INTEGRATING POPULAR WEB APPLICATIONS IN CLASSROOM LEARNING ENVIRONMENTS AND ITS EFFECTS ON TEACHING, STUDENT LEARNING MOTIVATION AND PERFORMANCE

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ABSTRACT
Advancements in information and communication technology (ICT) allowed several tools and systems to be proposed for improving classroom experiences to both instructors and students. However, most of these tools were brand-new and stand-alone programs that require users to invest additional time and effort to become familiar with their use. This requirement could adversely affect the users' motivation on using these particular programs. However, enhancing student learning motivation and participation is crucial for the teaching and learning of new knowledge or skills since motivation would affect how instructors and students interact with learning materials. In the era of Web 2.0, both instructors and students are heavily immersed in various web applications such as SkyDrive, Evernote, DropBox, and Google Apps on a daily basis. These web applications were also well-received by both instructors and students in their daily lives. Therefore, the use of well-known web applications could be a potentially novel method to engage instructors and students in meaningful teaching and learning activities. Bearing this in mind, this study proposed a learning environment supported by well-known web applications to supplement classroom teaching and learning activities, assist instructors in facilitating student learning and participation, and help improve student learning motivation and performance. Experimental results revealed that students had higher learning motivation and participation when using the proposed web application supported learning environment during and after class as it gave them access to adequate learning support. The proposed approach also gave effective assistance to instructors and students in administering and conducting learning activities during and after class.

BACKGROUND AND OBJECTIVES

Education has undergone significant changes with the advance of information and communication technology (ICT) in the last decade. Teachers could now use ICT to administer various educational activities that engage students in meaningful learning contexts. Additionally, learning motivation of students could be stimulated by integrating ICT into learning processes (Law, Lee, & Yu, 2010). Consequently, the ultimate goal of using ICT would be to enhance teaching and learning performances of teachers and students.

Several tools or systems had been proposed to support various classroom activities (Jou, Chuang, & Wu, 2010; Lee, Lu, Yang, & Hou, 2010; Lin, Tan, Kinshuk, & Huang, 2010). Nevertheless, most of these systems and tools were brand-new and stand-alone programs. This means that users (instructors and students) had to spend additional time and effort to familiarize themselves with the use of these tools or systems. Moreover, users may need to install additional programs on their own devices or apply for new user accounts. These requirements could adversely affect user motivation on using these particular programs that was supposed to support specific educational contexts (Lin, Lin, & Huang, 2011).

Enhancing student learning motivation is important for the teaching and learning of new knowledge or skills because motivation would affect how instructors and students interact with learning materials (Hung, Chao, Lee, & Chen, 2012). From the instructors' perspective, student learning motivation would often influence their teaching efforts and how they plan teaching strategies for new classes in order to enhance student learning performance (Keller, 1983). From the students' perspectives, poor learning motivations would mean higher risks that new knowledge would be built upon faulty foundations (Murphy & Alexander, 2000). Strong learning motivation could also encourage students to continue their learning after a learning session (Maehr, 1976).

The era of Web 2.0 introduced several web applications that have been developed for free and open use. Examples include SkyDrive, Evernote, DropBox, and Google Apps. These web applications provided friendly user interfaces and powerful functions, and were well-received by both instructors and students in their daily lives. Several literatures that reviewed these features indicated that well-known web applications could be potentially utilized in novel methods in engaging users in meaningful teaching and learning activities (Alexander, 2006; Hughes, 2009; Schneckenberg, Ehlers, & Adelsberger, 2011; Thompson, 2007; Wang, Woo, Quek, Yang, Liu, 2012). Furthermore, instructors and students would already have the necessary technical skills required to use these applications, and would therefore be more motivated to use them in educational contexts

(Dohn, 2009). They would only need to consider the means of applying these applications to help them administer educational activities in class (Pretlow & Jayroe, 2010). Additionally, previous studies also found that participants who took part in a web-enhanced class outperformed those in a traditional lecture class (Crook & Harrison, 2008; Hamann & Wilson, 2002). Effective use of web applications could also soften the boundaries between formal and informal learning (Bennett, Bishop, Dalgarno, Waycott, & Kennedy, 2012).

Therefore, in order to assist instructors in facilitating student learning participation, improve student learning motivation and performance, and support learning and teaching activities in class, a web application supported learning environment that integrated Google web applications was proposed in this study. An experiment was also conducted on an industrial course in a Taiwanese university to investigate the effectiveness of the proposed approach.

Web application supported learning environment

In this study, a web application supported learning environment was proposed to enhance classroom teaching and learning experiences. Figure 1 shows the framework of the proposed environment, which consists of three major components – web application, teacher side, and student side.

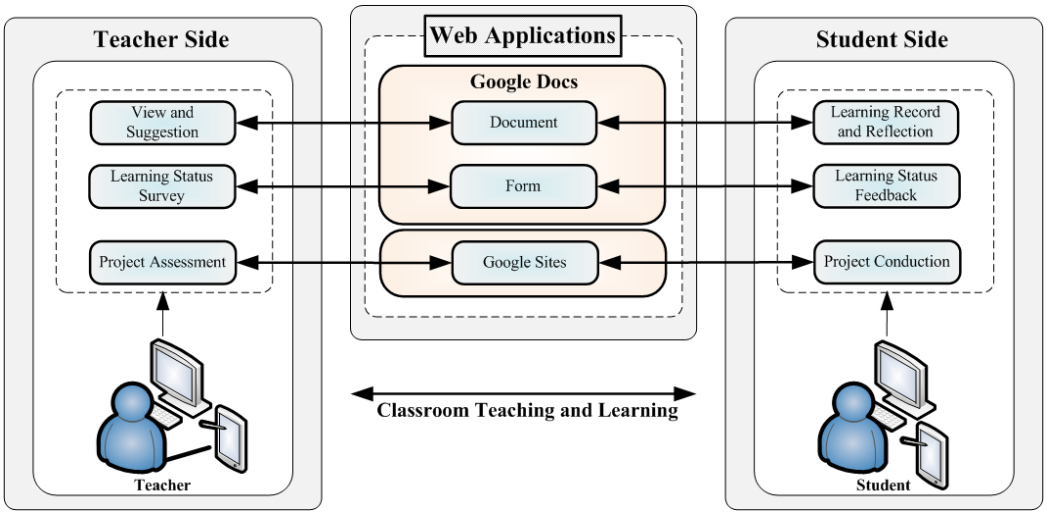

Figure 1. The framework of the web application supported learning environment

- *Web application side*. Two Google web applications, Google Docs and Sites, were adopted to develop the proposed learning environment. Two types of Google Docs, document and form, were used to facilitate participant interaction. Google document provided a web-based document service that enabled users to create and edit online documents through a web browser. Users could also easily share their own documents with others. Furthermore, Google form provided an online questionnaire service, allowing users to create and conduct online questionnaires and surveys efficiently and effectively. Google Sites provided an easy way for users to create dynamic web pages for team projects with the ease of writing a document. This meant that users without any web programming skill could also create web pages without hindrance.
- *Teacher side*. Instructors could ask students to use Google document to provide their feedback on a certain learning activity. Students would be able to improve the comprehension of their own thinking processes through giving feedbacks and reviews (Jou & Shiau, 2012). Moreover, instructors could also use Google document to view each student submission and share comments and suggestions immediately with the students. Furthermore, Google form allowed the instructors to immediately administer online questionnaires and assess student learning statuses and performances during the teaching process, as shown in Figure 2. The information obtained could provide a useful basis for the instructors to understand how students felt about the teaching and adjust teaching paces if required (Hwang & Chang, 2011). In addition, Google Sites allowed instructors to lead students collaboratively in team projects.

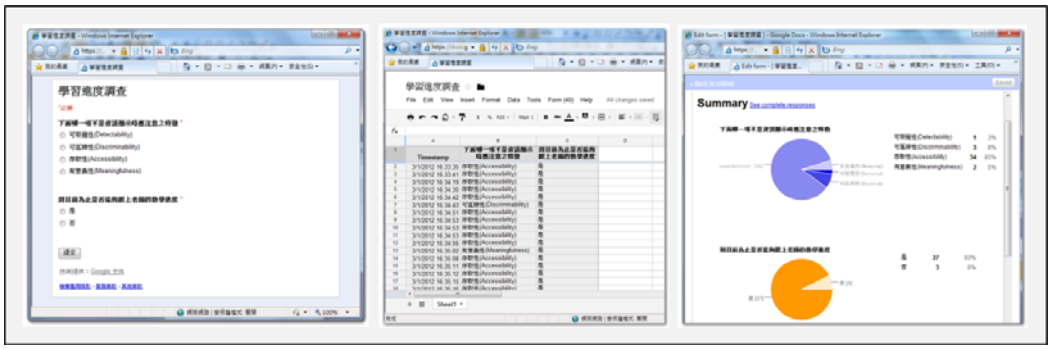

Figure 2. Screenshots of online questionnaire created using Google form

- *Student side*. Students could create a Google document to record their learning status and notes as though they were using Microsoft Office Word. They could also express their opinions and thoughts by responding to Google forms written by the instructors. Additionally, students could present their learning results to their peers via Google sites, as shown in Figure 3.

Figure 3. Screenshots of a developing project created using Google sites

Experiment

To investigate the influence of web application supported learning environment in classroom teaching and learning, an experiment was conducted on an industrial course at a university in Taiwan.

Research instrument, measures and goals

To evaluate the effects of the proposed approach on teaching and learning performance, two data sources, questionnaires and interviews, were utilized. The questionnaires were designed to gauge student learning motivation and attitude, while interviews were used to investigate participant perception towards the entire teaching and learning process.

As mentioned above, in order to assess student learning motivation, a questionnaire with intrinsic value scales for learning motivation (MSLQ, Motivated Strategies for Learning Questionnaire) was adopted. The intrinsic value scale was recommended by researchers for assessing student goals and beliefs about the importance and interest of class work. The questionnaire we used included nine items based on a seven-point Likert scale (Pintrich & De Groot, 1990).

Student learning attitude was surveyed using a learning attitude questionnaire that consisted of six questionnaire items based on a five-point Likert scale. This questionnaire had been used previously to measure student learning attitudes towards learning activities (Lai & Wu, 2006; Lin, Lin, & Huang, 2011).

Experimental design, participants and procedure

To investigate the effectiveness of the proposed approach, a quasi-experimental research was conducted on an industrial course on the subject of product design at a university in Taiwan. A course instructor and 40 university students participated in the experiment. The average age of the students was 20. To instruct the subject, a website was developed to consolidate all relevant learning content as shown in Figure 4. The subject was taught in the sixth week of the course syllabus and was divided into six units as described in Table 1. The subject had a total of 500 min of learning activities that included instruction, discussion, reflection, and practice sessions. Time allotment for each learning activity was planned by the course instructor.

Figure 4. Screenshot of the learning site

Table 1. Major teaching and learning activities in the industrial course

Subject: Product Design		
Unit	Instruction Activities	Time (min)
Design Theory	1. Instructor presentation (35) 2. Instruction of Google document manipulation (5) 3. Discussion (20) 4. Reflection (20)	80
Human Factors Engineering	1. Review of previous instruction (5) 2. Instructor presentation (35) 3. Discussion (20) 4. Reflection (20)	80
Ergonomics	1. Review of previous instruction (5) 2. Instructor presentation (35) 3. Discussion (20) 4. Reflection (20)	80
Product Patent	1. Review of previous instruction (5) 2. Instructor presentation (35) 3. Product patent practice (20) 4. Reflection (20)	80
Creative Design Management	1. Review of previous instruction (5) 2. Instructor presentation (35) 3. Discussion (20) 4. Reflection (20)	80
Team project presentation	1. Instruction of Google sites manipulation (20) 2. Development of team project (60) 3. Project presentation (20)	100

Figure 5 shows the experimental process. All students were asked to fill out the learning motivation questionnaires before and after participating in the learning activities. A separate learning attitude questionnaire was distributed to each student after the learning activities as well. Two interviews were carried out after the questionnaires to document participant perception towards the entire teaching and learning process.

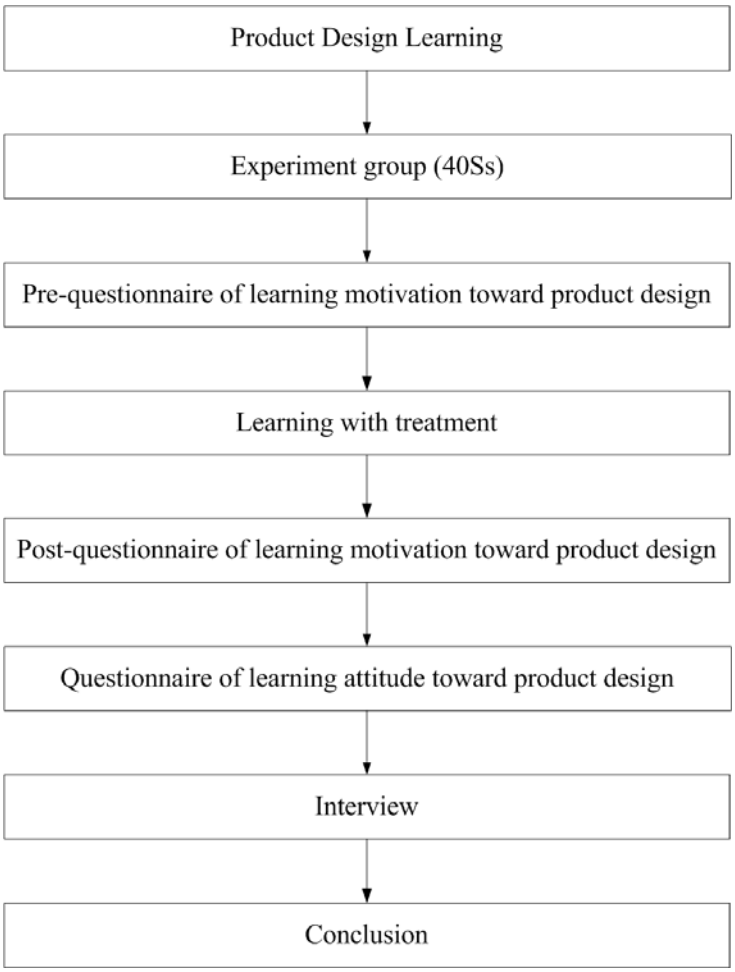

Figure 5. The experimental process

Experimental Evaluation

Learning motivation survey

In this study, a web application supported learning environment was utilized in a university-level industrial course. All students were asked to fill out MSLQ questionnaires before and after participating in the learning activities. Cronbach's alpha values of the questionnaire items were .776 and .828, respectively. It was found that students were significantly motivated after learning with the proposed approach. From the statistical results of the MSLQ questionnaire survey, it was found that more than 87.5% of the students had increased learning motivation after going through the proposed learning environment. However, learning motivation of the remaining students (12.5%) had decreased. Additionally, a paired *t*-test was used to examine differences in learning motivation of each student before and after the learning activities. The results, as shown in Table 2, revealed that students were motivated after participating in the learning activities. However, the study was limited as the effect of the proposed approach could not be clearly identified using the paired-samples *t-test* on student learning motivation in the experimental group. To eliminate this limitation, two interviews were carried out to survey participant perceptions, with special focus on learning motivation when using the proposed approach.

Table 2 Paired-samples *t-test* on the learning motivation of the students

	Group	*N*	Mean	S.D.	*t*(39)
Learning Motivation	After participating in the learning activity	40	4.86	1.14	5.398*
	Before participating in the learning activity	40	4.06	1.01	

* $p < .05$.

Learning attitude survey

In this experiment, students were asked to fill out a learning attitude questionnaire after participating in the learning activities to provide a feedback on the instruction of product design. The Cronbach's alpha value of the questionnaire items was .786. The statistical results are shown in Table 3.

Result analyses revealed that most students reported having positive attitudes towards learning in the web application supported learning environment (82.5%, Table 3, 'SA & A' column). Only 7.5% of the students said that they disliked this kind of learning ('D & SD' column). Moreover, most students indicated that the learning activities assigned by the instructor were helpful. A majority of the students stated that they liked to use the web applications in learning (item 1). Nearly four-fifths of the students felt that the use of the web applications was very easy (item 4), and almost none felt otherwise. 80.0% of the students agreed that they had good interactions with their peers and the course instructor (items 5 and 6).

Table 3. Students' attitudes towards learning activities

#	Item	SA & A (%)	Neutral (%)	D & SD (%)	Mean
1	I like learning in the web application supported learning environment	82.5	10.0	7.5	4.10
2	The learning activities are helpful	87.5	7.5	5.0	4.35
3	I like to use web applications in learning	87.5	5.0	7.5	4.35
4	The web applications are very easy to use	80.0	17.5	2.5	4.175
5	I had good interactions with other students	85.0	12.5	2.5	4.30
6	I had good interactions with the instructor	75.0	17.5	7.5	4.15

Interview Investigation

Next, the course instructor and students were interviewed to investigate how they felt about teaching and learning with the web application supported lessons. Since the instructor had taught the same course and implemented similar learning activities without the proposed approach in other semesters, this study specifically asked him to analyze differences of student learning motivation and performance between the traditional and proposed learning environments. Students were also asked to assess their own learning outcomes as they had never experienced the proposed learning approach before. Instructor and student responses were recorded and then transcribed for each and every interview. To clearly present the interview results, the transcripts were processed into the three main categories of instruction, interaction, and technology aspects, as described in Table 4.

Table 4. Sample comments for the three categories

Inductive Categories	Sample Comments
Instruction Perspective	*The instructor believed that the proposed approach could assist him in administering the class.*
	The instructor observed that the students had higher learning motivation in activities that integrated web applications than those in activities without the web applications he taught before.
	Most students specifically emphasized that engaging in the learning environment motivated them to record what they had learned and enabled them to make a deep impression on their learning.
Interaction Perspective	*The instructor observed that students often gave feedback and asked questions on product design concepts in the learning environment.*
	The instructor felt that students had better discussions and reflections in each learning activity during and after the course.
	Most students emphasized that the proposed approach could effectively facilitate interactions and collaborations with each participant, especially after class.
Technology Perspective	*The instructor felt that most participants could accept the use of web applications in this class.*
	The instructor indicated that the web applications were convenient. They allowed him to easily check the student documents and projects anytime and anywhere.
	Most students indicated that the use of the web applications was easy for them.

Instruction perspective

When comparing with the industrial course without the proposed approach that the instructor had taught in other semesters, the instructor believed that the proposed approach assisted him in administering the class especially

when reviewing student feedback and learning statuses. Moreover, he stated that the students were interested in using web applications during the learning process since they never used web applications to support learning before. He also observed that students in activities that integrated web applications had better learning motivations compared to students he taught before that underwent activities without the web applications. With regard to student learning performance, the instructor indicated that students using the proposed learning environment were more engaged in the learning events and activities during and after class as they could easily and conveniently administer, share, and consolidate individual thoughts and knowledge. Furthermore, he was impressed that students were able to demonstrate excellent performance in every discussion and reflection activity. In addition, the instructor said that Google Sites was an appropriate and useful tool for students to present individual or team projects.

During student interviews, most of them believed that they had better learning performances and motivation when using the proposed approach in class. They specifically emphasized that using the learning environment motivated them to record what they had learned and enabled them to make a deep impression for their learning. Moreover, students with no prior programming skills found a sense of achievement in using Google Sites to develop an independent website for the team projects. Nevertheless, a small number of students felt that Google Sites hindered their projects as they were unfamiliar with its use.

Interaction perspective

For interaction, the instructor observed that students who used the proposed learning environment gave additional feedback and asked more questions on product design concepts compared to those that did not. Students using the learning environment also had better discussions and reflections in each learning activity during and after class, and the instructor felt that the use of Google document could enhance student interactions during each activity. Moreover, the instructor indicated that the use of Google Docs allowed him to gauge student learning statuses and their perceptions efficiently and effectively, especially for the more introverted students. Furthermore, the instructor stated that the sharing of student notes through Google document allowed him to easily provide learning suggestions and comments to the students.

From the perspective of the students, most thought that they could express personal opinions better when the instructor applied Google form to survey their learning statuses. Moreover, several students said that Google Docs was a useful tool for conducting group-work with their peers since it supports simultaneous reviews and corrections by several reviewers. Additionally, over half of the students indicated that the use of Google Sites could strengthen peer-interaction and further enhance project productivity. When compared with other industrial courses the students had participated before, they emphasized that the proposed approach could efficiently facilitate participant interaction and collaboration, especially after class, since the proposed approach included useful sharing and collaborative functions that allowed them to stay connected on a daily basis.

Technology perspective

The technology context surveyed the experience of participating students and course instructor when utilizing the web application supported learning environment. The instructor felt that most students could accept the use of web applications in class since these applications were already widely used by the students on a daily basis. Another critical benefit of these web applications was that they were mutually supportive. Therefore, users could easily apply the same web applications to support different activities. Furthermore, the instructor indicated that since web applications were supported in various devices such as PC, tablet, and smart phone, he could conveniently administer his class anytime and anywhere via the Internet. He also observed that several students used Google document to edit their feedback notes after-school. This implied the convenience and usefulness of the web applications which allowed most students to use them actively, motivating them to review their lecture notes after the lesson.

Most students indicated that Google document was easy for them to use as the user interface of Google document was similar to that of Microsoft Office Word. They also felt that Google document was convenient for reviewing learning activities since they need not worry about losing documents given that they were available anytime and anywhere. Due to these advantages, students stated that they were willing to apply Google document as a learning tool for taking lecture notes for other courses. Furthermore, several students thought that Google Sites was a useful tool for administering large-scale activities or study groups in addition to carrying out team projects.

STUDY LIMITATIONS

The proposed approach in this study was conducted in a computer-aided classroom. One of the limitations was that the approach was not yet possible in traditional classrooms as tablet PCs and smartphones were not

available for every student. However, this issue will be resolved in the future as portable devices become more popular. Another limitation was that many participants had poor understanding of how web applications could support their learning despite being familiar with their use (Ng, 2012). Therefore, course instructors must provide adequate information and instructions for the use of web applications as an educational tool to the students.

CONCLUSIONS AND DISCUSSIONS

This study proposed a web application supported learning environment for classroom teaching and learning activities that could be seamlessly used by instructors and students with Web 2.0 tools they use daily. To evaluate the performance of the proposed approach, an experiment was conducted in an industrial course at a university in Taiwan.

The following paragraphs are detailed descriptions on how this research contributed to classroom teaching and learning, giving novel ideas and expanding upon existing literature. Future use of web application supported learning environment, research limitations, and proposals for further research on the development of web application supported learning environments were provided as well.

Contribution of the web application supported learning environment to teaching and learning

Enhancing learning motivation and participation for individual students during and after class is critical in improving classroom teaching and learning. Poor learning motivation would often confound an instructor's best efforts to teach effectively. Nevertheless, most learning tools and systems were often unattractive to instructors and as they were incompatible with other tools that were used daily. The major contribution of this study was the proposed learning environment supported by well-known web applications. The proposed learning environment provided appropriate learning tools to facilitate student learning motivation and participation. In other words, the objective of this research was to promote student learning motivation and participation during and after class by enhancing the learning environment via the use of familiar web applications. Teaching became more successful as a result of improved motivation and participation.

A web application supported learning environment was implemented in an experiment on a product design course at a Taiwanese university. A series of evaluation processes that included questionnaires and interviews were used. We verified that both instructor and students obtained effective support from the proposed learning environment. Experimental results revealed that students had higher learning motivation and participation as they had access to adequate learning support from the proposed web application supported learning environment during and after class. Although learning motivation and participation are important for students and instructors, they could be difficult for instructors to induce. Instructors often fail to interact with students effectively due to limits on class duration. Therefore, we concluded that the web application supported learning environment was able to effectively assist instructors and students in administering and conducting learning activities during and after class.

Further applications of web application supported learning environment for educators

This study applied the proposed web application supported learning environment to a product design course. The proposed approach could be used by educators in different educational contexts to achieve various pedagogical objectives. Before teaching a specific subject, educators could use the learning environment to interact with students and survey their opinions to improve both teaching and learning experiences. The environment could also be used during instruction to conduct a formative assessment on student learning statuses and identify learning issues. Finally, educators could use the environment to conduct performance assessments after instruction to find out how well the students had acquired relevant knowledge taught during the learning process.

Future work

The well-known web applications applied in this study could be integrated with other learning tools or systems like the learning management system (LMS). Therefore, the future research directions would be to integrate appropriate web applications into the LMS to strengthen the proposed learning environment for other subjects, disciplines, and educational pedagogies. The integration of web applications and LMS would allow instructors and students to obtain comprehensive educational services and use familiar web applications to support their teaching and learning. Therefore, further investigations should analyze student learning effects and develop suitable solutions to support the proposed approach using application program interfaces (API).

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