between the 2-year program students and 4-year program students has reduced, with the exception of multiple choice questions. For the most part, the difference in post-test scores between the 2-year college program students and that of 4-year college program students is minimal. This result demonstrates the positive effect of the online self-learning system on students with less prior logistics knowledge. Furthermore, the 2-year college program students had very limited knowledge of the logistics-related certification before their interaction with the online self-learning system. However, in the latter stage, the 2-year college program students showed a significant improvement in their logistics-related certification knowledge, to the point where they actually outperformed the 4-year college program students with $p < 0.1$.

Finally, this research attempted to examine students' evaluations of the self-learning system in Table 6, as well as the impact of such a system on their future logistics certification test-taking plans. At the end of the process, students were invited to express their opinion about the self-learning system based on the 7 points Likert scale: 1 for very dissatisfied with the self-learning system, 4 for a neutral response toward the system, and 7 for very satisfied with the system. The overall average is 5.45, which reveals that most students have a positive assessment. The participating students' familiarity with logistics has improved from the original mean = 2 to mean = 4.68 with $p < 0.001$ after their interaction with WLE. However, when asked about their future logistics certification test-taking plans, only about 60% of the students indicated such a plan in the future, which shows that there is still room for improvement.

5. Conclusion

We set out to examine the impact of student's interaction with a WLE on their logistics knowledge and also career development plans. The results of our research indicate that there is a positive impact on students' test scores and logistics related knowledge after students' interactions with the WLE. The results also reveal a positive correlation between time spent on WLE and students' self-test assessment. However, when asked about the impact of WLE on their future certification placement plans, the results show that only 60% of students were planned to take the certification exam in the future. Consequently, we are cautious about the impact of WLE on students' future careers. Overall, the results reveal a positive performance effect of the WLE. The results also provide possible support for the blended approach. The ongoing debate about the effectiveness of WLE has been based on either a WLE or a face-to-face environment, with only one learning approach being used independently of the other. This study, however, focuses on the effectiveness of WLE at improving students' comprehensive knowledge in the target subject, namely logistics, when they had already gained a base of knowledge in a conventional face-to-face learning environment. Thus this study's application of the blended approach sets it apart from other research which focuses on the differences in effectiveness between a single WLE course and another conventionally-taught course. The effectiveness of WLE is visible in our case when the WLE was adopted as

a supplement to classroom instruction after students have received their professional training.

Taiwan is trying to position itself as a logistics hub within the global supply chain. However, an international logistics certification system has long been absent in Taiwan's development history. Government authorities, university associates, and industry professionals have all recognized the urgency to establish a logistics certification system that can accommodate Taiwan's situation. In light of the recent e-learning boom on the internet, this research has tried to utilize the benefits of the internet, which allows easy access for students, to provide students with logistics certification information. In combination with the online testing tool, students can utilize systematic access to all the certification-related materials. The online self-learning platform also fosters interaction and reduces instructor teaching load. Early results indicate positive effects from this system in stimulating students' learning. While at the same time, the online self-learning system faces several challenges, such as copyright complications and personal privacy issues. The preliminary results of this investigation indicate that students do perform better after their interaction with the online self-learning system. However, a more comprehensive test with greater student participation might be necessary in order to assess the full effect of the online self-learning logistics certification system.

6. Limitations

Although we have made every possible effort to reduce any bias that might affect the results of this investigation, we have encountered some limitations which provide possible avenues for further research. Our sample is small in scale, with only 22 out of the original 40 participants managing to complete the entire process. This participation rate is over 50%, despite the level of commitment required from participants being much higher than that of most conventional survey research. Still the dropout rate is indicative of the difficulties inherent in long-term research. We cannot ignore the possibility that only the most motivated students completed the questionnaires by the end of the 6-month study. However, each individual participant can be treated as a case instead of a sample, and from this perspective, we have a total of 22 cases. We offer the results of our research, as well as the conclusions that may be drawn from them, with caution based upon these limitations. This study, though small in scale, may indeed serve as a plot study for future large-scale research. Thus this is a seminal step towards broad-scale research into the benefits of web-based learning environments.

Acknowledgements

The authors would like to thank the editors and the anonymous reviewers who provided insightful and constructive comments on the paper. This work is mainly supported by National Science Council of Taiwan (NSC 100-2628-S-110-006-MY4). In addiiton, research support is also given by "Aim for the Top University Plan" of the National Sun Yat-Sen University and Ministry of Education, Taiwan.

References

Allan, B. (2007). Time to learn?: E-learners' experiences of time in virtual learning communities. *Management Learning, 38*, 557–572.

Biasutti, M. (2011). The student experience of a collaborative e-learning university module. *Computers and Education, 57*, 1865–1875.

Chou, S. W., & Liu, C. H. (2005). Learning effectiveness in a web-based virtual learning environment: A learner control perspective. *Journal of Computer Assisted Learning, 21*, 65–76.

Clark, R. (1994). Media will never influence learning. *Educational Technology Research and Development, 42*, 21–29.

Easton, R. J. (2002). On the edge: The changing face of supply chain management in China. *Accenture*.

Easton, R. J., & Zhang, T. B. (2002). Supply chain excellence in Asia: Challenges and opportunities. *Accenture* (January).

EL-Deghaidy, H., & Nouby, A. (2008). Effectiveness of a blended e-learning cooperative approach in an Egyptian teacher education programme. *Computers and Education, 51*, 988–1006.

Erridge, A., & Perry, S. (1993). Closing the skills gap: The national standards development programme and purchasing competence. *Management Learning, 24*, 368–387.

Gammelgaard, B., & Larson, P. (2001). Logistics skills and competencies for supply chain management. *International Journal of Physical Distribution and Logistics Management, 22*, 27–50.

Hew, K. F. (2011). Student's and teacher's use of Facebook. *Computers in Human Behavior, 27*, 662–676.

Hu, H., & Gramling, J. (2009). Learning strategies for success in a web-based course: A descriptive exploration. *The Quarterly Review of Distance Education, 10*, 123–134.

Jiang, B., & Prater, E. (2002). Distribution and logistics development in China: The revolution has begun. *International Journal of Physical Distribution and Logistics Management, 32*, 783–798.

Johnson, R. D., Hornik, S., & Salas, E. (2008). An empirical examination of factors contributing to the creation of successful e-learning environments. *International Journal of Human–Computer Studies, 66*, 356–369.

Lancioni, R., Forman, H., & Smith, M. F. (2001). Logistics programs in universities: Stovepipe vs. cross disciplinary. *International Journal of Physical Distribution and Logistics Management, 31*, 53–64.

Liaw, S. S., Huang, H. M., & Chen, G. D. (2007). Surveying instructor and learner attitudes toward e-learning. *Computers and Education, 49*, 1066–1080.

Lohman, E. M., & Dingerson, M. R. (2005). The effectiveness of occupational–technical certification programs: Assessment student career goals. *Community College Journal of Research and Practice, 29*, 339–355.

Luo, W., & Findlay, C. (2002). *Logistics in China: Implications of accession to the WTO*. Washington, D.C.: The World Bank.

Lupo, D., & Erlich, Z. (2001). Computer literacy and applications via distance e-learning. *Computer and Education, 36*, 333–345.

Mahdizadeh, H., Biemans, H., & Mulder, M. (2008). Determining factors of the use of e-learning environments by university teachers. *Computers and Education, 51*, 142–154.

Marien, E. J., & Evenson, C. G. (1986). Education for transportation professionals: Practical help from universities. *Defense Transportation Journal, 42*, 17–19.

Monks, K. (1993). Professional education: A means to an end? *Management Learning, 24*, 430–441.

Ozment, J., & Keller, S. B. (2011). The future of logistics education. *Transportation Journal, 50*, 65–83.

Piccoli, G., Ahmad, R., & Ives, B. (2001). Web-based virtual learning environments: A research framework and a preliminary assessment of effectiveness in basic IT skills training. *MIS Quarterly, 25*, 401–426.

Pohlen, T. L. (2011). Meeting the challenge of educating the transportation and logistics professional: The American Society of Transportation and Logistics. *Transportation Journal, 50*, 84–90.

Shim, J. P., Shropshire, J., Park, S., Harris, H., & Campbell, N. (2007). Podcasting for e-learning, communication, and delivery. *Industrial Management and Data Systems, 107*, 587–600.

Sitzmann, T., Kraiger, K., Stewart, D., & Wisher, R. (2006). The comparative effectiveness of web-based and classroom instruction: A meta-analysis. *Personnel Psychology, 59*, 623–664.

Stock, J. R. (2001). Doctoral research in logistics and logistics-related areas: 1992–1998. *Journal of Business Logistics, 22*, 125–256.

Sulcic, V., & Lesjak, D. (2009). E-learning and study effectiveness. *Journal of Computer Information Systems, 49*, 40–47.

Swan, K. (2003). Learning effectiveness online: What the research tells us. In J. Bourne & J. C. Moore (Eds.), *Elements of quality online education, practice and direction* (pp. 13–45). Needham, MA: Sloan Center for Online Education.

Wright, M. F., & Li, Y. (2011). The associates between young adults' face-to-face prosocial behaviors and their online prosocial behaviors. *Computers in Human Behavior, 27*, 1959–1962.

Wu, Y. C. (2006). Skill requirements for logistics license in Taiwan. *Supply Chain Management: An International Journal, 11*, 415–424.

Wu, Y. C. (2007). Contemporary logistics education: An international perspective. *International Journal of Physical Distribution and Logistics Management, 37*, 504–528.

Wu, W. C., & Hwang, L. Y. (2010). The effectiveness of e-learning for blended course in colleges: A multi-level empirical study. *International Journal of Electronic Business Management, 8*, 312–322.