Applying Web-Enabled Problem-Based Learning and Self-Regulated Learning to Involve Low Achieving Students in Learning Application Software

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Abstract: - This study explored the effects of web-enabled pedagogies on students' involvement in learning. A series of quasi-experiments were conducted to investigate whether students' involvement increases over time if intervened respectively by problem-based learning (PBL), self-regulated learning (SRL), and their combinations. Two classes of 102 freshmen at a vocational school in a one-semester course were chosen for this empirical study. The results were generally supportive. The authors further discuss the implications for schools, scholars and teachers engaged in e-learning.

Key-Words: - Web-Enabled PBL, Web-Enabled SRL, e-learning, Involvement, Application Software Education

1 Introduction

The Student Learning Imperative states that the key to enhance learning and personal development is not only for faculty to teach more and better, but also to create conditions that motivate and inspire students to devote their time and energy to educationally purposeful activities, both in and out of the classroom [1]. Involvement, especially academic involvement, generates strengthened student effort, and then leads to enhanced learning [2]. Many scholars accept the concept of involvement as a key determinant of learning outcomes. For example, Astin's study strongly supported the importance of involvement as a powerful means of enhancing almost all aspects of the undergraduate student's cognitive and affective development [3].

Involvement can be defined as a person's perceived relevance of a certain object based on inherent needs, values, and interests [4]. Literally hundreds of studies of undergraduates have shown that the greater the student's degree of involvement, the greater the learning and personal development they have ([3], [5]). It was revealed by Tinto that the more students are involved academically and socially, the more likely they invest more time and energy in the learning process [2].

As a group, vocational students in Taiwan can be characterized as lower academic achievers, less self-regulated learners, and in general, having fewer positive experiences in their learning. Professionals with a vocational degree represent a major portion of the work force in Taiwan. However, vocational

education is facing severe competition to attract student enrollments due to the number of vocational schools having increased while birthrate continually decreased. In this regard, vocational schools often emphasize the proportion of students awarded professional certificates before they graduate instead of quality learning. This materialist aim puts students' attention less on mastering necessary skills such as deploying application software and more on preparing for tests through memorization. Consequently, a student who has passed an examination may still be unable to apply what was learned in school, and worse, lacks motivation to learn more in the future.

The computing education in vocational schools in Taiwan can hardly be deemed as effective. Courses in application software traditionally emphasize memorization by applying short, disjointed, lack-of-context examples. The lack-of-context examples in textbooks and teaching only by lectures may result in uncompetitive graduates and incompetent employees. There is a gap between what is learned in school and what is required in the workplace. To bridge this gap and to increase students' involvement in learning and develop practical skills, problem-based learning (PBL) is considered to be most appropriate. PBL uses real-world, simulated, cooperative, contextualized problems of practice to motivate, focus and initiate content learning and skill development [6]. Therefore, it is believed that PBL would help involve students in learning to develop practical computing skills.

Web-based instruction seems to be an ideal learning environment because students can access an almost unlimited amount of information and apply it in multiple ways [7]. The strength of the Internet is to deliver information directly to individuals; however, it may also be one of its greatest dangers. Students may avoid school activities and course involvement, and instead be content with self-gratifying Internet entertainment [8]. Many vocational students are addicted to shopping websites, online games, and online messenger, spending hours therein rather than being involved in their courses, particularly in online courses. Therefore, implementing e-learning for low self-regulatory students inevitably runs high risks.

Success in online courses often depends on students' abilities to successfully direct their own learning efforts [9]. Students in the online environment equipped with self-regulated learning (SRL) competence become more responsible for their learning and more intrinsically orientated [10]. So, self-regulation is particularly important when learning in WWW-supported environments [11]. To respond to this challenge, the authors turn to some approaches that can help students to be better regulated and involved more in their learning. That is, SRL is applied in this study to help vocational school students concentrate and be involved in their learning, leave time for learning after their part-time jobs, and furthermore, take responsibility for their learning.

It is important to increase our understanding of factors that predict involvement in learning and development activities, not only of the types of people that get involved in learning but also the types of contexts or situations that may facilitate involvement [12]. If one of the primary goals of e-learning is to prompt active involvement, then teachers and instructional designers need to better understand the design of learning tasks in stimulating and sustaining learner engagement [13]. The call for students to become more involved in their academic study is not new in technology-based approaches. For, example, the use of computer-mediated communications in education has been shown to improve students' involvement and initiative [14], and lead to higher commitment and higher critical thinking [15]. However, few studies have investigated academic involvement as it is experienced by low academic achievers through e-learning. In this regard, the authors have redesigned a course in application software to integrate innovative teaching methods and learning technologies to help students learn and be more involved in an online course. Specifically, this study explores the potential effects of web-based PBL and SRL on the development of vocational students' involvement in an online course. Based on suggestions from earlier research, the authors conducted a series of quasi-experiments to examine the effects of web-enabled PBL, SRL, and their combinations on students' involvement.

2 Methods

2.1 Participants

The participants in this study were 102 freshmen students taking a compulsory course titled 'Packaged Software and Application' in a university of science and technology in Taiwan. None of them is an information or computer technology major. However, in an institution for technological/vocational education, practical applications of technology are core skills. Students are expected to spend much more time and effort in

mastering a variety of technological skills as compared to those in comprehensive universities.

2.2 Course Setting

The course was a semester-long, 2 credit-hour class, targeted at college students in different majors. Students solved a series of authentic tasks by applying Microsoft Office (including Word, Excel, and PowerPoint).

2.3 Experimental Design and Procedure

The experimental design was a 2 (PBL vs. non-PBL) × 2 (SRL vs. non-SRL) factorial pretest-posttest design (see Fig. 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 in such a way that each condition contained 24 to 30 subjects. The PBL and SRL group (C1, N=28), 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=25) was the control group.

	PBL	non-PBL
SRL	The most significant effect (C1 Group)	Medium effect (C3 Group)
non-SRL	Medium effect (C2 Group)	No difference (C4 Group)

Fig. 1 Expected effects of variation in teaching methods

The course design in this study consisted of three subsequent modules: the Word module, the Excel module, and the PowerPoint module. There was a skill test held after the completion of each module. All participants completed a questionnaire, which served as the instrument for gathering data on students' learning attitudes and experiences, three times. The first questionnaire was delivered in the beginning (2nd week) of each class just before the start of the experiment. The second questionnaire was administered during the midterm examination (8th week) and the final one directly after the experiment. The schedule of module teaching and skill tests is depicted in Fig. 2.

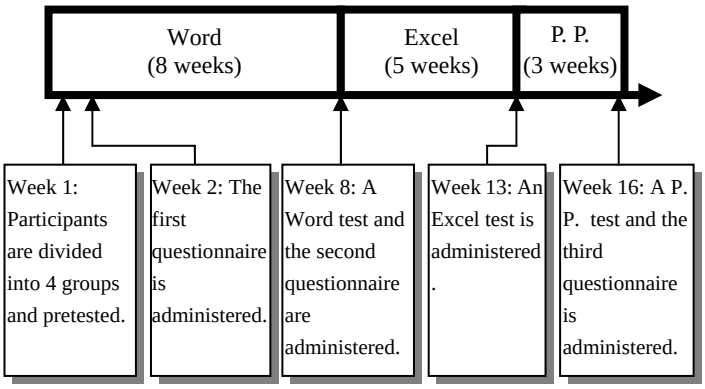

Fig. 2 The schedules of the three modules' tests

PBL Treatment

The teacher created interesting, challenging, and authentic problem situations. In the Word module, students were required to apply for a job as Marketing Assistant in an online game company. They were required to design and then build autobiographies and resumes by applying skills of application software that they just learned. In the Excel module, students played roles as if they were employed by this same software company, and a marketing manager asked them to compare expenses resulting from different distribution channels. They had to survey for information, then complete a worksheet with some graphs and tables to contrast differences between channels. In the last module, PowerPoint, they were promoted to the higher rank of Marketing Managers. They were asked to develop a business proposal for a new on-line game. They had to convince the managing director to enter the market via a presentation with visual aids. Therefore, a persuasive PowerPoint file was built into this phase.

The teacher first demonstrated how he could approach the situation and solve the problems 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

Students in SRL groups received instruction in an after-school lecture teaching them 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. The content of this

SRL course was composed of the four processes addressed by Zimmerman, Bonner and Kovach, that is, self-evaluation and monitoring, goal-setting and strategy planning, strategy implementation and monitoring, and monitoring of the outcome of strategy [16]. Students were taught how to implement these four processes to become more 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 behavior every week. The data was recorded on the course website instead of in their notebooks in order to prevent falsification of records. The teacher casually examined students' records. The treatments in 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… ● demonstrates how to solve authentic problems and discusses its potential applications. ● teaches SRL skills and urges students to study regularly.	The students… ● take on authentic tasks and learn by problem solving. ● practice SRL and record learning behaviors every week.
C2	The teaching activities are the same as C1 but without SRL lectures.	The students experience authentic situations and solve the problems without extra requirements of SRL.
C3	The teacher… ● converts his traditional way of teaching without any modification into an online format. ● teaches SRL skills and urges students to study regularly.	The students… ● receive the traditional computer software course through Internet. ● practice SRL and record learning behaviors every week.
C4	The teaching activities are the same as C3 but without SRL lectures.	The students experience the traditional style of teaching and do not deal with the extra requirements of SRL, although teaching is conducted via the Internet.

2.4 Measures

The instrument used in this study was that of Zaichkowsky, which measures the psychological states regarding personal relevance or importance of an object [4]. Zaichowsky's Personal Involvement Inventory (PII) measures three constructs: interests, needs, and values. To examine levels of change manipulated by variations in experimental conditions, the authors first measured students' involvement with application software as a baseline before the start of the experiment. In the second week, students completed the first questionnaire as a pretest. The difference in students' involvement in application software at this beginning stage among the four groups was not statistically significant. Therefore, it was considered that the students had equal involvement when they began this course. In addition, none of them had any experience in taking a web-based course. The authors then evenly and randomly divided the students into the four experimental groups. Finally, the authors compared the students' involvement in the beginning and in the end of the semester. We tested whether student involvement in the online course was enhanced under different conditions over time.

3 Results

The results of an independent samples t-test showed significant increases in scores of PBL students' posttest involvement (5.3708) comparing with those of their pretest involvement (5.0651) (see Table 2). In contrast, students in non-PBL groups even showed decreased involvement, though not statistically significant, from the beginning (4.9144) of the course to the end (4.8745). Therefore, the effects of web-based PBL significantly increase students' involvement in the online course in a period between the beginning and the end of the course.

Table 2 Independent samples t-test: Involvement

		Pretest		Posttest		Change	
Teaching Methods	N	M	S. D.	M	S. D.	t	P
PBL	53	5.0651	.72976	5.3708	.62699	-2.313	.023**
non-PBL	49	4.9144	.56886	4.8745	.63829	.327	.744

Note. $^{**}P < 0.05$

Shown in Table 3, the results for groups receiving SRL intervention indicated a significant increase in scores of involvement, from the beginning of the course (4.9078) toward the end f the course (5.2231). In addition, students in non-SRL groups showed slight but insignificant increases in scores of involvement in the beginning of the course (5.0810) in comparison with those at the end of the course

(5.1450). Therefore, the effects of web-based SRL significantly increased students' involvement in the online course from the beginning of the course to the end.

Table 3 Independent samples t-test: Involvement

		Pretest		Posttest		Change	
Teaching Methods	N	M	S. D.	M	S. D.	t	P
SRL	52	4.9078	.62677	5.2231	.68050	-2.457	.016**
non-SRL	50	5.0810	.68519	5.1450	.70060	-.462	.645

Note. $^{**}P < 0.05$

Shown in Table 4, the results for the group receiving intervention of PBL and SRL in combination (i.e. C1) indicated a significant increase in students' posttest involvement (5.2875) in contrast to their pretest involvement (4.8911). Therefore, it is substantiated that students learning from a web-based instruction that applies the combination of PBL and SRL significantly improved their involvement in the online course from the beginning of the course to the end. However, for C2, C3, and C4 groups, the data showed no significant differences between the pretests and posttests.

Table 4 Independent samples t-test: Involvement

		Pretest		Posttest		Change	
Groups	N	M	S. D.	M	S. D.	t	P
C1	28	4.8911	.69069	5.2875	.70588	-2.124	.038**
C2	25	5.2600	.73640	5.4640	.52351	-1.129	.265
C3	24	4.9274	.55708	4.9250	.55364	.015	.988
C4	25	4.9020	.59116	4.8260	.71838	.408	.685

Note. $^{**}P < 0.05$

4 Discussion

Teachers face tremendous challenges in implementing e-learning among students who are addicted to the Internet and live in an environment full of many free online games. It is not immediately clear how to focus students' attention, improve their learning, and help them be more involved in a web-based course without the teacher's on-the-spot monitoring. In this regard, we believe that our research contributes to e-learning theory in three different ways. First, our research specifies how teachers can improve students' involvement under authentic conditions by applying PBL instructional method and asking students to regulate their learning by applying SRL method in an online course. Second, this study is one of the first attempts to explore the learning effects of the various combinations of PBL, SRL, and web-based learning. Finally, this empirical study provides evidence that students' involvement can be improved from the beginning of the semester to the end through e-learning.

PBL was found to play a positive role in improving students' involvement in the online course in contrast to the involvement of those in the non-PBL group (see Table 2). For the PBL group, there is a significant increase in students' scores of involvement from the beginning of the course to the end. However, students in the non-PBL group showed a decrease, though insignificant, in scores of involvement measured at the beginning and the end of the course, respectively. It was demonstrated that PBL could help students to become more involved in an online course that consists of conscientiously designed and simulated situations. The findings in this research were also similar to those appeared in Chanlin and Chan's study, which revealed that students in the PBL treatment group perform better than those from the control group in a web-based approach [17]. Therefore, in order to enhance students' practical skills and help them be more involved in an online course, teachers could redesign their courses by simulating meaningful and interesting business situations, and thus engage students to solve challenging problems.

The evidence also supports that the teaching method, SRL, also enhances students' involvement in the online application software course (see Table 3). There is a significant increase in students' involvement from the beginning of the course to the end in the SRL groups. This result indicates that SRL can help students to be more involved in an online course. In contrast, in the non-SRL groups, students have an insignificant enhancement in their involvement. Students without SRL skills may be less involved in the web-based course because they are still used to learning in the traditional spoon-fed way. The physical absence of the instructor, the lack of teacher's on-the-spot monitoring, and students' addiction to the Internet, may result in the students' ineffective learning and lower involvement in an online course. The importance of self-regulation to learning in Internet-supported environments is also mentioned by Winnips [11]. Providing students with

opportunities to integrate their knowledge through web-enabled instruction may not be effective if they lack the skills needed to regulate their learning. Thus, strategies that prepare students for the rigors of learning at a distance, which may increase the probability of retention and success, must be put into practice [10]. Therefore, it is very critical for teachers to develop their students' SRL skills to help students concentrate on online learning.

Finally, we found support for the effectiveness of a combination of PBL and SRL. As shown in Table 4, the results revealed that students in PBL and SRL group (C1) have enhanced, in a statistically significant level, their involvement in the online course from the beginning of the course to the end. However, there is no significant difference between the pretests and posttests among the other three groups (C2, C3, and C4). Paris and Paris reveal that 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 [18]. In Perels, Gürtler and Schmitz's study of mathematical problem solving, it was found that the combined training in self-regulatory and problem-solving strategies is effective for enhancing self-regulatory competences in solving problems [19]. Moreover, Kramarski and Gutman revealed that SRL students significantly outperformed the non-SRL students in problem-solving procedural and transfer tasks regarding mathematical explanations in a web-based learning environment [20]. To conclude, it is strongly suggested that students who learn from web-based instruction that applies the combination of PBL and SRL will improve their involvement in the course from the beginning of the course to the end.

Based on the findings in this study, we advise that teachers should conscientiously redesign their courses and then adopt new instructional methods and appropriate technologies to fully exploit the benefits of web-based learning environments. This study may provide valuable insights and shed light on new and effective practices for schools (particularly vocational schools), scholars and teachers preparing for or presently engaged in implementing e-learning.

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