

# **Student Experience in an Online Maker Course During the COVID-19 Pandemic: A Case Study**

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## **Abstract**

This case study (1) describes how a face-to-face university maker education course employing a novel instructional design was redesigned to accommodate COVID-19 safety guidelines, and (2) presents an exploratory case study of how affordances of online learning were leveraged in the redesign impacted students' experience in the course. Online learning is a timely topic for educators and instructional designers to consider as the world grapples with options for maintaining educational standards during a global pandemic (Rapanta et al., 2020). Specifically, this study examined the following research questions: (1) How did students describe their experience of taking the course during Fall 2020 with the backdrop of COVID-19 and the impact of stressors that accompanied the pandemic? and (2) How did students reflect on their experience with maker-centered learning in an online learning environment versus an in-person environment?

## **Introduction**

In March 2020, the home university of this case closed its doors to students and faculty and moved teaching and learning to an emergency online format due to concerns about the rapid transmission of COVID-19. As the pandemic continued, the university, a large urban institution in the Southeastern United States, physically reopened in Fall 2020 but continued with guidelines to limit the size of groups that met on campus. These guidelines made it necessary for university course designers to quickly develop blended or online courses to meet instructional goals.

The designers of this maker education course faced a unique challenge with this conversion, as the course normally employs a lab-based, novel instructional design based on a mastery orientation and flexibility in which students complete modules largely of their own choice at their own pace both in the classroom laboratory and outside of class (Cohen et al., 2019; Cohen et al., 2020). The redesigned course employed a personalized online format that included whole group synchronous online meetings, individual online conferencing and in-person lab work, and a learning management system (LMS) that provided open access to course materials.

The emergency shift to blended learning because of the COVID-19 outbreak and resulting school closure required the course designers to consider how online affordances could be used to support maker-based education. Decentering the classroom and fostering autonomy among learners is an essential tenet of maker-centered learning (Cohen et al., 2019). Design decisions were made to engender student autonomy and foster personalization, staying away from the typical approach of a teacher-centered classroom that relies heavily on lectures (Barab

et al., 2001). Course designers embedded interactive learning activities and open communication channels within the whole group synchronous online meetings. Giving students a forum for sharing their work is another principle central to maker-based learning and was another key consideration as course designers shifted to an online learning environment (Reigeluth et al., 2017). In this shift to online learning, the course designers were deliberate in maintaining a learner-centered environment incorporating constructionist principles, empowering students to create tangible objects and share the experience of making in a collaborative environment (Cohen et al., 2019).

To understand how this modality shift impacted students' experiences in the course, this study explored the following research questions: (1) How did students describe their experience of taking the course during Fall 2020 with the backdrop of COVID-19 and the impact of stressors that accompanied the pandemic? and (2) How did students reflect on their experience with maker-centered learning in an online learning environment versus an in-person environment?

## Literature Review

During the emergency response to COVID-19, most colleges and universities switched to an online format to continue coursework that began in person. Studies of students have suggested that academic communities experienced a unique constellation of stressors that accompanied both the pandemic and the academic response to the pandemic.

Students were reportedly less satisfied with courses during the COVID-19 emergency response, where most face-to-face courses were moved to an online format. A study of 86 freshman college students who attended classes at an urban university similar to the university discussed in this paper had 63% of their student respondents report that their experience with instruction was worse during the pandemic after the shift to online education (Bono et al. 2020). This survey, which began as a longitudinal investigation and shifted to allow for investigation into COVID-19 related inquiry, included two points of collection, the first collection done in January-March 2020, prior to the COVID-19 pandemic response and the second collection done March-May 2020, after courses went online because of COVID-19. Another survey of a random national sample of 1008 undergraduate college students developed by Digital Promise and Langer Research Associates indicated that 51 percent of students were very satisfied with their face-to-face courses, but only 19 percent of those students were very satisfied with their courses when they moved online in response to COVID-19 closures (Means, 2020). The participants in this survey began classes in person and shifted online as a response to the pandemic. There was one point of collection for this survey between May and June of 2020 when students were attending online courses due to the COVID-19 shutdown protocols enacted by their universities. Only 17 percent of respondents who reported being very satisfied with their classes before shifting online reported being very satisfied with how well they learned after COVID-19 (Means, 2020).

Aucejo et al. (2020) reported on the results of a survey that collected student experience and expectation data about the impact of COVID-19. This study collected responses from around 1500 undergraduate students at a large public university in the United States. Data from this

survey indicate that learning during COVID-19 changed student expectations for graduating, with more than 13% of students reporting that they will delay their graduation dates. Eleven percent of students reported withdrawing from classes during the pandemic, and 50% of students surveyed reported that they studied less and were less successful academically during the pandemic. Students also experienced a reduction in their income during the pandemic, with 31% receiving fewer wages and around 40% of students losing a job or internship opportunity.

Most college students experienced both internal and external stressors that impacted their experience with teaching and learning during the COVID-19 pandemic (Bono et al., 2020). Stressors are identified as events or phenomena that negatively affect a person's wellbeing (Li et al., 2020). During the COVID-19 pandemic, students reported an impact on their mental health due to pandemic-related stressors. Students experienced the effects of quarantine isolation, illness of self or family members, and financial insecurity (Bono et al., 2020, Aucejo et al., 2020).

During the pandemic, students reported stressors related to technology issues that included hardware or software problems. Some students did not have equitable access to internet connectivity. Some shared a device with another family member or had to borrow a device from their university. Some students reported difficulty attending synchronous courses due to bandwidth issues caused by multiple users within their households. One-quarter of students surveyed by Means et al. (2020) reported hardware and software problems that impacted their ability to experience an online course.

The most pervasive problem reported by students during online learning during COVID-19 was the lack of motivation to participate in and complete the course (Means, 2020). Meeter et al. (2020) reported that students surveyed attended fewer synchronous class meetings, reported less engagement within those meetings, and tracked less time studying than they reported for pre-COVID 19 face-to-face courses. In the survey of students reported by Means (2020), 79% of students cited motivation as an issue. Fifty-seven percent of respondents indicated that maintaining interest in the course content was an issue during COVID-19.

Students in online courses reported feeling disconnected from their peers and the instructors in their online courses, specifically missing the chance to collaborate with peers and feeling part of the class community (Means, 2020). Students have expressed the importance of peers to support learning and engagement during the face-to-face iterations of the maker courses discussed in this paper. Past research on this maker course has discussed the vital importance of peer tutoring and other peer input in developing content learning and understanding the course's organization (Cohen et al., 2020). Collaborative learning, where peers equal in both knowledge and experience work together to complete a task (Damon et al., 1989), is another social aspect in the face-to-face maker course that students reported as important. Students formed learning groups in previous face-to-face offerings of the course and often worked together in these collaborative groups during the in-person lab sessions. Many students reported this sense of community and learning within this community as one of the most important takeaways of their experience with the course (Cohen et al., 2020). Students in face-to-face iterations of this course appreciated the opportunity to see what their classmates were making and using that sharing as an opportunity to inform their own choices in which projects they completed. Students

eventually pushed one another to continue along a certain path or pursue a new skill (Cohen et al., 2019)

## Methods

This research design is an exploratory case study, with the unit of analysis being the whole class.

### Participants

This course included 13 masters and 9 undergraduate students whose career and education goals spanned from K-12 teaching to coaching sports to corporate instructional design. Ten master's students and 2 undergraduates consented to participate in the study. Many of the students also shared that they were either starting or managing small businesses while attending the course. Most class members did not have any experience with maker-centered learning at the outset of the course. Though most of the participants had previous experience with online learning and expressed comfort with the online meeting format, they were less familiar with the mastery-based nature of the course, the unique LMS used to manage course content, and the student-centered approach implemented by the course designers.

### Data Collection

Data were collected during the Fall 2020 semester and primarily consisted of student writing and midterm one-on-one check-ins with the professor. Student writing was prompted within regular classroom assignments and final exams. Midterm check-ins were conducted by the professor via videoconference and were recorded and transcribed for analysis.

### Data Analysis

Researchers used Dedoose, a web-based software product, to organize and code the qualitative data. Inductive line-by-line coding was initially done by two of the research team to identify major themes (Saldaña, 2021). The researchers coded sections of the data, engaged in a discussion to reach an agreement about codes, and then researchers coded the remaining data.

## Results

Thematic analysis of the data revealed that COVID-19 related stressors, peer-based learning, making remotely, and navigating the unique course design were major themes impacting student experience of the maker course online during the COVID-19 pandemic closure.

## COVID-19 Related Stressors

Participants shared issues related to health and wellness, stressors created by COVID-19 that impacted their experience of the course. Several students mentioned that they had been ill themselves and that their illness—though not serious—had hampered their ability to finish some of the module content. Many students mentioned that they had family members or friends who were ill with varying degrees of seriousness. Most students shared their experience with health-related issues and how they impacted their interaction with the course during the one-on-one midterm meeting with the course instructor. Some students shared their experiences in a course reflection:

Unfortunately, I don't feel that much can be done for what I truly need to stay on track. It's because it's impossible to control, but I will still share what I need. I need the mounting deaths and loss that have occurred in my family to stop or at least slow down. You see, since the start of the class, I have lost about 15 family members. This week it was my dear cousin's wife, who is a pediatrician. Two weeks ago, it was my dear friend's mother. These losses have sometimes caused me to sit and do nothing. It has been overwhelming. What helps is having a moment to regroup, but it has caused me to fall behind with regard to deadlines.

While participants did share technology-related stressors that hindered their ability to fully participate in synchronous class sessions or manage their coursework, these remarks did not often appear in the data. Most students expressed being comfortable using the LMS for the course. Most students also expressed being well prepared with software, hardware, and internet connectivity for online work after their experience in other online courses throughout their college experience.

## Peer-based Learning

Participants described satisfaction with experiences with decentering that were designed as part of the course. Still, many students shared what they perceived as missed opportunities for peer collaboration and tutoring that occur naturally in an in-person classroom environment. Past iterations of this course in a face-to-face environment have identified the importance of collaborative learning and peer tutoring to the students (Cohen et al., 2020). As one student expressed, the fully online format "limited the organic connection to my classmates and instructors."

Many students recognized that they would have benefited from peer collaboration during the course and missed that possibility during the online version of the course. Several students indicated that participating in class was difficult as they felt anxiety whenever they attempted to share and were interrupted by or interrupted another student. Some students mentioned that they would have liked to hear and see their classmates more and were disappointed that more people did not chime or turn on their video during synchronous sessions. Students felt that the synchronous online course meetings were not ideal for building collaborative relationships.

Several students mentioned that increased use of small breakout groups regularly may have increased their connection to their classmates and their comfort level in sharing during synchronous classes. One student remarked,

I would have really benefited from more opportunities to collaborate and interact with my peers. I know that is a normal component of the course in the face-to-face setting, but I believe I had some really cool classmates and could have benefited from conducting more discussions and projects with them.

Some students suggested tools that they believed would help them communicate and collaborate with one another during the online course, typically a forum that "would be very helpful in case we get stuck in a module and need to reach out to our peers for help."

### Experiences with Learning about Making in a Remote-Based Environment

Students overall reported a positive experience interacting with maker-based learning in this online version of the course. Several students pointed out that the pandemic had highlighted the need for schools to shift education towards a more student-centered approach. Some mentioned the need for more educational experiences that encouraged problem-solving and gave examples of how working through problems with both the modules and with logistical aspects of the course helped them be more engaged and motivated to complete the course.

Though the skill- and disposition-based benefits of making resonated with the students, the practical aspects of remote maker-based learning were more of a challenge. Students expressed that access to equipment, materials, and supplies did present a barrier that impacted their experience with the course. Many students voiced difficulty finding the time to come to campus to pick up kits for home use. Several also indicated travel, health, and wellness-related issues that kept them from making the trip to pick up supplies or schedule an appointment to use the equipment located in the lab, which was essential to completing many of the modules.

Nearly every student indicated that what they have learned about making will impact the way they think and how they will teach, learn, and engage in many other activities in their lives. In their final exam remarks, several students quoted a story told by a classmate that described a student who misbehaved in every class except when they were asked to work with others and complete hands-on activities. This story was used as an example by several students to show how they think making can empower students and help them learn

### Experience with Course Design

Most students indicated a positive interaction with the course and felt that it was designed well for online learning even though they thought it would be better in a face-to-face situation. One student wrote:

This was the best online class I have taken. It was very interactive and felt the most like the students mattered to the instructors. The struggle to transition an in-person class to

feel natively virtual is difficult no matter how great the content. I am still learning how to do this and will be taking many ideas from this class.

Most students expressed appreciation for the modular design of the course and felt empowered by the ability to make choices about which modules they attempted. But many of the students who appreciated the autonomy of choosing their own modules strongly indicated that managing coursework within this course design required additional time and attention. Some of the students expressed difficulty tracking module completion independently. Several students detailed the management activities they engaged in to track progress and complete the modules on time. Some students made suggestions for strategies that the instructors could provide to help students remain on track to make adequate progress in the future. The following was a typical suggestion:

One proposed idea is to have a weekly progress report that would give me guidance on the number of remaining modules in accordance with the time remaining for the semester. Also, the idea of a one-on-one meeting with the professor is great as it provides better feedback and makes room for a conversation to gain insight on the progress and potential questions.

Most students in the online version of the course indicated that time management on a personal level impacted their experience with the course.

### Discussions and Implications

Data made it clear that students' experience of taking the maker-centered learning course and their interaction with making were impacted by taking the course online. Stressors that accompanied learning during the COVID-19 pandemic further complicated their experience in the course.

#### Experience with Maker-Centered Learning

While students reported enjoying the course overall and understood the skills and disposition-based benefits of making, they found it difficult to connect to the practical elements of making in the online environment. Students in the online version of the course expressed frustration with access to equipment and materials to complete the maker activities during the course. Students reported challenges to making appointments to visit the lab to pick up kits to use at home and also reported challenges to making appointments to do their work in the lab space. Students missed the opportunities to work with an instructor on challenging modules. Future maker-based learning courses should consider the accessibility of materials, equipment, and supplies and explore additional means to make the lab experience more accessible to students.

## Collaborative Learning

In previous research into maker-based educator preparation courses, peer teaching and learning and collaborative learning were important elements that evolved throughout the course delivery and were highly valued by the students involved (Cohen et al., 2017; Wohlwend et al., 2018). Future research may examine ways to embed peer teaching and collaborative learning in an online maker-based learning course.

Many students in the course were disappointed the lack of opportunities for peer teaching and learning and collaborative learning that they experienced during the online version of the course. As online learning continues within the backdrop of COVID-19 and beyond the pandemic, course designers should consider the logistics and potential benefits of embedding peer-based learning experiences effectively into an online learning situation for a maker-based course.

## COVID-19 Stressors

Concerns about travel, health safety issues, and scheduling constraints were all indicated as stressors that impacted students' perceived access to what they needed in order to complete the course. Students reported that personal issues had a real impact on their interaction with peers, teachers, and course instruction. These types of concerns were not echoed by students in the past, face-to-face, iterations of the course, but appear to be consistent with emerging research on the impact of COVID-19 stressors on students (e.g., Fruehwirth et al., 2021). Future research may focus on emergency situations like the COVID-19 pandemic response and consider ways that academic institutions can prepare students to better manage personal issues and stressors so they may reduce their impact on education.

## Course Design

Data indicate that students were not hampered by the modular design of the course and were able to use technology effectively to join the class and to track and complete modules. Students reported satisfaction with the modular, mastery-based design of the course, and several indicated that the course was the gold standard for online learning in their experience. But some students self-reported that they lacked self-regulation skills to maintain progress and stay motivated to complete course materials. Students' difficulties with self-regulation in online learning environments is not uncommon (Cho & Shen, 2013), and further exploration of the nature of the issues impacting students' self-regulation—and potential design-based solutions—require further investigation.

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