

A case study of short-term exposure to hybrid learning

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Abstract: In this study, we: 1) investigated whether short-term use of online/off-campus learning modules would help instructors and students engage in teaching and learning if class schedules were abruptly switched to online; 2) suggested design improvements for short-term hybrid intervention. We assumed that the supportive features of hybrid learning would benefit students with low motivation and negative feelings prior to short-term online intervention. We used a mixed-methods approach, gathering data from two typical on-campus undergraduate classes. The results show that student emotions significantly differed before and after the short-term online intervention. These findings aligned with comments made by the students. The instructors reported positive effects of the online pedagogy due to the affordances of network technologies. Participant reflections suggested four design improvements: clear goals, cohesive alignment, clear guidance and feedback, and technologies with which students are familiar.

Keywords: hybrid learning; online learning; motivation; academic emotions; case study; higher education.

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1 Introduction

In 2017, hundreds of California schools shut down for a week due to raging wildfires (Strauss, 2017). In addition, flooding in Houston from Hurricane Harvey and abnormal snowstorms in Atlanta disrupted college classes for an entire week (Davis, 2017; Roll, 2017). On a more regular basis, professors cancel a week of class due to conference-related travel. Ensuring course continuity during schedule disruption is both critical and challenging for higher education institutions. The cost of cancelled classes is two-fold. Students lose instruction time, and their knowledge decays when they are not engaged in the content, similar to the learning losses and lack of focus that occur during semester breaks (Clauss-Ehlers, 2010). We developed this case study based on a project conducted at a university in Los Angeles that helped faculty continue their work with students in the event that classes were disrupted by emergencies.

Given the pervasive use of network technologies, the deployment of online learning enhanced with communication technology might be a feasible substitute for traditional meetings, enabling instructors and students to work together while campus is closed. The use of online modules in conjunction with face-to-face classes creates a hybrid learning environment. In the current study, we:

- a investigated whether short-term use of online/off-campus learning modules (i.e., two weeks or fewer) might help instructors and students engage in teaching and learning if class schedules were abruptly switched to online
- b suggested design improvements for short-term online intervention.

We examined student perceptions of motivational and emotional engagement during a short-term online learning intervention and instructor perceptions of hybrid pedagogy. We predicted that online learning and technology-mediated communication would fill the gap caused by campus closures and promote positive teaching and learning experiences.

Courses that mix face-to-face and online learning have evolved, allowing integration of new technologies and various learning modes with face-to-face courses (Moskal et al., 2013). Graham (2006) defined blended learning as a combination of two different types of instruction found in traditional face-to-face and network-based learning. We built on this simple and clear definition to provide instructors some flexibility in how to integrate short-term online learning experiences into their face-to-face courses. As required in the design of blended learning, the instructors deliberately planned online activities to continue course work in case of schedule disruption. However, we used the term ‘hybrid’ to distinguish short-term intervention from typical ‘blended’ learning. In this study, we operationalised hybrid learning as short-term online activities to replace face-to-face meetings that would otherwise be lost.

We introduced hybrid learning designs in two undergraduate courses (i.e., neurobiology of aging and pharmaceuticals) and investigated whether short-term online learning in a regular face-to-face course might help the participants continue their work and remain sufficiently engaged. We proposed two research questions:

- RQ1 To what extent do the students experience changes in motivation and emotion during the short-term online intervention?
- RQ2 How do the participants perceive their affective experience during the short-term online intervention?

2 Conceptual framework

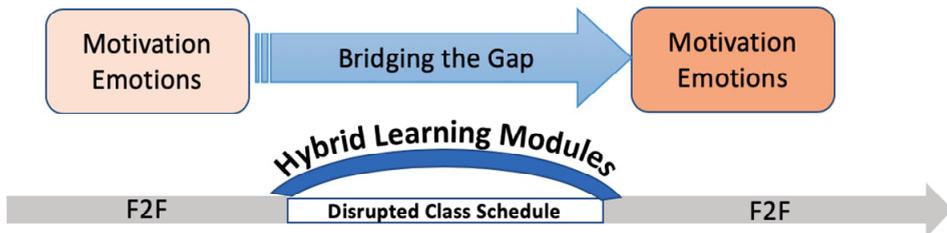
2.1 Hybrid learning

Hybrid learning can be an effective learning model for higher education institutions (Dziuban et al., 2006; Vaughan et al., 2013). Previous findings suggest that college students enjoy mixed instruction (Garrison and Kanuka, 2004; Moskal et al., 2013), willingly engage in online learning experiences (Alonso et al., 2011), and perform better in blended learning courses than fully face-to-face courses (Bernard et al., 2014). While findings from a large body of research support blended learning, most are based on long-term, full-semester courses, retrospective reflections on prior coursework experiences, or extremely short-term interventions (30–90 minutes) in either online or computer-based learning environments (Chaffar et al., 2009; Lehman et al., 2012). We found no case of short-term hybrid intervention in which scholars examined student motivation and emotion during online work to replace face-to-face learning.

2.2 Motivation and emotion

As Figure 1 depicts, we assumed that short-term online modules could create dynamic learning experiences that would retain student motivation and positive emotion during a gap in face-to-face classroom meetings. According to Pekrun (2006), students consciously or unconsciously evaluate their learning experience and learning progression. Such cognitive appraisals influence motivational belief [e.g., self-efficacy (Bandura, 1997) and task value (Eccles et al., 2005)] and feelings in the context of a particular learning situation [i.e., academic emotions (Linnenbrink-Garcia and Pekrun (2011))].

Figure 1 Conceptual framework (see online version for colours)



We examined student motivation changes during short-term online intervention. Motivation energises learners to engage in learning activities (Greene, 2015). Levels of motivation directly relate to the effort that student exert when completing online tasks (Kim et al., 2014). In studies about affective domains in online or blended learning, scholars have reported that students had greater interest in and enjoyed the features of online learning environments more than the face-to-face sessions (Martinez-Caro and Campuzano-Bolarin, 2011; Sansone et al., 2012).

Task value and self-efficacy are crucial factors in online learner motivation (Kim et al., 2014; Noteborn et al., 2012; Roblyer et al., 2008). For example, self-efficacy was highly associated with learner interaction in an online learning community (Shea and

Bidjerano, 2010; Xu et al., 2013). Collaborative online learning environments allow students to explore multiple perspectives, learn from vicarious experiences, and reflect on their progression, in turn influencing motivation regulation (Çakır et al., 2009; Stahl et al., 2006). Motivation level is positively correlated to student success in an online course (Agudo-Peregrina et al., 2014; Brooks et al., 2015).

Previous findings about emotions in online learning often refer to achievement-related emotions such as enjoyment, hope, pride, anger, frustration, shame, anxiety and boredom (Pekrun, 2006). Interactive and collaborative online activities fostered positive student emotions (Schutz et al., 2006). In contrast, technological barriers and a lack of interpersonal interaction in online learning have led to feelings of anxiety, frustration and boredom (Kim et al., 2014; Zembylas, 2008). At the same time, “negative achievement emotions do not always produce negative effects on academic learning and achievement” [Pekrun, (2006), p.327]. The effects of emotions can be complex, diverse, and mixed. For example, negative student emotions (i.e., frustration and anxiety) paired with high task value might not negatively affect online learning under certain circumstances (Marchand and Gutierrez, 2012; Tempelaar et al., 2012). We predicted that students with low motivation and negative emotions could benefit from hybrid learning due to increased autonomy, flexibility, and connectivity inherent in online learning environments (Ashton and Elliott, 2007; Bruning and Horn, 2000; Ravid et al., 2008).

3 Methods

For this hybrid learning case study, we collected mixed data from two undergraduate-level courses to determine overall changes in student motivation and emotion during short-term online activities and to describe how the participants (i.e., students and instructors) perceived the benefits and drawbacks of online learning intervention (Creswell, 2013; Greene, 2007). Multiple data sources helped increase the reliability and validity of our interpretations (Stake, 1978; Yin, 1984). We analysed quantitative data to describe changes in student motivation and emotion and coded qualitative data for contextual information and suggestions for design improvement (Creswell and Plano Clark, 2007).

3.1 Participants

Participants included two instructors and the students enrolled in the two courses:

- a neurobiology of aging
- b pharmaceuticals.

The instructors submitted their course materials (i.e., syllabi and plans for online weeks) and final reflections. We administered student surveys before and after the online learning week(s). The number of students was 59 and 184 for neurobiology of aging and pharmaceuticals, respectively. Thirteen students from each course responded to both surveys, 22% and 7% response rate, respectively ($N = 26$).

3.2 Case description: short-term online intervention

The project, conducted at a university in Los Angeles, piloted online assignments as a temporary replacement for face-to-face teaching in the event of campus closure. The overarching goal of the project was to encourage faculty to create at least one week of online activities and to help faculty and students adapt to online learning strategies and technologies. The participating instructors planned which week of face-to-face instruction would be replaced or augmented by online assignments and notified students as early as possible during the week of online work, but not before.

Table 1 Summary of the activities during online weeks

<i>Course</i>		<i>Hybrid learning activities</i>
Neurobiology of aging	Assignment	Stress experienced in the university community during crisis.
	Duration	Weeks 3–4; technology used: Twitter, Blackboard, smartphones.
	Description	During the online weeks, student teams ventured out to monitor the wellbeing of neighbours living in local assisted living facilities and documented their experience using Twitter.
	Goals	Apply the content to the real-life experience of elderly people experiencing the mock stress-inducing crisis. Use social networking disseminates key information during the crisis.
	Benefits	Students applied knowledge about stress as ambassadors to the community and acted as agents to provide emergency information and communication.
Evaluation	Based on the quality of content posted to Twitter to document the response of people found in these assisted living facilities, including text, photos, and videos, for everyone in the course.	
Pharmaceutics	Assignment	Virtual case study discussion.
	Duration	Week 13; technology used: Google Hangouts, Skype, Blackboard
	Description	As part of a three-week case study, student groups met online via a video conference tool and shared ideas using the discussion forum in an LMS during the hypothetical school closing.
	Goals	Understand principles involved in molecular movement across biological barriers and how to evaluate various dosage forms in collaboration with peers in virtual discussion.
	Benefits	Problem-based learning (PBL) assignments can be adapted to online collaboration enhanced by virtual discussions during a crisis situation.
Evaluation	Based on a group score for the case study report and individual participation as evaluated by peers and instructor.	

Neurobiology of aging was a 16-week undergraduate course that covered a broad spectrum of cognitive and neurological examples of aging and age-related diseases of the nervous system. Each week, students read online materials and viewed supplementary multimedia resources via a learning management system. They then participated in

classroom lectures and activities. One or two students were also assigned as assistants during each lecture, helping the instructors convey their ideas to the rest of the class. Near the time of the online work, the course topic was the bio-psycho-social aspects of stress.

As detailed in Table 1, during the online weeks, students first reviewed materials on physiologic stress. Students learned new content using an online module in Blackboard for a team project designed to help community members living in local assisted living facilities. Then, in teams, they ventured out to monitor the wellbeing of neighbours in those facilities. Students documented their experience (including photos and videos) and reported back via Twitter, which was integrated into the LMS, to promote interactive learning.

In pharmaceuticals, the instructor delivered content via classroom lectures. In the first half of the semester, the lectures covered the theory of dosage form design, delivered in parallel with laboratory sessions. The second half of the semester focused on absorption, distribution, metabolism, and excretion properties, culminating in a three-week group activity: a case study examining these properties in common drugs.

For this group activity, students typically worked in small groups during class meetings. During the online week, student team adapted to online discussion. To support virtual discussion, the instructor used software that was easy to install, supported audio and video, permitted uploading and downloading of documents, and featured a whiteboard and desktop sharing. For the online week, the instructor provided materials to teach students the technologies they used. The case study score was 20% of the final grade, including 15% for the report (same score for each member of a group) and 5% for individual scores based on peer review (2.5%) and faculty review (2.5%). Table 1 summarises the assignment titles, activities, duration and technologies used.

3.3 Data collection

3.3.1 Student surveys

We administered student surveys before and after the online intervention to measure student motivation and emotion. For motivation, we adopted the motivated strategies for learning questionnaire (MSLQ), which scholars have used to assess college student motivation orientations for over 20 years (Duncan and McKeachie, 2005; Pintrich et al., 1991). MSLQ contains 26 items across five motivational domains: intrinsic goal orientation (IO), extrinsic goal orientation (EO), task value (TV), control of learning beliefs (CB), and self-efficacy (SE) for learning and performance. Students rated themselves on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The reliability of each domain reported in the literature was fairly robust (alpha: .74–.93) (Artino, 2005).

Scholars have used the achievement emotions questionnaire (AEQ) to assess college achievement emotions such as enjoyment, hope, pride, anger, anxiety, shame, hopelessness and boredom (Pekrun et al., 2011). In the current study, we used enjoyment, anxiety, and shame because they each included items that reference the time before and the time after a learning situation. The overall reliabilities reported in Pekrun et al. (2002) were .78, .84, and .86 for enjoyment, anxiety and shame, respectively. The post-survey

also included open-ended questions such as ‘Tell us your experience about completing the online assignment’, ‘Describe any barriers that you encountered in class or during the online assignment’, and ‘How would you change the assignment to be more valuable to you?’

3.3.2 *Instructor reflection*

After the online learning week(s), the instructors submitted reflections on their experience in response to a self-reflection protocol addressing three major areas:

- a how online learning events were defined by specific instances
- b how the instructors implemented the designed events
- c how their students engaged in the events.

3.4 *Mixed data analysis*

We used the student survey data to describe overall changes in motivation and emotion during the online intervention. To measure differences between the before and after survey results, we used paired-samples *t*-tests. We used the student responses to open-ended questions and the instructor reflections to explain and interpret further their hybrid learning experiences. Focusing on emotional and technological experiences, two independent coders conducted an initial review of the data and developed a code book (see Appendix). The two coders first used randomly selected cases and discussed conflicting views until they reached an agreement. Then, each one coded all of the responses separately and reached a good level of agreement for each category (i.e., at least 0.81).

4 **Results**

4.1 *Significant changes in emotion*

We conducted paired-samples *t*-tests to compare the pre and post-scores for all motivational factors and emotions in each course (see Table 2). We first tested the assumptions required for a paired-samples *t*-test: independent observations and normality. We reasonably assumed that the participating students were independent of one another when responding to the student surveys, which we administered using an online form. We checked normality using the Shapiro-Wilk test. Most variables were normally distributed except for pre-EO, pre-TV, and pre-enjoyment in neurobiology of aging and pre-IO and pre-TV in pharmaceuticals ($p > .05$). None of the variables that violated the normality assumption were related to a significant result.

Motivational factors did not notably change in either class. In contrast, significant changes in emotion emerged. In neurobiology of aging, we found a significant difference in anxiety, $t(12) = -2.19$, $p = 0.049$. In pharmaceuticals, we found a significant differences in anxiety, $t(12) = -3.47$, $p = 0.005$, and shame, $t(12) = 3.03$, $p = 0.010$. Enjoyment increased in both courses, but not significantly. Student anxiety increased, while shame decreased.

Table 2 One-sample *t*-test results

		<i>Neurobiology of aging (n = 13)</i>			<i>Pharmaceutics (n = 13)</i>		
		<i>Pre</i>	<i>Post</i>	<i>t-value</i>	<i>Pre</i>	<i>Post</i>	<i>t-value</i>
Motivation	IO	3.87 (.38)	3.83 (.34)	.28	3.42 (.55)	3.52 (.59)	-.69
	EO	4.21 (.73)	4.15 (.71)	.49	3.65 (.71)	3.60 (.81)	.43
	TV	4.22 (.33)	4.23 (.41)	-.10	3.69 (.45)	3.69 (.67)	.00
	CB	3.94 (.62)	3.88 (.53)	.51	3.65 (.55)	3.75 (.53)	-.63
	SE	3.91 (.63)	3.92 (.48)	-.07	3.31 (.60)	3.42 (.50)	-.76
Emotion	Enjoyment	3.31 (.95)	3.66 (.45)	-1.34	2.62 (1.04)	2.92 (.51)	-1.38
	Anxiety	2.82 (1.17)	3.54 (1.05)	-2.19*	2.71 (.85)	3.69 (.75)	-3.47*
	Shame	3.08 (1.32)	2.46 (.55)	1.61	3.53 (1.13)	2.69 (.62)	3.03*

Note: * $p < .05$.

The quantitative results align with student comments in the qualitative data. Students enjoyed the online component of the course because it gave them more flexibility when working with group members or because it engaged them in new and interesting learning activities that could not be completed in the classroom. One student wrote, “My team and I were able to collaborate easily online so that we did not have to work around our schedules and [could] complete things in our own time.” Another remarked, “We were able to connect/communicate effectively via Twitter while each of the groups went to their respective elder care facilities, something that was a good way to apply what we learned in class.”

Because the online component operated differently than the in-person component, students understandably felt anxiety. Many students explicitly mentioned feeling anxious in their survey responses, most often stating that they were less certain of deadlines and instructor expectations, used unstable technology, and experienced difficulty in online collaboration. One student wrote, “There should have been a few more guidelines as to what we should investigate while on our trip.” A student in pharmaceuticals exhibited anxiety about the case study: “For the assignment was much more difficult or confusing, I would have preferred an in-class discussion. I would prefer the in-class discussion, so the professor can show me how I approach a problem on a paper.”

Unstable network technology was one of the most common causes of anxiety. One student wrote, “The day that the groups were supposed to Skype with the professor was a little hectic, we couldn’t understand the professor, probably a bad connection.” Another student felt anxious about online interaction, “I personally would prefer to meet in person. Some people had trouble accessing the Google Hangout, either because the link wouldn’t work or their internet connection was weak.”

In addition to technological problems, difficulty in coordinating online/off-campus group collaboration likely caused uncomfortable feelings. Student comments included the following: “Coordinating meetup times online was difficult,” “Needing to push people to respond was tough. Meeting in person would have been easier than online communication”, and “The most difficult barrier was finding a time to work together in person with my group.”

In contrast to increasing anxiety, online learning activities helped alleviate feelings of shame. Though no specific results from the qualitative data address feelings of shame, a

few of the students said that they were more comfortable speaking up during online work, suggesting a reduction in shame. One student wrote, "I really enjoyed being able to connect with my fellow classmates and instructors that we usually wouldn't be able to do in any other setting, especially because talking in class makes me nervous."

Pharmaceutics used the online time to conduct peer reviews of student work individually instead of peer feedback during in-person meetings. This setting might have helped reduce shame for the reviewer, who had more time to provide a thoughtful response, and the reviewee, who could view the feedback in a private setting. Contrary to typical autonomous online environments in which students often lack tangible support such as timely scaffolding by an instructor or close interactions with peers, the students built upon existing relationships with peers in the online activities, creating a comfortable online collaboration.

4.2 Participant experiences

During the online learning time in neurobiology of aging, the student groups first completed background training using the LMS and then visited assisted living facilities to interview senior citizens living there. They reported what they did and learned via a Twitter feed that all students and the instructor followed. The students in each group then communicated using an online conferencing tool to develop a multimedia-enhanced report of their experience. The groups shared their reports through the LMS.

The instructor shared positive aspects of the online pedagogy enhanced by selected technologies:

"Twitter gave the students a sense of combined purpose and made it an interesting means for communication. The online curriculum showed students the power of the internet for learning, and using Twitter illustrated how they could all keep in touch. Going to an assisted living facility is an important way of connecting the curriculum on aging to a real live person."

These reflections were mirrored in feedback from students. One student wrote about the benefit of synchronous communication: "Twitter helped keep us updated with what other groups were doing." Another wrote that "I was able to see what the other groups were experiencing at other nursing homes." New affordances of the technologies increased student interest and joy in performing the assignment. One student wrote, "I really [enjoyed] being able to connect with my fellow class mates and instructors that we usually wouldn't be able to do in any other setting. I had a lot of [fun] doing the assignment, and I feel like everything worked very well."

In pharmaceutics, the instructor opted to conduct discussions, which normally happened in-person, through an online medium during the online learning time. The course had one case study assignment, which was performed in groups during the final three weeks. The second week was designated the online week, and discussion sessions took place on Google Hangouts. Students submitted answers for each week of the case study on Blackboard.

The instructor generally found the online discussions effective but had some words of caution (i.e., internet connection and time constraint) for others attempting a similar activity:

“Most students were capable of connecting to Google Hangouts successfully and on time. In each group, there was usually one problem [connection] where the student was repeatedly dropping out of the hangout, video or audio was absent, or they could not connect at all... One aspect of moving discussion sessions online that should not be taken lightly is the [time constraints] of a typical student. Evening hours are difficult and precious. Students prefer to keep classroom requirements to the scheduled hours.”

Students perceived benefits such as flexible asynchronous collaboration (“The Google Doc allowed us to all collaborate without all of us being present in the same area” and “I loved the freedom and the ability to work on my own time”) and focus on tasks (“allowed me to spend more time on the assignment than having to drive to school”). Students seemed to acknowledge the value of the online tasks and to be confident in performing the assignments. One student wrote, “I felt like I didn’t have to contribute much work before the session because it was just online. Everything worked the way it should have. I attended the discussion on time, and we ended on time.”

5 Discussion

In this study, we explored participant experiences in short-term online learning events during the time of a hypothetical school closing. Results show that student feelings of anxiety and shame significantly changed during the short period of online learning. Despite some negative emotions, many participants valued their hybrid learning experiences. Reflections on online teaching and learning also suggested some ways to improve online learning intervention design that might motivate students and sustain positive emotion.

5.1 Motivation and emotion

Student enjoyment increased, but significant changes occurred only in negative emotions: anxiety and shame. Compared to motivation, emotions tend to be more malleable, changeable, and dependent on learning context, likely producing the contradictory relationships (Marchand and Gutierrez, 2012; Tempelaar et al., 2012). The students tended to enjoy the courses during the short-term online learning intervention. Interestingly, the growth in enjoyment, though not significant, was accompanied by a notable increase in anxiety. One interpretation is that anxiety resulted from the novelty of online activities. The students were not informed of the online assignments until the designated time began, in order to simulate a situation such as a sudden campus closing. The new modality of online learning could have made the students feel excited and anxious simultaneously due to uncertainty while working on assignments and technical problems (Zembylas, 2008). This co-occurrence of contrasting feelings is consistent with the theory of inverted-U, which explains that high learner engagement is accompanied by an optimal level of negative emotions (Yerkes and Dodson, 1908). A significant decrease in shame signified positive changes despite increasing anxiety.

5.2 *Design suggestions*

We primarily drew design suggestions for short-term online intervention from the qualitative data. Although we found positive comments from both instructors and students in both classes, several reported technology problems. Unstable internet connections disrupted group collaboration (e.g., “Some people in my group had trouble connecting”) and collaboration tools sometimes malfunctioned (e.g., “There were some issues with group video chatting”), causing some students to feel frustrated (“Unpredictable internet connection [frustrated] me”) and to express their preference for face-to-face sessions (“we met at Starbucks”).

Carefully designed hybrid learning environments should help students manage proper affective states and deeply engage in online learning (Marchand and Gutierrez, 2012). Unexpected school closing and insufficiently prepared online assignments can raise student anxiety and decrease attention to learning. We proposed four general design suggestions for creating meaningful short-term online periods.

5.2.1 *Provide clear goals*

One student indicated the need to be persuaded of the value of the assignments: “Maybe make [the assignment] have more of a purpose, it seemed kind of like thrown in as something the professor and class could check a box that they did.” Apart from their teaching interests, instructors need to develop student appreciation for the tasks they perform during the online intervention (Brophy, 2008). To do so, instructors should emphasise and explain the value of the assignment and the benefits of using online technologies.

5.2.2 *Provide cohesive alignment*

Online assignments should align with in-classroom work. Scholars have warned that the lack of cohesive alignment could make students frustrated and distract them from engaging in online activities (Buerck et al., 2003; Strayer, 2012). Online assignments cohesively tied to in-classroom activities can help students pursue learning goals (Ginns and Ellis, 2007). One student made a similar suggestion: “Maybe if we got to know more about the residents and their personal stories, that would’ve been amazing.”

5.2.3 *Provide clear guidance and feedback*

Some students reported anxious feelings: “The time things were due was unclear, so I didn’t know if I was missing deadlines” and “It was challenging to schedule meetings with team members.” Owston et al. (2013) warned that a lack of guidance and feedback could make low-achievers consider online learning simply free time, as though the class were simply cancelled. A solution to these problems is to provide specific guidance on what the students should do and how they could do it in the suggested online environment (Strayer, 2012). One instructor highlighted the importance of guidance: “The most valuable lessons are fairly basic: plan for technical problems and practice with the technology before an emergency event; don’t overestimate the technical abilities of the students.”

5.2.4 Provide technologies with which students are familiar

Short-term hybrid courses should deploy online learning technologies that are familiar to students. The use of improper technologies can increase negative student feelings, such as anxiety, frustration, and boredom (Zembylas, 2008). In our study, students expressed high anxiety related to the technologies (e.g., “The Google Hangout for me is still a little confusing. I would need someone else to lead the group”). Both instructors shared their success cases: “Skype was essential. Nearly all my students already had active Skype accounts, so implementation was immediate” and “Students preferred to communicate via Facebook, to strategize their team meetings.”

6 Conclusions and limitations

Our findings show that a hybrid learning approach to fill and instruction gap caused by unexpected school closings could help sustain student motivation and help students develop their learning-related emotions. In particular, short-term online modules elicited dynamic student emotions, which could enable students to attend to the work. Given a well-prepared hybrid learning module, students can find positive value in the online pedagogy and exert effort to achieve their learning goals, minimising their negative emotions.

The current exploratory study has some limitations. We used combined student data from two separate classes. The data is insufficient to reflect the domain-specific and pedagogically different contexts of the courses. Due to the relatively small sample size, some variables violated the normality assumption. A larger sample size could provide sufficient variance among students and detect a significant finding for a medium or low effect size. Scholars should secure larger samples in future studies.

Scholars should also consider examining whether affective changes during short-term online intervention influence cognitive effort and learning achievement. Such a study could be further elaborated by investigating different instructional strategies (e.g., individual vs. group activity). Scholars should take advantage of courses with multiple sections and large student enrolment in order to secure control groups and to discover how different online learning modes impact student changes in the cognitive and affective domains.

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Appendix

Coding scheme

<i>Categories</i>	<i>Codes</i>	<i>Example</i>
<i>Student survey</i>		
Emotion	Anxiety: description of events that cause anxiety or feelings of anxiety	“The time things were due was unclear, so I didn’t know if I was missing deadlines.”
	Confusion: expressions of uncertainty or feelings of confusion	“The Blackboard file sharing was confusing for some because there were so many functions.”
	Frustration: description of difficulties or feelings of frustration	“The different groups struggled to get connected to the professor for the Skype session.”
	Satisfaction: description of aspects of the course that students liked	“It was easy to stay connected to my team members.”
	Technology interaction	Collaboration: description of students working with each other, including positive, neutral and negative experiences
	Human-computer interaction issues: description of difficulties using technology or software interfaces	“That system has a terrible, outdated interface, is slow and difficult to navigate, and too heavy – there are too many features that I just don’t use.”
	Scheduling group work: description of scheduling group work, including positive or negative experiences	“Helped with planning a project, made it much easier since our schedules were different and could not meet in person.”
	Technology problems: description of problematic internet connections and technologies	“My internet connection is not very strong in my house so the video would freeze and malfunction during the Google chat which was frustrating.”
<i>Teacher survey</i>		
Lessons learned	Teaching presence: providing clear structure, guidance, feedback, support, etc.	“The most important instructional strategies were to be very clear in describing the project (we provided a written and a video/Powerpoint version of the assignment) and to provide concrete step-by-step goal setting for students (i.e., giving them definite deadlines for task completion steps that built on each other).”
	Other	“To my surprise, some of the students were not that familiar with technology outside of Facebook and Skype.”
Technical problems	General	“Adobe connect did not work well. A big part of the problem was the students were at different places around the campus and city and they were connecting using wireless. We had a number of drops that were disruptive to a flowing conversation.”