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Evaluating the learning experience of web-conferenced case-based learning

Peter Nicklen[1], Jennifer L. Keating[1], Stephen Maloney[1]

[1]Monash University, Clayton, Australia

ABSTRACT

Objectives: The objective of this study was to evaluate web-conferenced case-based learning (WCBL) through the student experience across a semester of learning. Also, learning was evaluated via unit examination and compared to the previous year's cohort, which utilized face-to-face case-based learning (F2F-CBL).

Methods: This study took place over the first semester of the third year of a Bachelor of Physiotherapy program at Monash University, Australia in 2014. Having experienced 2 years of weekly F2F-CBL activities since commencing the program, students were transitioning to WCBL for the duration of this study. Primary outcomes included measures of satisfaction, attendance, communication, issues with information technology, and perceived depth of learning, with data collected via a post-unit survey. The secondary outcome was student learning, evaluated with the unit examination results.

Results: 76/78 students completed the post-unit survey (non-participation rate 2.6%). Although 95% of participants reported that WCBL was a valuable addition to the teaching activities of the unit, students reported a range of new challenges and rewards from the transition to small-group WCBL activities. Strong themes emerged encompassing adaptation of communication, increased responsibility for learning, technical difficulties, and learning in a remote environment. Overall, 92% of participants agreed that they were satisfied with WCBL. The unit exam result was comparable for the 2013 (F2F-CBL) and the 2014 (WCBL) cohorts [Mean (standard deviation) 2013 (%) 75.97 (9.56) n = 73; 2014 (%) 76.74 (6.57) n = 78, effect size [95% confidence interval (CI)] = 0.09 (−0.23–0.41)].

Conclusions: Web conferencing may be a suitable medium for students to participate in collaborative CBL activities. Furthermore, study should evaluate the financial implications of implementing WCBL across an entire semester with regard to student and facility costs.

Introduction

Web-based learning (WBL) (WBL encompasses all educational interventions that make use of the internet and can be broadly categorized into tutorials, online discussion groups and virtual patients [1]) provides flexibility in timing and location, and accessibility. It has been proposed that these features might promote student autonomy, facilitate active, self-directed learning, and enhance student knowledge and understanding [2]. Web conferencing provides a platform to present information and share concepts enabled by the functions of typical web conferencing software: real-time communication, shared note taking, and screen sharing [3]. In the university setting, web conferencing is more commonly utilized for faculty meetings than small-group student learning activities. It has been suggested that synchronous distance education is advantageous as it allows for the proposed benefits, while offering an environment similar to the traditional classroom [4]. Web conferencing software has also become increasingly reliable, with versions that are free to the public. Subsequently, its popularity and practical applications in education are increasing.

Contact Peter Nicklen ✉ peter.nicklen@monash.edu ▣ Monash University, Clayton, Australia.

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Potential benefits of web conferencing are not limited to the learner. Benefits for educational institutions include improvements in running costs, a reduction in space requirements, and flexibility with timetabling; however, it is not without its risks. Technical difficulties are commonly reported with web-based programs [3–6]. Resistance from staff and lack of resources to transition and maintain web-based programs are also important considerations. Maloney et al. [7] found that although transitioning cost was high, this was recovered within 5 years of implementation due to the associated reduction in operating costs. It is also important to consider that face-to-face (F2F) activities might enable a sense of community, expose learners to teacher enthusiasm, and positively influence student motivation, which are not possible in a web-based environment.

The value of web conferencing in case-based learning (CBL), (CBL is an educational approach where students work in small collaborative groups to share knowledge and solve a series of problems that are presented in contexts similar to those typical of clinical practice [8]) and its ability to complement the current CBL process [8] or replace it, remains unclear. In CBL, the student is responsible for identifying their knowledge deficits relating to the case, which is a practice thought to develop and manage learning goals and other strategies needed for lifelong learning [9]. CBL typically involves F2F interaction with a focus on self-directed study [10]. In this study, web conferencing was integrated with the previous CBL format and we labeled the resulting education format "web-conferenced case-based learning" (WCBL).

There is a general paucity of research evaluating web conferencing in education, particularly within the health sciences [11]. It has been reported that web conferencing produced equivalent learning outcomes when compared to F2F learning, though this was evaluated through an observational case study [6]. Others have compared web conferencing to asynchronous text-based lectures or discussion boards [12,13]. In regard to web-based CBL, Crawford [8] reviewed six qualitative investigations into web-based CBL and concluded learning that utilizes computers may complement the current CBL learning experience. There were no data reported in the review on the effect on learning outcomes. Data from four randomized controlled studies [14–17] indicate that web-based CBL is comparable to F2F-CBL on learning outcomes; however, none of these studies incorporated web conferencing with real-time student interaction and asynchronous discussion boards.

Based on our recent work [18,19], we concluded that WCBL and F2F-CBL may produce comparable learning outcomes and comparable levels of perceived learning. Technical difficulties, such as imperfect Internet connectivity, and issues with communication were encountered. Valaitis et al. [11], suggested that interruptions in communication may reduce the overall effectiveness of web conferencing and might also reduce student satisfaction [4]. Anecdotally, participants generally have a high level of satisfaction with web-conferenced learning [5,11,12,20]; however, potential technical and communication difficulties, along with an apparent risk of social isolation, can contribute to students' negative preconceptions of WCBL [21].

Student preconceptions of course engagement may be linked to their perception of quality and quantity of learning [20,22]; these preconceptions must be addressed prior to implementing web-based programs. Valaitis et al. [11], also suggested that learners must adapt to an online environment in order to be engaged in meaningful discussions. In this study, we designed the implementation and training process to meet the needs of the students, as identified through this previous work. We also aimed to evaluate WCBL across a semester of learning in order to account for the learner adaption.

Aims

Primary aim

The primary aim of this study was to evaluate WCBL through student experience across a semester of learning.

Secondary aims

The secondary aim was to compare unit examination results for the semester that included WCBL to the previous year's cohort, which did not include WCBL (F2F).

Methods

Design

This study utilized a mixed methods design to evaluate students' experiences with WCBL. It took place over the first semester of the third year of a Bachelor of Physiotherapy at Monash University, Australia. All 20 F2F-CBL activities across the semester were replaced with WCBL. Ethical approval for the study

was obtained through the Monash University Human Research Ethics Committee (Ethics CF14/307—2014000115).

Context

This first semester of the third year of the Bachelor of Physiotherapy is the final campus-based unit prior to clinical placements. It is made up of a 10-week teaching calendar and incorporates a range of learning activities including campus-based lectures, F2F-CBL, practical sessions, and F2F tutorials. The unit structure and teaching methods were familiar to students, as they are common to all previously experienced units.

Intervention

In 2014, WCBL was implemented. CBL activities were previously completed on campus, in groups of 4–6. Changes were only made to the mode (e.g., web-based versus F2F) and space (e.g., students were not restricted to on-campus participation) of the WCBL learning activities. This reduced the number of days completed on campus from 5 days per week to 3 days per week, as the WCBL activities enabled students to work off campus for the 2 days of the week when F2F-CBL had previously been scheduled. The learning objectives and assessment tasks for the unit were unchanged.

Students were introduced to WCBL over three training modules (see online supplement for an outline of each module). The first CBL session was then completed on campus, giving students the opportunity to log on and operate the web conferencing software with immediate technical support. All subsequent WCBL sessions were conducted remotely. Google Hangouts was the web conferencing software used; however, only the features of the program generic to other web conferencing programs were utilized to counter the potential impact of software brand and facilitate generalizability of study findings (see online supplement for key features of the web conferencing software). One academic facilitator was responsible for monitoring all groups' online chat rooms. Students supplied their own computers, microphones, and video cameras.

Participants

The entire third year cohort ($n = 78$) was invited to participate. Students were assigned to one of the 18 WCBL groups. This cohort had experienced four semesters of weekly F2F-CBL prior to transitioning to WCBL. This allowed them to compare the experience of WCBL and F2F-CBL formats. To meet unit requirements, students had to complete all learning activities and assessment tasks associated with the unit. At the completion of the semester, consenting participants completed a survey evaluating WCBL. Participation in data collection was voluntary. Unit examination results were compared to those for the third-year cohort ($n = 73$) in the previous year. Students who chose not to consent to the study were not required to complete the surveys relating to this study. An independent research assistant recruited participants through F2F invitation and distribution of an information package, which included an explanatory statement.

Outcomes

Data were collected on perceived learning, attendance, process/information technology (IT), collaboration/communication, and satisfaction, as these issues had emerged as relevant to students in our previous work and the work of others [18,19]. These data were collected using a post-unit survey and included open-ended questions, yes/no/ sometimes questions and five-point Likert scales, with comparison to historical control for some data (Tables 1 and 2).

The secondary outcome was student learning, evaluated with unit examination results, which were compared to those for the previous year cohort. This enabled the comparison of WCBL and F2F-CBL in regards to learning. All outcomes were distributed and collected by an independent research assistant.

Data analysis

Primary outcomes

Yes/no/sometimes questions and Likert scales were tallied and reported using descriptive statistics. In response to anecdotal feedback concerning the difficulties in transitioning to WCBL, informing the design of the post-unit survey, a thematic approach was selected for the open-ended responses. This involved classifying and grouping segments of text to create and define themes in the data [23]. Data analysis was conducted until a saturation of themes was achieved. Two independent researchers completed this process. Once identified, both researchers came together to reach a consensus on the final themes to each response. Themes were then summarized with supporting quotes along with overall response rate. The number of repeated responses was reported for key statements to highlight the weighting within the corresponding theme.

Table 1. Yes/no/sometimes responses.

	Yes	No	Sometimes
Perceived learning			
Did the WCBL format impact on the attainment of learning objectives?	16/65 (25%)	39/65 (60%)	10/65 (15%)
Did the WCBL impact on the depth of exploration of learning objective?	23/71 (32%)	36/71 (51%)	12/71 (17%)
Attendance			
Did the WCBL format allow you to attend/participate when you would have otherwise have been absent if it had been campus-based (i.e., due to illness or other unforeseen circumstances)?	54/72 (75%)	18/72 (25%)	-
If so, how many times was this the case?		1 = 10; 2 = 20; 3 = 11; 4 = 5	
Process/IT			
Was your preparation/training adequate to participate in a WCBL?	75/76 (99%)	1/76 (1%)	-
Could you effectively engage in the WCBL? Why/Why not?	64/75 (85%)	2/75 (3%)	9/75 (12%)
Were you able to reliably and to consistently partake in WCBL? Why/Why not?	68/75 (91%)	0/75 (0%)	7/75 (9%)
Did you routinely complete your CBL at home? If not, why not?	69/76 (91%)	5/76 (6%)	2/76 (3%)
Collaboration/Communication			
Did you have to change your communication style to accommodate for this medium? If yes, how?	37/68 (54%)	28/68 (41%)	3/68 (4%)

Table 2. Likert scale responses.

	1	2	3	4	5
Collaboration/Communication					
I was able to effectively communicate in the WCBL	0 (0%)	2 (3%)	9 (12%)	36 (50%)	25 (35%)
Satisfaction					
I was satisfied with the WCBL experience	0 (0%)	1 (1%)	5 (7%)	45 (59%)	25 (33%)
The negatives of the WCBL outweigh the positives	26 (35%)	29 (39%)	4 (5%)	13 (17%)	3 (4%)
WCBL is a valuable addition to the teaching activities of the unit	0 (0%)	1 (1%)	3 (4%)	47 (63%)	24 (32%)
WCBL provides a valuable learning experience	0 (0%)	0 (0%)	13 (17%)	44 (59%)	18 (24%)

Key: 1 = strongly disagree—5 = strongly agree

Secondary outcome

Unit examination results for 2013 and 2014 were compared using independent t-tests with alpha set at 0.05. Differences between cohorts were expressed using the standardized effect size and 95% CI.

Results

Participants

Of the 78 eligible students, 76 accepted the invitation to participate in data collection by completing the post-unit survey (non-participation rate 2.6%). All students in the 2013 ($n = 73$) and 2014 ($n = 78$) cohorts completed the unit examination.

Primary outcomes

Likert and yes/no/sometimes responses

Responses to yes/no/sometimes questions and Likert scales are summarized in Tables 1 and 2. Responses to open-ended questions are summarized under their respective domain heading.

Open-ended responses

Perceived learning

Did the WCBL format impact on the attainment of learning objectives?
   (48 responses)
   A large variation was reported with regard to the impact WCBL had on attaining learning objectives with some ($n = 7$) reporting a positive impact, some

(n = 11) reporting no difference to F2F, and others (n = 3) reporting a negative impact. It was suggested that the positive impact was due to increased efficiency, ease of use, and improved learning in the home environment. Students felt that WCBL relied more on self-directed learning compared to F2F, which meant that students had a greater responsibility to achieve learning objectives—"I felt as long as you participated it was just as good as being in person." Participants commented that they were more likely to skip over things in the online environment due to this decreased supervision, and that they felt there were fewer opportunities to seek guidance when needed—"I just feel, on campus, supervised. It was harder to skip ahead and we were forced to do it properly." Others reported this was not an issue—"I think we were prepared enough from previous semesters to achieve learning objectives with less tutor guidance."

Did the WCBL impact on the depth of exploration of learning objectives?

(45 responses)

Although some participants reported that depth of learning improved (n = 9) or was unchanged (n = 6), a larger body of students felt that depth of learning decreased when compared to F2F-CBL (n = 26). Proposed explanations for this were a decrease in tutor input compared to previous units—"less tutor prompting may have had a negative influence on our depth," students trying to finish the CBL quickly, and a computer lag affecting communication. In cases where participants felt that WCBL improved learning, proposed explanations were a greater ease in discussion and increased emphasis on self-directed learning.

Process/information technology

Could you effectively engage in the WCBL learning process? Why/why not?

(63 responses)

Some participants (n = 8) found that communication issues negatively impacted on engagement due to issues with sound, difficulty in concentrating at home, the ability to withdraw in the web-based environment, and online etiquette—"It was harder to gauge when people were about to speak." A large number of students (n = 17) reported connection, hardware or software issues, which meant they could not effectively engage in the learning process. In contrast to this, other students (n = 23) found that transitioning to the web-based environment

did not affect engagement. These participants proposed that this was because they had adequate Internet connection or hardware, with others suggesting WCBL was "no different to normal (F2F-CBL)" and that they were "already well-practiced in conducting CBLs, so moving online wasn't difficult." Students (n = 10) commented on the online environment, suggesting that it allowed everyone to "work together" and "communicate with the group." Others reported that the smaller groups "allowed for greater participation individually" and that they were "less anxious to contribute."

Were you able to reliably and to consistently partake in WCBL? Why/why not?

(61 responses)

A significant number of participants (n = 19) reported issues with Internet connection and the web conferencing software, which meant they could not reliably and consistently partake in WCBL—"Technical difficulties meant I couldn't effectively engage." In contrast to this, other participants (n = 21) reported that adequate Internet connection and hardware enabled them to reliably and to consistently partake—"There weren't any technical difficulties that made it any more difficult than regular CBL.". Students also recognized the time and location flexibility that WCBL allowed as it meant that WCBL could be completed from home, reducing the need to travel.

Did you routinely complete your CBL at home? If not, where did you complete CBL and why?

(42 responses)

Generally, WCBL was completed from home (n = 22). Participants proposed this was possible due to adequate Internet connection, an increased ability to concentrate, or convenience—"It was the most comfortable and convenient situation." Others (n = 8) were unable to complete WCBL from home due to poor Internet connection or a decreased ability to concentrate at home.

Collaboration/communication

From a social perspective, how did WCBL contrast to a campus-based CBL experience?

(76 responses)

From a social perspective, some students (n = 9) reported that WCBL was no different to F2F. A large number of participants (n = 52) reported that it differed. Some students (n = 3) felt that WCBL was "still social" in comparison, with others (n = 9) reporting that WCBL reduced irrelevant conversation, meaning it was more time effective. In contrast,

other participants (*n* = 20) felt that WCBL was more socially isolating compared to F2F-CBL—"It lacks a bit of social interaction as the cohort isn't together in a large group room"—and was less interactive initially—"Sometimes it was harder to interact with people but you got used to it and adapted pretty quickly." Participants (*n* = 11) also reported that WCBL allowed students to be less focused and participate less in discussions compared to F2F-CBL.

Did you have to change your communication style to accommodate for this medium?

If yes, how?

(58 responses)

A large number of participants (*n* = 43) reported that their communication style had to change to accommodate for the web-based environment, with few (*n* = 6) finding they did not need to. Participants reported that they needed to speak slower, louder, and more succinctly, while reducing irrelevant conversation and ensuring pauses were left between sentences. Others found they needed to repeat themselves often and consciously take turns in speaking, as they could not rely on physical cues—"You just have to be more clear in description as there is less ability to use body language to express." Connectivity issues also caused a lag, which made it difficult to determine when to speak—"Learning how to not talk over each other with being there in person."

Secondary outcome—unit examination

The unit examination results for 2013 (F2F-CBL) and 2014 (WCBL) cohorts were comparable (Table 3).

Discussion

This research evaluated the student learning experience of WCBL. Generally, participants were satisfied with WCBL, with 95% reporting that WCBL was a valuable addition to the teaching activities of the unit. Participants also reported that training was adequate, allowing learners to effectively engage in the learning platform. This was supported by student learning outcomes, which were comparable between the 2013 (F2F-CBL) and the 2014 (WCBL) cohorts. There is conflict in the results, as a number of participants reported a decrease in perceived learning and depth of discussion, with 25% of participants responding "yes" to the question "Did the WCBL format impact on the attainment of learning objectives?". Issues with connectivity and communication were also recognized.

The majority of participants who perceived a decrease in learning attributed this to a perceived decrease in tutor input, relative to F2F. Participants suggested this decreased concentration levels. It has been suggested that students may be less motivated when the instructor is not physically there [4]. Participants also commented that they were more likely to skip over information. These factors may have contributed to the decrease in depth of discussion. Given Bolliger [24] suggests that instructor variable is the most important influential factor of student satisfaction in online learning, this perceived decrease in tutor input is an important one to address. Improving this perceived decrease in tutor input could be overcome by increasing access to tutors or by introducing hurdle requirements that encourage the learner to slow down, reducing the ability to skip over information and enhancing the focus on self-directed learning. Participants in our study did recognize that WCBL increased the emphasis on self-directed learning, which is a key goal of CBL [10]. While many students reported technical difficulties, only one participant linked this to their perceived decrease in learning.

Technical difficulties with hardware, software, and Internet connectivity were reported by the participants. Such connectivity issues have been reported in other studies [3–6]. Video and sound interruptions have been reported to impede communication [3,4], which might potentially reduce participant engagement and student satisfaction [24]. Karal et al. [4] highlighted that issues with video and sound became less common as students became more experienced with web conferencing, while participants in our study recognized that sufficient Internet connection and hardware were key enablers in completing WCBL remotely. We anticipate that with ongoing evolution of hardware, software, and Internet delivery options, issues with connectivity are likely to diminish. Participants in our study also suggested that communication

Table 3. Secondary outcome—unit examination.

	2013 (*n* = 73)	2014 (*n* = 78)	Effect size (CI)	*P*-value
Unit examination [mean (SD) (%)]	75.97 (9.56)	76.74 (6.57)	0.09 (−0.23–0.41)	0.56

SD = standard deviation

issues that arose might have been due to the change in mode and subsequent difficulties with online discussion etiquette.

Over half (54%) of the participants reported that they had to change their communication style to accommodate for the web-based environment. This included both individual changes: e.g., speaking slower and louder; and group changes: e.g., taking turns to speak. There was no suggestion as to how long students took to adapt to the online environment. Participants recognized that they could not rely on physical cues in the web-based environment, which also impeded communication. Bower [3] suggests that many of the problems that occur in web-conferencing environments are due to not understanding the views of others. Participants in our study also noted the social isolation associated with WCBL. Ensuring participants are adequately prepared to adapt to the web-based environment is key to overcoming such communication and social isolation issues. In contrast to this, participants in our study reported that the online environment enhanced discussion as the smaller group sizes allowed greater individual participation, irrelevant conversation was reduced, time efficiency increased, and having no competing distractions or background noise from other groups enhanced individual group communication. This increase in efficiency may contribute to the perceived decrease in the depth of discussion.

One of the key benefits of WBL is the flexibility it provides. Participants reported that WCBL allowed them to participate in learning when they otherwise would not have been able to due to distance or location. This was also reported in two other studies [11,12]. Ellingson et al. [5] reported that distance education students appreciated a mixed "hybrid" format of learning (combining distance and campus-based students), as it allowed them to connect with the campus community. Participants in our study recognized that this flexibility allowed them to complete the CBL from home, eliminating travel time and costs. Maloney et al. [7], suggested that cost effectiveness should be measured alongside measures of learning outcomes and learning experiences in refining new education approaches. Participants also reported that they were much more comfortable completing CBL from home, as this reduced anxiety associated with contributing to a F2F discussion. This is a common finding in other studies [6,11].

This study contains a number of limitations that may influence the strength of the findings. All qualitative and quantitative data used to evaluate WCBL were taken from the 2014 cohort, except student learning outcomes, which compared the 2014 and 2013 cohorts. This may potentially affect the validity of the student learning outcome; however, given the high level of consistency in teaching methods, we feel this is a fair comparison. We also recognize that a large number of factors might influence examination results. To counteract this, we ensured the learning objectives of the unit at the past and present time points remained unchanged, and all assessment tasks and formats were retained during the study period. The chosen cohort also had 2 years of previous F2F-CBL experience, so it is possible that a cohort with less CBL experience may produce a different result. It is also possible that an element of novelty influenced students' perception of WCBL; further research is required to explore this. It would also be of interest to explore learner response to WCBL in a cohort that has no experience with F2F-CBL and explore whether or not a poor perceived depth of learning was reported.

The findings in the context of this study indicate that web conferencing may be a suitable medium for students to participate in CBL. Overall, WCBL might provide a more consistently rewarding learning platform compared to F2F-CBL. There are still some challenges associated with remote learning, which were recognized by students with regard to perceived learning and depth of discussion. This highlights the importance of training and remote technical support when implementing WBL, to reduce connectivity issues and provide necessary skills for learners to adapt to the web-based environment. The flexibility and accessibility provided by WCBL allows students to partake when they otherwise would not be able to due to distance or location barriers. This might create potential opportunities in remote learning courses. Furthermore, research should evaluate the financial implications of implementing WCBL across an entire semester with regard to student and facility costs.

Key recommendations for implementing web-conferenced learning:

- Ensure students have adequate lead time to source the required hardware, i.e., computer, microphone, and webcam.
- Consider timing/scheduling of WCBL activities to ensure students capitalize on the potential flexibility provided by WCBL; e.g., do not schedule the activity on the same day as F2F classes.

- Provide training to both staff and students. It is important that this includes troubleshooting and suggestions on communication etiquette in the online environment in addition to navigating the software and setup.
- Utilize peer-to-peer support during training; i.e., schedule the CBL group to meet F2F prior to their remote learning sessions, in preparation for carrying on the relationship online.
- Provide access to remote IT support.

Conflict of Interest

There is no actual or potential conflict of interest that could inappropriately influence, or be perceived to influence, this work.

Ethical approval

Ethics approval for the study was obtained through the Monash University Human Research Ethics Committee (MUHREC) (Ethics CF14/307—2014000115). This work was carried out in accordance with the Declaration of Helsinki, including, but not limited to there being no potential harm to participants, the anonymity of participants is guaranteed, and the informed consent of participants was obtained.

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Online Supplement

Methods

Outline of training modules

The first module was a video sent to students prior to the commencement of the semester. The video described WCBL and outlined student resources required for participation, i.e., access to a computer with webcam and microphone. The second module was a lecture, which took place in the first week of semester. The lecture demonstrated how to navigate the web conferencing software, how to log on, and how to use other features of the program. The third module was considered the first CBL session for the semester. This module was conducted on campus, giving students the opportunity to log on and operate the web conferencing software with immediate technical support.

Key features of the web conferencing software

The web conferencing software allowed students to interact via webcam and microphone as well as access, and work collaboratively on, a shared document. This shared document saved automatically and could be viewed by students at any time during or after the WCBL. Students were also able to upload documents and share their screen with other group members, allowing students to present research findings to the group.