Maintaining Student Engagement during an Abrupt Instructional Transition: Lessons Learned from COVID-19

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Because of the COVID-19 pandemic, many colleges and universities announced an abrupt transition to remote learning during the spring 2020 semester. In this report, we discuss the instructional changes that were implemented in an undergraduate microbiology course at a small liberal arts college as a result of this transition. The effectiveness of these curricular changes was assessed using a standard course feedback instrument to understand student attitudes and perceptions. Our results indicate that the switch to a thematic focus enhanced the course and specific instructional changes, including the use of preclass introductory videos and electronic forums, were useful and informative. Based on these findings, we propose that relatively minor changes to instructional strategies may enhance remote learning. Moreover, these same changes could be used to improve in-person classes.

INTRODUCTION

The COVID-19 pandemic forced many higher-education institutions to change their method of instruction for the spring 2020 semester. In March 2020, at least 1,100 colleges and universities across the United States announced the closure of campuses and implemented a widespread shift to remote learning (1). In almost all cases, this transition occurred abruptly. For example, our institution announced a switch to remote learning on March 12, 2020. All in-person classes were suspended until remote instruction began on March 16, 2020. Thus, within a matter of days, faculty members scrambled to redesign their courses to deliver high-quality instruction and create an online learning community.

Understandably, instructors encountered several challenges during this instructional transition. For example, the switch to remote learning exposed many inequalities, such as the digital divide: some students lacked access to the Internet or necessary technology resources. Additionally, many professors struggled to connect with students who were geographically distant and thus required asynchronous instruction due to time zone differences (2). Also, it was challenging for some faculty to replicate certain hands-on experiences, including laboratory activities and experiential learning opportunities. Finally, and perhaps most importantly, many instructors lacked prior experience with online teaching and learning.

Online learning has expanded rapidly in recent years for a number of reasons, including cost, flexibility, and technological advances (3, 4). Generally, these online courses follow a weekly format and require students to engage with course readings, materials, and class discussions. Although course standards and guidelines vary depending on the provider, courses typically are offered asynchronously (4). However, some providers offer synchronous online instruction through the use of webcasting, chat rooms, and audio or video technology (4, 5). Planning, preparing, and developing these courses may take from 6 to 9 months (5).

Studies have shown that well-designed online or hybrid undergraduate biology courses can be as effective as traditional face-to-face courses (6). While most of these studies examined student performance in nonmajors or introductory biology courses (7–9), studies have also reported equivalent online versus face-to-face learning outcomes among students in more advanced biology courses, including microbiology (10–15). However, another study found that students in a hybrid microbiology course performed less well than their counterparts in a face-to-face learning environment (16).

Evaluations of online courses have shown that online learning is most effective when the instructor promotes collaborative and interactive, rather than independent, learning (4). Furthermore, successful online courses emphasize active learning modalities, such as small-group discussions, activities, or hands-on exercises, which may increase student engagement (17). Finally, online courses that include a variety of activities to support the needs of different learners are most effective (18). Indeed, as it became clear that...
many schools would transition to remote learning in response to the COVID-19 pandemic, numerous education experts and journalists suggested that instructors adopt these online teaching best practices (19, 20).

Although online courses can provide an effective method of instruction, the COVID-19 pandemic resulted in the need for "emergency remote teaching" (13, 21). Many instructors simply did not have enough preparation, time, or training to develop well-designed online courses. Consequently, early surveys, essays, and op-ed pieces reported that students became less satisfied with their courses after the switch from in-person to remote instruction. For instance, a study by Niche Partners discovered that only 15% of college and graduate students found online classes as effective as in-person classes (22). Additionally, a survey by Digital Promise found that student course satisfaction significantly declined, as 51% of students felt very satisfied with their courses prior to the pandemic and only 19% reported this same level of satisfaction with their courses after the transition (23). Students primarily claimed that this decreased satisfaction resulted from limited interactions with their peers, as 65% cited fewer opportunities to collaborate with other students on coursework (23). Likewise, another study noted that 78% of higher-education students perceived their online class experience as unengaging, and 75% claimed they missed face-to-face interactions with faculty and other students (24).

Even though early surveys showed substantial decreases in student satisfaction following the transition to remote learning, some reporters did note that the greatest student satisfaction was reported in courses that used at least six of the following practices: live sessions for group discussion and question clarification, real-world examples, meetings in “breakout groups,” dividing course activities into shorter pieces, frequent quizzes, personal messages from instructors addressing course progress and expectations, group projects, and reflective assignments (23). Specifically, it was noted that the “breakout room” function on Zoom encouraged student participation and enhanced feelings of inclusion (25).

In this study, we describe several instructional changes that were implemented in an undergraduate microbiology course during the spring 2020 semester in response to the abrupt switch to remote learning. Briefly, these changes included the use of pre-class introductory videos, electronic forums, and, as required by the institution, synchronous Zoom classes. More notably, the pedagogical changes also included a shift to a thematic focus. We hypothesized that these modifications helped maintain student engagement with the course during the abrupt transition to remote learning. To investigate the value of these interventions, student attitudes about the effectiveness of these changes were assessed. Insights gained from this analysis may help inform future online teaching practices. More importantly, this analysis may lead to the development of more effective in-person courses.

METHODS

Demographics

Davidson College is a private, residential undergraduate institution of approximately 2,000 students. During the spring 2020 semester, a total of 32 students, including sophomores, juniors, and seniors, were enrolled in BIO202: Microbiology. This course typically includes 3 h of in-person lecture and a 3-h laboratory session each week. It satisfies an upper-level laboratory requirement for Biology majors and is a recommended or required course for students interested in attending medical school, veterinary school, or various postgraduate allied health programs.

Instructional changes

When the administration announced that all in-person instruction would end due to the COVID-19 pandemic, several changes were made to the course structure to accommodate the abrupt switch to remote learning. Three main content changes were implemented. First, in accordance with institutional policy, all classes were held synchronously via Zoom during their originally scheduled times. Recordings of live Zoom sessions were provided to all students for asynchronous viewing. Second, an introductory video was posted for students a day or two prior to each class. Generally, these introductory videos provided background information on the daily topics and articles that would be discussed. Third, discussion forums were created and made available to students one to 2 days prior to each class meeting. On these forums, students were invited, though not required, to share their thoughts on assigned readings and respond to the ideas of their peers.

In addition to these changes in content delivery, the content itself was changed. The course was reimagined as a thematic microbiology course, and content for the second half of the semester focused exclusively on SARS-CoV-2 and COVID-19. Topics originally included in the syllabus, such as immunology, pathogenesis, and public health, were retained. However, these topics were addressed through the lens of the current pandemic. Previously assigned readings from the textbook largely were replaced with recent and relevant open access primary journal articles, which were provided to the students via our course management system. These articles then served as a basis for discussions about topics such as virus identification, drug development, and clinical trials.

Assessment

At the end of every semester, students in all courses offered by the institution are asked to complete a standard course feedback instrument. Although the instrument is online, students typically are asked to complete it during a regularly scheduled class period. For the spring 2020 semester, instructors were encouraged to administer the feedback instrument during a synchronous class period, and also provide students a
link to the survey so that they could complete it later. The survey remained open until the beginning of the final exam period. As in past semesters, data from the survey were not made available to instructors until after final grades had been submitted.

To assess student perceptions of curricular changes, the standard feedback instrument for this course was modified to include several questions related to specific interventions implemented when the institution announced that all instruction would transition to a remote format (Table 1). Students were asked to respond to these questions using a Likert-type scale of 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree. Students also were invited to provide opened-ended responses to these same questions. The Davidson College Institutional Review Board approved the use of this information for this study.

RESULTS

Respondents and data collection

Roughly two-thirds of the students (21/32; 65.6%) submitted responses to the course feedback instrument. This response rate was comparable with the campus-wide response rate of 62% for this semester, but substantially below the campus-wide response rate for previous semesters. For comparison, the institution-wide response rate for the fall 2019 semester was 83%. Because the surveys were anonymous, no demographics about the respondents are available.

Thematic focus

A few days before the institution transitioned to remote instruction, students were informed that the course would become a thematic microbiology course, with all material focused on SARS-CoV-2 and COVID-19. When asked at the end of the semester about this switch to a thematic focus, all respondents (21/21; 100%) agreed or strongly agreed (mean: 4.67; standard error of mean [SEM]: 0.105) that the switch enhanced the course (Fig. 1). In open-ended comments, respondents most often noted the relevance of the material (Table 2).

Instructional changes

Three specific instructional changes were implemented in this course. Briefly, short pre-class introductory videos were

![Image](https://via.placeholder.com/150)

FIGURE 1. Student evaluation of the switch to a thematic focus. At the end of the semester, students were asked whether the mid-semester switch to focus almost entirely on SARS-CoV-2 and COVID-19 enhanced the course, using a Likert-type scale (1 = strongly disagree, 5 = strongly agree). Absolute numbers of respondents for each option are shown. Mean = 4.67; SEM = 0.105. SEM = standard error of the mean.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
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<tr>
<td>Number of Respondents</td>
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TABLE 1

Questions used for course feedback survey

- During the 2nd half of the semester, we focused almost entirely on SARS-CoV-2 and COVID-19. This change in focus enhanced the overall course.
- For each class, an introductory video was posted on Dropbox. These videos were useful.
- For each class, a forum was posed on Moodle. These forums were useful.
- Although obviously different from typical in-person classes, discussions during the Zoom classes were informative.
provided to students, electronic forums were made available prior to each class, and synchronous classes were held via Zoom.

A majority of the respondents (17/21; 81%) agreed or strongly agreed (mean: 4.24; SEM: 0.194) that the pre-class introductory videos were useful. Most respondents (19/21; 90.5%) agreed or strongly agreed (mean: 4.26; SEM: 0.146) that the forums were useful. All respondents (21/21; 100%) agreed or strongly agreed (mean: 4.714; SEM: 0.101) that discussions during synchronous online classes were informative (Fig. 2). Open-ended comments about these instructional changes were mostly positive. For each change, respondents noted that it enhanced their ability to understand the material. Respondents noted, too, that the forums and synchronous classes recreated the discussion-based format used previously in this course. However, some respondents also commented that remote learning had limitations (Table 3).

### DISCUSSION

Students overwhelmingly appreciated the switch to a thematic focus. They also reacted very favorably to pre-class introductory videos and electronic forums. These results suggest that the implementation of relatively minor changes can positively affect student engagement in a remote environment. Moreover, we posit that these same changes can have a positive effect when implemented during in-person classes.

In an effort to maintain student engagement and because of the unusual circumstances, a thematic approach was adopted in this course following the shift to remote learning. In contrast to topical teaching, which places an emphasis on subject content, thematic instruction focuses on the application of principles around a central theme, thereby integrating instructional units and demonstrating the relevancy of concepts to events happening outside the classroom (26–28). Thematic courses may be especially effective in online settings because students often report that application activities are engaging (29, 30). Although the benefits of thematic courses have not been extensively studied, research has indicated that thematic instruction can enhance the learning process (26). One study, for example, found that theme-based teaching in undergraduate courses can promote positive student emotions and perceptions toward learning through increased excitement and interest (31). Likewise, another study showed that, after completing a thematic course, students reported an increase in excitement and

### TABLE 2

<table>
<thead>
<tr>
<th>Selected student comments about the switch to a thematic focus</th>
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<tbody>
<tr>
<td>I loved getting to see real-world applications of the material we had learned all semester.</td>
</tr>
<tr>
<td>[I]t...allowed us to see how the concepts we learned in class are applied.</td>
</tr>
<tr>
<td>[I]t...definitely made me a more informed individual.</td>
</tr>
<tr>
<td>I gained a much deeper understanding of the virus as well as public health measures.</td>
</tr>
</tbody>
</table>

| FIGURE 2. Student evaluation of specific instructional changes. At the end of the semester, students were asked whether three specific instructional changes (pre-class introductory videos, pre-class electronic forums, synchronous remote classes) were useful, using a Likert-type scale (1 = strongly disagree, 5 = strongly agree). For each change, mean ± SEM is presented (n = 21). SEM = standard error of mean. |
intellectual curiosity (32). Additionally, students who participate in thematic courses have been shown to feel more comfortable with learning new material (31).

Our results demonstrate that the change to a thematic focus enhanced the student experience, with many respondents citing the applicability and relevance of the material. Based on this finding, we propose that it may be helpful for student engagement and learning to develop courses that include more real-life examples. These thematic elements may help students think creatively and critically about topics (28). Moreover, the switch to a thematic focus does not necessarily require a complete course overhaul. Case studies can be incorporated into an existing course to create a platform for active learning (33). Indeed, previous research has found that students enrolled in classes with case studies as a pedagogical focus reported that these activities made the course more interesting and engaging and helped them learn, think about, and apply concepts (33). Even more limited thematic assignments can help students understand the real-world applicability of topics covered in a course (34).

Finally, thematic courses, case studies, and thematic assignments can be used to integrate social justice issues into traditional biology courses. The addition of social justice issues into the STEM curriculum allows students to explore concepts from a variety of perspectives and viewpoints (35), contextualize material, and enhance their motivation by establishing increased feelings of relatedness (36, 37). Most notably, a thematic approach may increase retention of students from underrepresented groups in STEM courses and encourage underrepresented minorities to pursue STEM pathways (38).

To help foster discussions during the synchronous class sessions, electronic forums and pre-class introductory videos were incorporated into the course. The majority of respondents agreed that these features were useful. This finding may suggest the importance of delivering content through a variety of methods and platforms. It is interesting to note that several students emphasized that the pre-class forums and the Zoom breakout feature used during synchronous remote classes allowed them to see different perspectives. Before the transition to remote learning, students frequently participated in small group discussions. However, group membership generally remained static. In the remote environment, discussion groups were more dynamic. During Zoom classes, for instance, breakout room membership was randomly determined. For the forums, everyone participated. Several students commented on this change, noting that pre-class forums and breakout discussions created opportunities to interact with more of their classmates. This observation may reveal the true value of building an online learning community.

Of course, it is important to acknowledge the difficulties associated with this abrupt switch to emergency remote instruction. Technological limitations prevented some students from fully participating in all class activities. Moreover, the remote learning environment lacked the face-to-face communication that existed during our pre-pandemic, in-person instruction. Indeed, some respondents mentioned the challenges in replicating in-class discussions. Additionally, it is important to acknowledge the limitations of this particular study. Because our instructional interventions were implemented abruptly, we were only able to assess student attitudes about the curricular changes at the end of the semester. A pre- and post-change comparison was not possible. Also, because of the small enrollment in all courses at our institution, the number of respondents is low. However, the impact of emergency remote teaching at a small liberal arts college is of value within the broader discussion.

**CONCLUSION**

Despite the obvious difficulties experienced by many instructors during the emergency switch to remote
learning, our results show that relatively minor instructional interventions helped students remain interested in and engaged with the course material. Perhaps more importantly, our results suggest that similar, simple changes may also be useful in face-to-face learning environments. Short introductory videos helped students prepare better for class. Electronic forums and randomized small group discussions allowed them to engage more deeply with the material and created a broader community of scholars. Most notably, a thematic focus provided them with a contextualized understanding of the content and enhanced their engagement with the material. All of these elements easily can be incorporated into any course and, potentially, improve the student experience.

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REFERENCES


