AC 2010-105: A BLENDED WEB-BASED LEARNING COLLABORATIVE APPROACH FOR A SEDM COURSE IN MANUFACTURING ENGINEERING

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A Blended Web-based Learning Collaborative Approach for a SEDM Course in Manufacturing Engineering

Abstract

This research describes the results and implications of a research into the effectiveness of a blended web-based learning collaborative approach on student's achievement, attitudes towards web-based learning in an SEDM (Sink Electrical Discharge Machining) course. Quantitative and qualitative methodologies are used with participants of this research. Thirty-two students in mechanical engineering, enrolled in an YTIT, represented the study's experiential and control groups. Pre and post-tools are administered to participants in the two groups in a quasi-experimental design. Instruments (including web-based learning system) to measure dependent variables of the research are developed by the authors in light of relevant previous studies.

The results show that students in the experimental group have higher achievement levels in their post-overall-course-test, comprehensive score, and attitudes towards web-based learning environments to measure compared to those of the control group. The specific design of the course may be responsible for these changes. Future implications and suggestions for engineering educational course are presented.

Keywords: Blended web-based learning, SEDM, Imitated interaction, Media in education

Introduction

Technology is not new to education as contemporary computer technologies, such as e-learning, allow new types of teaching and learning experiences to flourish. Research shows that the corporate education market has spent 16% in year 2000 on e-learning initiatives and 24% in year 2001 with expected raise in years to follow [1]. Meanwhile, the global e-learning market is US\$33.6 billion in 2005 [2]. Already the 2007 U.S. e-learning market is \$17.5 billion and the global e-learning market to surpass \$52.6 billion by 2010. While Europe and Asia lag on e-learning adoption compared to the United States (U.S. enterprise e-learning adoption accounts for 60 percent of the market, while Europe's accounts for 15 percent), overall usage of e-learning in Asia is expected to reach a compound annual growth rate of 25 percent to 30 percent through 2010, according to the report. Worldwide that rate should hit between 15 percent and 30 percent [3]. The above expenditure acknowledges the advantages of e-learning experiences. These experiences rely mainly on learner-centered approaches where learners are active and positive as they learn from direct and authentic experiences and instructors' roles change dramatically to facilitators and guides.

In the previous study [4], there are several goals have been achieved by the author: (1) generating a prototype blended SEDM learning architecture to implement the concept; (2) constructing a web-based SEDM practical environment that allows end users to do exercises over the Internet; (3) applying this system in a distance course and creating the evaluating instruments. The purpose of this research, therefore, is to investigate learning effectiveness issue in distance learning environments. Specifically, the present study aimed to achieve this purpose

by examining the relationships among achievement level, collaborative learning, and satisfaction in a blended web-based SEDM learning system.

Theoretical background and literature review

There are important issues reviewed and depicted for blended web-based SEDM learning framework in this section.

Blended learning

Blended learning has been referred to as the "third generation" of distance education systems [5]. The first generation was correspondence education which utilized a one-way instructional delivery method, including mail, radio, and television. The second generation was distance education with single technology, computer-based or web-based learning. The third generation is blended learning, characterized as maximizing the best advantages of face-to-face (F2F) learning and multiple technologies to deliver learning. Generally, blended learning means any combination of learning delivery methods, including most often F2F instruction with asynchronous and/or synchronous computer technologies [6-7]. Furthermore, the term blended learning is used to describe a learning situation that combines several delivery methods with the goal of providing the most efficient and effective instruction experience by such combination [8-10].

From a course design perspective, a blended course can lie anywhere between the continuum anchored at opposite ends by fully F2F and fully online learning environments [11]. Kerres and De Witt [12] proposed a 3C-conceptual framework for blended learning designers. It is to consider the 'content' of learning materials, the 'communication' between learners and instructor and between learners and their peers, and the 'construction' of the learners' sense of place and direction within the activities that denote the learning landscape. For the above reasons, there has been an increasing movement toward blended learning approaches where students can have opportunities for both online and offline interaction with their instructors and classmates [13]. Martyn [14] offered that a successful blended e-learning environment consists of an initial F2F meeting, weekly online assessments and synchronous chat, asynchronous discussions, e-mail, and a final F2F meeting with a proctored final examination. Osguthorpe and Graham [15] suggested a framework that is a particularly useful example in demonstrating the application of a systemic approach in deciding what is blended learning and what are the goals of blending. They identified the three types of mixing in a blended course: (a) learning activities, (b) students, and (c) instructors. They further suggested that blended learning environments vary widely according to the following goals: pedagogical richness, access to knowledge, social interaction, personal agency, cost effectiveness and ease of revision. Assuming such an environment results in students having more control over their learning [16-17]; improves student learning motivation and overall satisfaction [18]; enhance information skills acquisition and student achievement [19] and foster communication and closeness among students and instructors [20].

It appears that blended learning methods are effective in facilitating the process of online collaborative learning [21-23]. Another problem in blended learning is that when several components in a learning environment are not well integrated, this can increase the extraneous or

ineffective cognitive load in learning process. These findings imply that simply turning classroom course into blended formats do not necessarily provide students with more interactive and flexible learning experiences [24].

Collaborative learning

Collaborative learning is a form of learner and learner interaction and it has been considered as an effective instructional method in both traditional and distance learning settings [25]. Johnson and Johnson [26] defined collaborative learning as the pedagogical use of small groups of two or more students who work together to maximize their own and each other's learning. This could be achieved through assigning students to one of the following four types of CL: formal, informal, collaborative base groups, and academic controversy. This helps provide one another with efficient and effective help and assistance. It is also a chance to exchange information or materials, discuss the concepts and strategies being learned, decide how to solve problems, and provide for the necessary support and encouragement.

Regarding the technical dimension of collaborative learning, computer-mediated communication tools have played an important role in facilitating group learning processes among group members who may live in different geographical areas and have different learning styles. Curtis and Lawson [27] have suggested that it is important to provide distance learners with multiple channels, both synchronous and asynchronous, in order to accommodate their preference for different communication styles. In particular, the availability of synchronous communication tools appeared to be critical in the process of collaborative learning [21]. Assigning learners to work on a group project does not necessarily mean that they will work collaboratively. Learners tend to use a task specialization approach where tasks are divided among group members and there are fewer opportunities to develop mutual engagement, knowledge and skill exchange, and interpersonal communication skills [28].

There are three general theoretical perspectives that have guided research on collaboration: cognitive-developmental, behavioural, and social-interdependence [29-30]. Cognitive-developmental perspective is based on the theories Vygotsky [31], which proposes that a learner's cognitive development is highly dependent on social interaction and collaboration with more capable and knowledgeable others. The behavioural learning theory is based on the work of various physiologists that focuses on the impact of group reinforces and rewards on learning assuming that students will work hard on tasks for which they secure a reward of some sort. The social-interdependence-theory views collaboration as resulting from positive interdependence among individuals' goals. Positive interdependence (collaboration) results in promotive interaction, as individuals encourage and support each other's efforts to learn. This can be established through: (1) mutual goals; (2) joint rewards; (3) shared resources; (4) complementary roles; (5) divided tasks; and (6) group identity.

When designed and applied appropriately in distance learning environments, collaborative learning strategies can provide learners with several advantages, such as opportunities to experience multiple perspectives of other distance learners from different backgrounds, and to develop critical thinking skills through the process of judging, valuing, supporting, or opposing different viewpoints [32-33].

Blended web-based learning collaborative approach

Due to the educational benefits of blended web-based learning, stated above, in addition to its economic benefits [7, 34], the predominate assumption that computer-supported learning is based on a single-learner changed to a collaborative-learning based [35-36]. This approach to blending asynchronous and F2F activities with the students working in collaboration during the learning process and pair assignments, as explained in this research. Three types of interaction: instructor, learner and content are integrated.

The first type of interaction is with the instructor who facilitates active learning and F2F interaction providing for a social environment. Nevertheless, instructors design and manage learning sequences and select the appropriate media before interacting with learners. The second type of interaction is with 'content'. This relates to cognitive interaction with the concepts and skills presented in course modules. Learner interaction, which represents the third type, is defined as the ability of learners to perceive themselves as a community that supports positive interdependent. Such interaction can happen throughout the learning process, as they shared resources and when accomplishing collaborative assignments.

This research was carried out in a Taiwan context with participants from the mechanical engineering, enrolled in an YTIT. The purpose of this research is to determine the effectiveness of a blended web-based learning collaborative approach to deliver a SEDM course in comparison to delivering the same course content by the same instructor in the form of F2F lectures.
The SEDM course is a 3-hour class throughout an 18 week term. The course emphasizes the fundamentals and practice skills in SEDM. Topics covered by this course exposed SEDM to a range of essential theories and operations. In addition, the nature, process skills, and programming techniques of SEDM are also covered. As part of the practice, SEDM has access to actual operational experiences through 6-8 week practicum. The course is organized into the following several interrelated units: (1) Concepts; (2) Mechanism description; (3) Machining skills; (4) NC programming techniques.

Methods

The experimental design, participants, instruments and procedure are explained in the following sections.

Experimental design

According to Gall et al. [37], the experimental design utilized for the purpose of the research is a pre/post test control group design. This experimental design does not suffer from potential internal validity problems and only suffers from one source of potential external validity, namely, from a possible interaction between pre-testing and experimental treatments. The main variation is in the method of course delivery. Using this approach allowed to 'control' for differences between the two groups. Post-test changes in the experimental group, this is case, could be attributed to the experimental treatment. This research set out to investigate the possible impact the approach of delivering the SEDM course may have on achievement-level, attitudes toward

web-based learning environments and collaborative by answering the following research questions:

(1) What is the effectiveness of a blended web-based learning collaborative approach on learners' achievement levels in SEDM course?
(2) What is the effectiveness of a blended web-based learning collaborative approach on learners' attitudes towards web-based learning?
(3) What is the effectiveness of a blended web-based learning collaborative approach on learners' attitudes towards collaboration?
(4) What are learners' views on implementing a blended web-based learning collaborative approach?

Participants are students in a 4-year undergraduate program in Taiwan. There are 32 members (two groups, experimental and control group, and 16 students each group) involved in department of mechanical engineering, enrolled in year four.

Instruments

A mixed-method design is used involving both quantitative and qualitative research methodologies in this research [38]. To answer the research questions, several instruments are created by the author: an achievement test, web-based learning attitude scale, collaboration scale, and open questions after course. They represent the dependent variables of the research, while the independent variable is blended web-based learning versus F2F instructional approach. Validity of the instruments is determined by Content-Related Validity. To establish content validity for this research's instruments a panel of professors from the school and experts from the manufacturing industry reviewed each item to ensure constructing an instrument that reflected the domains of interest. Suggestions for modifications on some of the items and scaling are provided by the panel. After carrying out the necessary modifications, the panel report that the instruments are appropriate for this research and that the language is clear.

Two statistical methods are used to determined reliability by means of SPSS. First of all, an internal consistency approach is applied by calculating the value of alpha reliability co-efficient. Results are 0.8524, 0.8212 and 0.8856, respectfully for the three instruments' total scores except the open questions. A coefficient of stability of the instruments is calculated using Spearman rank correlation coefficient formula. Items in the three instruments have positive correlations 0.80, 0.74 and 0.86 respectively, indicating the reliability of these instruments. Finally, the instruments are administered to SEDM course in the original research representing the two groups, experimental and control. Once at the beginning of the SEDM course, taught by the author of this research, as pre-tests and then re-administered at the end of the term as post-tests.

Achievement test

Analysis based on sub-scores gained through pair collaborative assignments during the process and a final course test are taken into consideration to evaluate learners' achievement levels. Pre/post test and the unit exercises for those in the experimental group are taken from the question storage. A variety of formats such as true/false, single choice, multiple choice, and short answer are included that reflect the content and unit objectives. The first three types of questions

required that answers be justified. 85% pass is required for each unit test in order to transfer to the following unit. The final course test is administered for both groups in a paper-and-pencil format.

Web-based learning attitude scale

A web-based learning attitude scale is generated after a literature review on papers related to learning by network and computers in general. The scale is composed of 24 items, where students are asked to check their level of agreement with each item using a five point Likert scale. The web-based learning attitude scale is divided into two sub-scales (attitude toward web-based learning in general and a SEDM course is learned by a web-based learning approach) that are summed together to calculate total scores.

Collaboration scale

Previous scales on collaboration in researches [39-40] assisted the author to develop a 20 item scale. Participants are asked to check their level of agreement with each item using a five point Likert scale. The positive and negative items are alternative distributed in the scale to avoid random selection of responses.

Procedure

The design and development of the blended web-based learning SEDM course, utilized in this research, are built in the light of the ADDIE framework [41]. This instructional model is based on the systematic development of instruction and learning and is composed of several states.

Learners in this research are randomly place, by the instructor of course, in stable collaborative pairs to accomplish tasks in and out official class times to apply and extend their knowledge and skills of SEDM learning. Pairs in the experimental group are given no instructions as to who was to interact with the computer. The decisions and procedures of handling the computer are left to the pairs to make on their own. Due to the nature of the participants, all pairs are homogeneous in terms of gender and there are eight male pairs included in each group.

The physical scene of the two groups varied. The experimental group (E.G.) used the multimedia lab where each pair shared a working place and computer. The control group (C.G.) sat in rows in a traditional lecturing environment. The E.G. had their assignments sent by means of email at pre-set dates and discussions via chat space where the tutor gave the appropriate feedback. The C.G. handed over paper-assignments. For the two groups, the achievement test of each unit is executed in specific week and is graded instantly after the completion of test. In addition, the pre/post course tests are also implemented. The phases and contents are listed in Tab. 1 for implementing this research.

Tab. 1 Phases and contents of the research

Phase	C.G.	E.G.
1	Pre-course test tools	
2	…	Explanation and test on computer skills

	Objectives of course and overview of unit 1 (F2F)	Objectives in blended web-based learning environment, course and overview of unit 1 (F2F)
3	Instruction of unit 1 – 'Concepts of SEDM' in a F2F environment in addition to collaborative assignments handed over to the lecturer with feedback presented in the next lecture	Presentation of unit 1 – 'Concepts of SEDM' in a blended web-based learning environment in addition to collaborative assignments sent by emails and chat region with feedback
	Achievement test of unit 1	
	Answer students' questions in F2F meeting and introduction of unit 2	
4	Instruction of unit 2 – 'Mechanism description' in a F2F environment in addition to collaborative assignments handed over to the lecturer with feedback presented in the next lecture	Presentation of unit 2 –'Mechanism description' in a blended web-based learning environment in addition to collaborative assignments sent by emails and chat region with feedback
	Achievement test of unit 2	
	Answer students' questions in F2F meeting and introduction of unit 3	
5	Instruction of unit 3 – 'Machining skills' in a F2F environment in addition to collaborative assignments handed over to the lecturer with feedback presented in the next lecture	Presentation of unit 3 –'Machining skills' in a blended web-based learning environment in addition to collaborative assignments sent by emails and chat region with feedback
	Achievement test of unit 3	
	Answer students' questions in F2F meeting and introduction of unit 4	
6	Instruction of unit 4 – 'NC programming techniques' in a F2F environment in addition to collaborative assignments handed over to the lecturer with feedback presented in the next lecture	Presentation of unit 4 –'NC programming techniques' in a blended web-based learning environment in addition to collaborative assignments sent by emails and chat region with feedback
	Achievement test of unit 4	
	Answer students' questions in F2F meeting and conclude the course	
7	Post-course test tools	

Experimental results

The information is collected on participants' previous experience with computer (educational and personal), computer ownership and daily hours using computers. Educational experiences are defined by formal use of computers (e.g. training, courses); personal experiences are defined by informal use of computers (e.g. emails, chats and entertainment). There are no statistical differences, by used a Mann–Whitney test, between the two groups ($p > .05$). The participant's background data is shown in Tab. 2. Meanwhile, the results below present answers to the research question of this research.

Tab. 2 Participants' information

Variable	C.G. (*n=16*)	E.G. (*n=16*)
Educational experiences	16 (basic training or course on computer skills)	16 (basic training or course on computer skills)
Personal experiences	16 (yes)	16 (yes)
Ownership	13 (yes) 3 (no)	12 (yes) 4 (no)
Daily hours of computer usage	4 (0-1 hr) 10 (2-4 hrs) 2 (beyond 4 hrs)	6 (0-1 hr) 8 (2-4 hrs) 2 (beyond 4 hrs)

Question 1 - What is the effectiveness of a blended web-based learning collaborative approach on achievement levels in SEDM course?

The achievement levels are based on scores gained from an overall post-course test and sub-scores gained from pair collaborative assignments during the process. Each participant in the pair is awarded the same score to ensure responsibility of the pair to complete their tasks. Sum of the tow grades (overall and pair-work) is termed by 'comprehensive score'. The former represented 60% of the comprehensive score, and the latter represented 40%. The result is listed in Tab. 3. It summarizes a Mann–Whitney analysis that reveals significant differences between the two groups in measuring the effect of a blended web-based learning collaborative approach in SEDM course on post-course test and comprehensive score. As for the collaborative assignments, the result isn't reveal significant difference. Meanwhile, the test analysis between pre and post test on the overall course for those in the E.G. shows a significant difference ($p < .05$). On the contrary, no significant differences are found between pre and post scores in the C.G.

Tab. 3 the results for achievement grades

Topic	U	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2[*](1-tailed Sig.)]
Post-course test	42.60	-1.812	.012	.010[a,**]
Collaborative assignments	85.10	-0.213	.892	.921[a]
Comprehensive score	45.20	-1.620	.014	.014[a, **]

Note: [a] means not corrected for ties.
[**] means <.05

Question 2 - What is the effectiveness of a blended web-based learning collaborative approach on attitudes towards this kind of learning approach?

Tab. 4 shows the results of a Mann–Whitney analysis between the two groups. The three items, attitudes towards blended web-based learning, learning SEDM course via a blended web-based learning, and total scores on the scale, are significant differences between the two groups. Therefore, the E.G. has positive attitudes towards blended web-based learning. This is represented by responses to various statements. The questions that positively related to blended web-based learning in general or learning SEDM course by means of blended web-based learning has a row score of higher than three points. As for the negative questions, they have a score of below three points. In the experimental group, it either deeply agreed (11 members) or agreed (5 members) that they prefer learning this course electronically; 15 positively agreed (10

deeply agreed and 5 agreed) that learning the course is interesting and effective; 9 deeply agreed, 5 agreed and 2 disagreed that they want to participate in a SEDM course only if taught electronically.

Tab. 4 the result for attitude toward blended web-based learning

Scale	U	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]
Blended web-based learning	48.00	-3.010	.050	.049[a,**]
SEDM learning via blended web-based learning	46.10	-3.032	.046	.045[a,**]
Total score on scale	44.05	-3.140	.042	.041[a,**]

Note: [a] means not corrected for ties.
    [**] means <.05

Question 3 - What is the effectiveness of a blended web-based learning collaborative approach on attitudes towards collaboration?

The result of a statistical analysis is listed in Tab. 5 between the two groups. The differences are in favor of the E.G. but does not reach a significant difference. However, there are significant differences ($p < .05$) between pre and post-collaborative scores in both groups (E.G. and C.G.).

Tab. 5 the result for attitude toward collaboration

U	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]
62.00	-1.286	.168	.201[a]

Note: [a] means not corrected for ties.

Question 4 - What are learners' views on implementing a blended web-based learning collaborative approach?

The feedback received with regards to the use of a blended web-based learning collaborative approach to deliver the SDEM course is mainly positive. The learners favor the layout and instruction mode of course (13 members) supporting its reach to other courses (12 members) and suggest the inclusion of an online for off-campus access (8 members). They have been valued most in this experience is the benefit of learning from peers as it helped clear problems and provide for encouragement (14 members). Most learners as they experienced a type of so called learner-centred environment (14 members).

Experimental results

The goal of this research is to determine the effectiveness of a blended web-based learning collaborative approach as a delivery approach to a SEDM course. The blended web-based learning collaborative approach is designed according to the ADDIE instructional design model.

The effectiveness of a blended web-based learning collaborative approach on learners' achievement levels in the SEDM course

Significant differences found in the post course test and comprehensive scores could be due to the affect of the independent variable presented in this research, namely a blended web-based learning collaborative approach that incorporates some aspects. First, the cognitive interaction that happened between learners in the E.G., while in pairs, and the content presented in the SEDM course. Second, pairs are drawn from a cohort familiar with each other for two years. The social context, which occurred through F2F interaction provided for opportunities of social discourse between participants in each pair in a form of peer-instructing. Finally, the process of a blended web-based learning collaborative approach utilized in this research. Pre/post tests and the 85% pre-determined level of transmission from one unit to another appear to have provided for some type of mastery learning of the content. Also, the immediate feedback from the instructor to learner's collaborative assignments that are sent by means of e-mail, chat space may have helped clarify areas of strengths and weaknesses in their learning progress.

The effectiveness of a blended web-based learning collaborative approach on learners' attitudes towards web-based learning

The significant differences are found in the post attitude towards web-based learning scale. The data the E.G. suggest the effectiveness of a blended web-based learning collaborative approach. This is can be mainly due to the positive novel experience the E.G. had in addition to feeling that they are dealing with a coexistent technological aspect. The qualitative data seem to support this statement. Most of learners response that the computer skills are improved, while three learners response that the experience induce the feeling of an 'unusual instructing'. In this research, the author find that learners develop more positive attitudes toward web-based lessons and learning with a computer when they work in collaborative learning groups than when they work individually. As for the negative attitude, it is also found that the usage of computer skills will retard the learning progress and influence the student perceptions for course.

The effectiveness of a blended web-based learning collaborative approach on learners' attitudes towards collaboration

The learners' scores in the collaborative assignments and attitude towards collaboration learning unexpectedly do not reach a significant level between the two groups ($p> .05$). However, significant differences ($p < .05$) are found between pre/post experimental and control collaborative data. This finding implies that collaboration is fostered in both groups with and without computer technology, but by different degrees.

It seems that the pair-collaborative assignments required from learners in both groups affect the final findings. Some aspects of positive interdependence are evident in both groups (e.g. mutual goals and joint rewards). Meanwhile, participants appear to communicate and interact positively together, especially that the interaction is face to face with peers and with the same instructor of the course. This research, however, employs a different process due to the experimental design, characteristics of the participants, and nature of its web-based learning. Besides, significant differences between pre/post experimental data can be attributed to other aspects of positive interdependence. This is the shared resources presented in the working place that may have facilitated peer-interaction while learning the content and resulted in higher though not

significant differences in post collaborative data between the tow groups.

The learners' views on implementing a blended web-based learning collaborative approach

Analysis from participants' answers to end of course open-questions revealed various advantages of a blended web-based learning collaborative approach. Responses are organized with post-experimental group data from the attitude scale towards web-based learning. Learners state that the experience in this research is easy to keep the key tips for learning SEDM course. This correlates with responses to item 14. Moreover, social interdependency is stated as one of the advantages. Responses to item 9 revealed positive attitudes that web-based learning encourages collaboration. Other advantages stated in the follow-up interview are interactivity with a facilitative instructor.

The results can be due to adopting theories of web-based learning that introduces various types of interaction (content, social and instructor). Meanwhile, some of the advantages of web-based learning, e.g. immediate feedback from pre/post tests, instructor feedback to assignments by means of e-mail, chat space, F2F meetings after studying units with peers and the revisit of content material could have positively affected learners' views.

Conclusion

According to the study presented in this research, it not only has significant practical implications for mechanical engineering education in Taiwan, but provides contributions to the current literature related to a blended web-based learning, collaboration and computer-supported collaborative work. There are several characteristics in this research:

(1) It contributes to the growing empirical literature on the effectiveness of contemporary computer technology instruction by providing a direction comparison between blended web-based learning and classroom delivery, represented in the lecturing instruction, via a naturally occurring quasi-experiment. Research and development into this type of learning has focused mainly on the implementation of technological resources. This research directly addresses the comparisons of delivery methods that specifically focus on the role of the adopted instructional design, learners' properties, the process of grouping, F2F interactions (e.g. peer-peer, student-instructor).

(2) This research uses web-based theories and technologies that highlight the various types of interaction (content, social and instructor) that can take place in a blended web-based learning environment. None of three modes of interaction function independently in practice. Meanwhile, the web-based theories are to focus on the learning process, instructional design, and the technology to understand the relative effectiveness of the delivery method.

(3) The result of this research that requests for web-based learning courses need to become more of a reality, particularly in the courses of manufacturing field. Furthermore, the studies are required in the future where various types of interaction can occur in order to develop learners' achievements, attitudes and collaborative necessary for different professional course learning through adaptive designed computer-supported collaborative delivery approaches.

Additionally, this research finds that a blended web-based learning format can be a viable option to increase learner satisfaction. Several considerations, however, should be taken into account

before incorporating blended web-based learning approaches: (1) it is obvious that the blended format is probably not feasible in distance learning contexts where a high percentage of learners work full-time and live in geographically different areas. Utilizing two-way interactive computer technology can be a more effective way to compensate for the lack of face-to-face interaction; (2) instructors and instructional designers should carefully design which course components should be delivered online and in class. Combining classroom and online activities is only a small step in blended web-based learning. Thus, it is important for instructional designers and instructors to carefully design web-based learning course to provide learners with meaningful opportunities for collaboration and social interaction.

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