

Applying Web-Enabled Problem-Based Learning and Self-Regulated Learning to Enhance Computing Skills of Taiwan's Vocational Students: a Quasi-Experimental Study of a Short-Term Module

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Abstract: Contrary to conventional expectations, the reality of computing education in Taiwan's vocational schools is not so practically oriented, and thus reveals much room for improvement. In this context, we conducted a quasi-experiment to examine the effects of applying web-based problem-based learning (PBL), web-based self-regulated learning (SRL), and their combination to enhance students' computing skills in a short-term module of deploying Microsoft Word. Two classes of 106 first-year students were divided into 2 (PBL vs. non-PBL) × 2 (SRL vs. non-SRL) experimental groups. Results were generally positive. This study thus provided a significant illustration of a promising design and implementation of chosen web-based pedagogies for a short-term module. With limitations in mind, we hope that the lesson learned is also useful for those teachers engaged in e-learning, specifically, in vocational schools.

Keywords: web-based PBL, web-based srl, e-learning, vocational students, computing education, short-term module

1. Introduction

Professionals with a vocational degree represent a major portion of the work force in Taiwan. The technological and vocational education in Taiwan spans over three distinct levels: (1) vocational high schools; (2) two-year junior colleges; and (3) institutes/universities of technology. The vocational education system constantly evolves to meet the needs and the new demand for highly skilled manpower, the continued progress of modern technology, the worldwide economic development, the changing industrial structure, and the social/cultural changes. No one doubts the guiding principles of practical applications in the vocational education in Taiwan (Tai, Chen and Lai, 2003). However, the courses of deploying application software traditionally emphasise memorisation by applying short, disjointed, lack-of-context examples. Take computing curriculum at National Open University in Taiwan as examples. In one class teaching Microsoft Office for on-the-job trainees through television, we observed that the trainees were taught to build up school timetables. In another similar class, diagrams were drawn to illustrate students' grades. These are inappropriate examples that could hardly match the requirements of students' future jobs. It seems that problem-based learning (PBL) is an appropriate pedagogy to bridge the gap between what is learned in school and what is required in the workplace (Wu, 2000). In PBL, real-world, simulated, contextualised problems of practice promote student learning and foster skill development (Dunlap, 2005). In this regard, we tend to believe that PBL could help develop vocational students' practical skills of deploying application software.

The applications of e-learning allow students to work on their assignments whenever and where they want (Schwieren, Vossen and Westerkamp, 2006). However, implementing e-learning for students with low self-regulatory skills inevitably runs high risks. In web-based learning environments, the physical absence of the instructor and the increased responsibility demanded of learners to effectively engage in learning tasks may present difficulties for learners, particularly those with low self-regulatory skills (Dabbagh and Kitsantas, 2005). It is a big challenge for teachers to help college students, who are often addicted to the Internet, engage in an online course in an environment with filled with millions of interesting websites, free online games, and online messenger. In this context, it is very important to develop students' skills of self-regulated learning (SRL) to manage their learning in web-based learning environments (Winnips, 2000). Students in the online environment equipped with SRL competence become more responsible for their learning and more intrinsically oriented (Chang, 2005). However, there has been relatively little empirical research on the effects of SRL on students' behaviours in such complex technology-based learning environments (Azevedo and

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Cromley, 2004). Thus, we applied SRL in this study to help students, vocational students in Taiwan in specific, concentrate on their learning, practice their schoolwork, and furthermore, take responsibility for their learning. Few studies have discussed effective online instructional methods for vocational students. Moreover, the restructuring and translation of traditional computer software courses into an online format has seldom been documented. In this study, we redesigned a short-term module in a course of deploying application software to incorporate learning technologies into instructional methods to help students learn and then apply what they have learned. Specifically, this study explored the effects of web-based PBL and SRL on the development of vocational students' computing skills within a short-term module.

2. Literature review

2.1 Problem-based learning

PBL is an instructional method that may engage students through authentic learning activities that use professional problems of practice as the starting point, stimulus, and focus for learning (Barrows, 1985, 1986). PBL not only emphasises the learning of the subject area, but also provides opportunities for students to practice and apply skills and knowledge just acquired. It has made a significant impact on medical education since the mid-1960s (Norman and Schmidt, 1992). The application of PBL in medical education focused on clinical training. Problem relevance was considered as the most important factor for increasing motivation and developing skills of clinical reasoning (Barrows, 1986). For instance, in Dorsch, Frasca, Wilson and Tomsic's (1990) study, where a multidisciplinary team in a problem-based format taught a ten-week critical appraisal course, the course was well received. The adoption of PBL in Information Systems (IS) helped develop students' generic skills required of an IT professional, such as analytical, problem-solving, creative thinking, teamwork, technical, and communication (Yip, 2002). In a teaching experiment, PBL was deployed as an alternative instructional method in the domain of Information Science and its effects of improving students' key competencies were supported (Greening, Kay, Kingston and Crawford, 1996). Similarly, Yip (2001) pointed out that PBL can enhance competencies both in professional and Information Systems education. While the interventions of PBL in the domain of medical and IS education were different, PBL is much the same in nature. It is a type of apprenticeship for real-life problem solving, helping students acquire the knowledge and skills required in the workplace (Dunlap, 2005). PBL may help students achieve learning goals such as professional reasoning, integration of scientific/academic and professional knowledge, and lifelong learning skills. For examples, students in PBL groups attained significantly higher scores than those students of control group in a course that was composed of physics, mathematics and computer science (Polanco, Calderón and Delgado, 2004). Chanlin and Chan (2004) applied PBL in a web-based environment. The results revealed that students who received the PBL treatment performed better than those in the control group.

The short-term problem-based instruction is effective for medical students in critical appraisal skills. In Wun, Chan and Dickinson's (1999) short-term module, the PBL group scored higher than those of the non-PBL group on the Inventory of Learning Preference (ILP). On the Study Process Questionnaires (SPQ), achieving-strategy of the PBL group was significantly improved over that of the non-PBL group. By following similar arguments in the present study, we tend to believe that PBL employed in this online module may positively effect enhancing students' computing skills.

2.2 Self-regulated learning

Zimmerman and Schunk (1989) defined SRL in terms of self-generated thoughts, feelings, and actions, which are systematically oriented to help each student to attain his goal. From a social cognitive perspective, Zimmerman (2000) indicated that self-regulatory processes and accompanying beliefs fall into three cyclical phases: (1) Forethought involves influential processes that precede efforts to act and set the stage for it; (2) Performance or volitional control refers to processes that occur during motoric efforts and affect attention and action; (3) Self-reflection refers to the processes that occur after performance efforts and influence a person's response to the experience. Ley and Young (2001) suggested four principles of self-regulation including: (1) Preparing and structuring learning environment; (2) Organising and transforming instructional materials; (3) Keeping records and monitoring progress; (4) Evaluating performance against a standard to embody both effective and flexible guideline for embedding SR into instruction. The principles could be embedded in instruction to support self-regulation regardless of content, media, or a specific population. The principles can be

systematically applied in various contexts such as instructor-led or print-based instruction as well as synchronous or asynchronous web-based instruction.

Characteristics attributed to self-regulated persons coincide with those attributed to high-performance, high-capacity students, as opposed to those with low performance, who show a deficit in these variables (Reyero and Tourón, 2003; Roces and González Torres, 1998; Zimmerman, 1998). In one study, students who are high self-regulatory skill users, as measured by a pre-existing index, scored significantly higher than their counterparts, low self-regulatory skill users, regardless of the level of control (Yang, 1993). To examine the effects of SRL on learning computer software, Bielaczyc, Pirolli and Brown (1995) incorporated self-explanation and self-regulation strategies in the attainment of the cognitive skill of computer programming. They had found that students in the treatment group outperformed those in the control group. This study asserted that SRL is appropriate to be applied in computer software education. Young (1996) also found that users with low self-regulatory skills performed inadequately and significantly in computer-based instruction that applied learner control of the sequencing. In line with the above evidence, SRL may contribute to students learning through both face-to-face and technology-based instruction. Winnips (2000) indicated that self-regulation is particularly important when learning in Internet-supported environments. Providing students with opportunities to integrate their knowledge only through web-enabled instruction may not be effective if they lack the skills needed to regulate their learning. Thus, strategies must be put into practice in order to prepare students for the rigors of learning at a distance and increase the probability of retention and success (Chang, 2005). In other words, it is even more critical for students to be transformed into self-regulated learners in web-enabled learning. Therefore, we included SRL in this study to investigate its effects on enhancing students' computing skills in an online module.

2.3 Problem-based learning and self-regulated learning

PBL is assumed to foster students' motivation and self-regulation (Galand, Bourgeois, and Frenay, 2005). PBL is a specific task-based approach that teachers can apply to support the development of SRL. PBL provides opportunities for self-regulated learning by offering students choices and control about what to work on, how to work, and what products to generate. PBL facilitates SRL because it places the responsibility on the students to discover information, to coordinate actions and people, to monitor understanding, and to reach goals (Paris and Paris, 2001). Hmelo-Silver (2004) pointed out that students' approaches to learning from solving problems are qualitatively different because of their degree of self-regulation. Learners with low self-regulatory skills may have difficulty in adapting to the kind of learning required in problem-based instruction. Ertmer, Newby, and MacDougall (1996) found that learners fluctuated their efforts according to their perception of the value of learning from solving problems. Highly self-regulated students valued learning from solving problems higher and tended to focus on the problem analysis and reflection processes. Ertmer *et al* asserted accordingly that students with low self-regulatory skills may have difficulty in dealing with the self-directed learning demands of a PBL curriculum. Combined training in self-regulatory and problem-solving strategies was effective for enhancing self-regulatory competences in solving mathematical problems (Perels, Gürtler and Schmitz, 2005). Kramarski and Gutman (2006) compared the treatments of e-learning with SRL and without SRL in solving mathematical problems. Their results showed that SRL students significantly outperformed the non-SRL students in problem-solving procedural and transfer tasks regarding mathematical explanations in web-based learning environment. Beyond these studies we found, however, there are very few studies investigating the effects of PBL and SRL simultaneously, particularly in the web-based learning environment. Therefore, in the present study the authors explored the effects of combinations of PBL and SRL on enhancing students' computing skills.

3. The empirical study

3.1 Course setting

The course under study is a half-semester (8 weeks), 2-credit-hour class, targeting first-year college students from different major fields of study. Students received a study task dealing with the subject of Microsoft Word. The major focus of this module was to develop students' skills in applying the functions of Microsoft Word. For example, students were required to change the appearance of text, format documents, present information in tables, work with charts, and apply toolbars.

3.2 Participants

The participants in this study were 106 first-year students taking a compulsory 'Packaged Software and Application' in a university of science and technology in Taiwan. None of them majors in information or computer technology. Students at this university were expected to spend much more time and effort in mastering a variety of technological skills as compared to those in comprehensive universities in Taiwan.

3.3 Experimental design and procedure

In the first week, the lecturer declared that this class section would be partially provided through Internet with innovative instructional methods as interventions, so students had the freedom to drop this class section and take another teacher's class section. After this declaration, 118 students continued in this class section. The experimental design is a 2 (PBL vs. non-PBL) × 2 (SRL vs. non-SRL) factorial pretest-posttest design (see Figure. 1). Students in the four groups solved the same tasks but in different learning conditions. The participants were randomly assigned to one of the four experimental conditions; each group contained about 30 participants. However, 12 students withdrew from this class section during the instructional process. At the end, there were 106 students still in the class section. The PBL and SRL group (C1, N=30), PBL and non-SRL group (C2, N=25), non-PBL and SRL group (C3, N=24) were experimental groups, while non-PBL and non-SRL group (C4, N=27) was the control group.

		PBL	non-PBL
SRL		The most significant effect (C1 Group)	Medium effect (C3 Group)
non-SRL		Medium effect (C2 Group)	

Figure 1: The variation and expected effects of instructional methods

This experiment was implemented in the learning module of 'Microsoft Word'. The skill test of this software package was held right after the completion of teaching the module (the 8th week). The detailed schedule of the experiment is depicted in Figure 2. In the beginning of the Word module, students were encouraged to adapt to learn via a course website. The teacher audiotaped every session of his lecture and later on translated lectures into HTML files with flash, video, and voice. These HTML files were then loaded into the course website. Students could preview and review the course sessions on this course website. After three weeks, most of the coursework was moved onto the website. Students were helped to adapt to learning on the Internet and lessen the feelings of isolation. Within the first three weeks, the teacher adjusted students' learning gradually and smoothly.

PBL treatment. There were two classes in this study, one was a PBL class., while the other was a non-PBL class. Popular software was taught in the 'Word module'. In the PBL class, the teacher created an interesting, challenging, and authentic problem situation. The teacher simulated the situation that students have to apply for a job titled "marketing assistant" located in a software company in an online game company. They were required to design and then build autobiographies and resumes by applying skills of application software that they had just learned. After that, the students were assumed to be employed by the same software company. The marketing manager asked them to develop a business proposal for the emerging new market of online games.

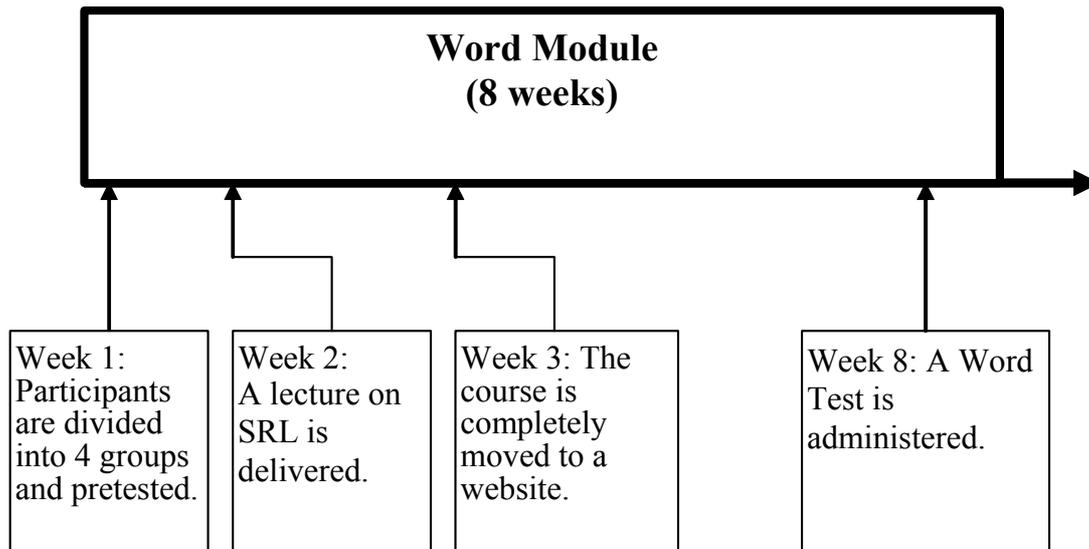


Figure 2: The teaching schedule of word module and associated tests

The marketing manager asked them to compare expenses resulting from different distribution channels. The students were required to survey and then complete a table to illustrate the difference among channels and rank them. When the optimal channel was decided upon, they had to design show bills using the skills they learned in this module. The teacher demonstrated first how to approach the situation and solved the problem accordingly through web-based multimedia. In addition to the teaching of skills of application software, similar situations and related applications were also discussed in the class. In the latter, the teacher guided students in constructing their own models of problem solving.

SRL treatment. There was a SRL group in both the PBL class and non-PBL class. The students in SRL groups were selected randomly and received instruction in an after-school course teaching SRL strategies. The two SRL groups from the PBL class and non-PBL class were gathered in a classroom and a two-hour lecture was delivered discussing how to manage study time and regulate their learning. The content of this SRL course was composed of the four processes addressed by Zimmerman, Bonner and Kovach (1996), that is, self-evaluation and monitoring, goal-setting and strategy planning, strategy implementation and monitoring, and monitoring of the outcome of strategy. Students were taught how to implement these four processes to become more self-regulated learners. In addition to the two-hour lecture, students in the SRL groups were required to regularly prepare and read the textbook before classes, and to review or practice the skills of application software they had learned after school. They were also required to record their learning behaviour every week. The data was recorded on the course website instead of in their notebooks in order to prevent falsification of records. The treatments in the four groups are illustrated and compared in Table 1.

Table 1: Teaching and learning activities in different experimental groups

Group	Teaching Activities	Learning Activities
C1	The teacher... demonstrated how to solve authentic problems and discussed its potential applications. taught SRL skills and urged students to study regularly.	The students... took on authentic tasks and learned by problem solving. practiced SRL and recorded learning behaviours every week.
C2	The teaching activities were the same as C1 but without SRL lectures.	The students experienced authentic situations and solved the problems without extra requirements of SRL.
C3	The teacher... converted his traditional way of teaching without any modification into an online format. taught SRL skills and urged students to study regularly.	The students... received the traditional computer software course through Internet. practiced SRL and recorded learning behaviours every week.

Group	Teaching Activities	Learning Activities
C4	The teaching activities were the same as C3 but without SRL lectures.	The students experienced the traditional style of teaching and did not deal with the extra requirements of SRL, although teaching was conducted via the Internet.

3.4 Measures

Students were tested at the end of this module. In this study, we applied two practical and authentic instructional methods. It is very important to measure students' practical skills in solving problems rather than just memorisation. In this regard, the lecturer simulated practical problems for students to solve to evaluate their enhancement of skills of deploying application software. We calculated a student's grade judging from his correctness and completeness of problem solving, and the artistry of his design. The students got high grades if they completely solved the problems with exquisite design. Before testing, students were assigned to random seats. The questions on the test were related to the content and examples taught in the module. The test consisted of 5 to 7 questions. The teacher graded and recorded the results immediately after the test. Finally, the enhancement of word processing skills was the result of one's grade minus his pretest grade. We tested the differences in the enhancement of the skills of WORD application software under different conditions in a short-term module.

4. Results

To examine levels of change manipulated by variants of experimental conditions, we first measured students' computing skills as a baseline before their entering the class. In the first week, students completed three Word documents as a pretest. The problems given in this test were taken from the Certification of Microsoft Office, which is administered by a trustworthy organisation in Taiwan called the Computer Skills Foundation (CSF). Each of these documents was assigned maximum scores of 30, 30, and 40, respectively. Forty minutes was given for students to complete the three documents. The pretest grades representing students' computing skills were similarly low. None of the participants were able to answer the pretest questions correctly. The differences among the four groups in students' skills of application software at this beginning stage were not statistically significant (see Table 2). It confirmed that all participants in the four groups had little knowledge or skills involving Microsoft Word before they took this course. In addition, none of them had any experience in taking a web-enabled course. We thus concluded that the students had in fact been randomly and evenly divided into experimental groups.

Table 2: One-way ANOVA: Pretest of students' computer skills

Pretest	(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.
Scheffe	1	2	.053	1.663	1.000
		3	2.183	1.681	.641
		4	4.119	1.629	.101
	2	1	-.053	1.663	1.000
		3	2.130	1.755	.689
		4	4.065	1.704	.135
	3	1	-2.183	1.681	.641
		2	-2.130	1.755	.689
		4	1.935	1.722	.739
	4	1	-4.119	1.629	.101
		2	-4.065	1.704	.135
		3	-1.935	1.722	.739

* The mean difference is significant at the .05 level.

We took grades on the Word module as a measure of student's computing skills. Mean and standard deviations of grades on this module were reported for the four groups in Table 3. The 'independent samples t-test' was used to compare the different types of learning promoted by PBL and non-PBL instructional methods. As shown in Table 3, the improvement of grades at the end of the Word module in PBL class (64.29) was significantly higher than that in the non-PBL class (56.84).

Therefore, it is believed that web-enabled PBL contributed to enhance students' skills of deploying application software in a short-term module.

Table 3: Independent samples t-test: The improvement of grades on word

		N	Mean	S. D.	F	t-value	df	P
Word	PBL	55	64.29	11.063	2.604	3.147	104	.002**
	non-PBL	51	56.84	13.269				

**P < 0.05; *P < 0.1

From Table 4, one can see the results that the improvement of grades on Word in SRL group (63.11) was higher than that in the non-SRL group (58.21). The difference between SRL group and non-SRL group was statistically significant. Thus, it could be concluded that web-enabled SRL improved students' skills in application of computer software in a short-term module.

Table 4: Independent samples t-test: Grades on word

		N	Mean	S. D.	F	t-value	df	P
Word	SRL	54	63.11	11.647	.102	2.018	104	.046**
	non-SRL	52	58.21	13.325				

**P < 0.05; *P < 0.1

Finally, the data from Table 5 showed that the improvement of grades on Word in group C1 was significantly higher than C4, and also higher than C2 and C3, though insignificantly. Therefore, we proposed that the combination of web-enabled PBL and SRL helped students learn better in an online module.

Table 5: One-way ANOVA: The improvement of grades on word

Dependent Variable		(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Word	LSD	1	2	5.447	3.270	.432
			3	8.225	3.307	.110
			4	11.433(*)	3.204	.007
		2	1	-5.447	3.270	.432
			3	2.778	3.451	.885
			4	5.987	3.352	.368
		3	1	-8.225	3.307	.110
			2	-2.778	3.451	.885
			4	3.208	3.388	.826
		4	1	-11.433(*)	3.204	.007
			2	-5.987	3.352	.368
			3	-3.208	3.388	.826

* The mean difference is significant at the .05 level.

5. Discussion

Teachers face tremendous challenges in implementing e-learning for relatively low academic achievers and in the setting where Internet addiction is quite common. It is not immediately clear how to concentrate students' attention and improve their learning in a web-based environment without the teacher's on-the-spot monitoring. To improve our understanding of how to solve these tough issues, we brought in and then tested rigorously a set of hypothesis among four experimental groups. According to the findings of this study, we believed that our research has made some contributions to e-learning theory in three different ways. Firstly, our research contributed to the existing literature by specifying how teachers can simulate the situation and climate and ask students to regulate their learning by applying PBL and SRL instructional methodologies in a web-based learning environment. Secondly, our study demonstrated that computing skills of vocational students can be improved through e-learning, even in a short-term module and with only a two-hour lecture about SRL. Thirdly, this study was an early attempt to investigate the learning effect of the combination of PBL, SRL, and web-based learning simultaneously in a short-term module.

5.1 The effects of web-enabled PBL

In this study, PBL was found to play a positive role in enhancing students' computing skills. As the data in Table 3 showed, there was a very significant difference between the PBL and non-PBL class

on the test of Word ($P = 0.002$). This demonstrated that PBL is good for computer software education in general, and e-learning in particular. It was suggested that the traditional lecturers should shift or adapt to problem-based learning and then align constructively in online teaching (Talay-Ongan, 2003). The findings of the present study were similar to those that appeared in Chanlin and Chan's (2004) study, which revealed that students in the PBL treatment group performed better than those from the control group in a web-based learning environment. It is our observation that many computer teachers apply short, disjointed, lack-of-context examples in teaching application software modules. The effects of such lessons are usually limited and can hardly help students solve real problems chosen from practice. We suggest that teachers design their modules (or whole courses) systemically and consistently. Teachers can simulate a business situation and setup a series of problems in terms of working modules before they transfer these materials into a format of e-learning.

5.2 The effects of web-enabled SRL

The data shown in Table 4 also supported that the difference of students' Word skills between SRL and non-SRL groups was statistically significant ($P = 0.046$). The importance of self-regulated learning in Internet-supported environments was emphasised in the literature, for example, Winnips (2000). Thus, strategies must be put into practice to prepare students for the rigors of learning at a distance and increase the probability of retention and success (Chang, 2005). According to our teaching experience, students in most vocational schools in Taiwan tend to have lower levels of academic achievement, and spend more time on their out-of-class jobs, get inadequately involved in their schoolwork, and care less about their grades. In this specific context of low achievers, teachers may take high risks in implementing e-learning. However, this study supported that SRL, once done right, helped low achievers learn better in a short-term module through Internet.

5.3 The effects of combination of web-enabled PBL and SRL

With respect to the effects of the combination of PBL and SRL, we found preliminary support from the results in Table 5. The results showed that the effects of combined training in PBL and SRL on enhancing students' computing skills were positive and higher than those who did not receive PBL or/and SRL, although the difference between C1 and C2 and the difference between C1 and C3 were not statistically significant. These results were also similar to those that appeared in Paris and Paris's (2001), Perels, Gürtler and Schmitz's (2005), and Kramarski and Gutman's (2006) studies. To conclude, this study suggested that teachers could apply PBL and SRL simultaneously in the modules rather than singly to strengthen the interaction of PBL and SRL to promote students' learning. For those teachers who wish to stick to traditional methods of teaching, directly translating their teaching materials into electronic form may not be a fruitful approach. Students in the control group (C4) received the poorest grades among the four groups (see Table 5). It is suggested that teachers should redesign their modules (or courses) and then adopt new instructional methods and technologies to fully exploit the benefits of deploying web-based learning environments.

5.4 Limitations

The results of this study generally supported that there were positive effects of web-based PBL, web-based SRL and their combinations on enhancing students' computing skills. However, there still exist some limitations, mainly due to the quasi-experimental design. A major problem with quasi-experimental design is that the four groups may not be necessarily the same before any instruction takes place and may differ in important ways that influence student performances. In this regard, the researchers empirically assessed the differences in students' computing skills and involvement in this course among the four groups at the beginning of the study as pretests. The definition of involvement used in constructing the PII that was applied this study had much in common with motivational theory (Schmidt and Frieze, 1997), and measured three constructs: interests, needs, and values. The differences among students' computing skills and involvement, according to the pretests, were not statistically significant. Thus, researchers ruled out initial differences and normal development as rival explanations for the differences resulting after treatments (Gribbons and Herman, 1997). Other factors might potentially influence students' online learning. A student with readiness for self-directed learning may appropriately adapt himself to a web-based learning environment, which may further result in better grades. For example, it is observed that several students who were more self-regulative in the traditional classroom recorded their online learning regularly, and performed better than those without self-regulation. These students were relatively more self-directed and had better grades in the traditional instruction, and also had better learning effects in the online environment.

The authors of the present study did not address or rule out this possibility in their research design. Some additional problems might result from students in the comparison group being incidentally exposed to the treatment condition, being more motivated than students in the other group, having more enthusiastic teachers, etc (Gribbons and Herman, 1997). One should be aware of these contextual factors, which threaten the validity of claims made by this study. Exploration in future studies of the relationship between the contextual factors and students' online learning would complement our understanding of these effects of web-enabled pedagogies.

6. Conclusion

PBL and SRL have been applied successfully for teaching in different academic fields for decades. These two instructional methods could make further contributions to students' learning through Internet. In this study, PBL and SRL were simultaneously applied as web-based pedagogies to help vocational students develop their practical skills of deploying computer software in a short-term module. Results were generally positive, showing enhanced student computing skills. Providing online courses in an environment that is full of Internet addiction with browsing shopping websites and playing online games challenges both instructors and students. Without systematic redesign and reconsideration of the learning settings, teachers and students may suffer from ineffectiveness resulting from replicating traditional instructional methods through Internet. This study provides a specific reference in the context of vocational education addressing how to increase students' interest and to help online students regulate their learning. Finally, this study may provide valuable insights and shed light on leading practices of web-based pedagogies for those schools (particularly for vocational schools) and institutes that hold short-term modules or workshops, or for scholars and teachers planning to implement, or currently engaged in, e-learning.

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