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Communication

Unleashing Our Chemistry Superpowers: Promoting Student Success and Well-Being at a Black Women's College during COVID-19

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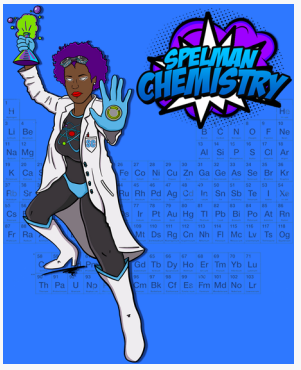
ABSTRACT: Spelman College, a small (~2150 students) Black women's liberal arts college located in Atlanta, GA, USA, is dedicated to empowering women of African descent to become global leaders and change agents. In the wake of the COVID-19 pandemic, and the resulting abrupt and unforeseen campus closure, Spelman experienced pressure and urgency to maintain a high quality curriculum for its students, while balancing student and faculty well-being. This communication is a reflection of the teaching practices that the faculty in Spelman's Department of Chemistry and Biochemistry implemented during the transition to emergency remote instruction (ERI). We first describe the initial week-long planning phase used to transition the Department to ERI, including detailed information on the faculty's efforts to redesign lecture and lab courses via the adoption of new learning platforms, teaching strategies, and student learning objectives. Next, we use student survey data, collected by individual faculty, to reflect on the challenges, opportunities, and iterative course redesign that occurred throughout ERI. Student well-being, engagement, and adaptation were of particular concern and challenge to the Department during ERI. Nevertheless, by embracing a spirit of "productive disorder", the Department was able to channel its faculty "superpowers" toward pedagogical change and transformation. More importantly, by allowing students to operate as independent and resilient learners in the time of COVID-19, we found that students rose to the challenge of creative expression and critique even in unconventional times.



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INTRODUCTION

Spelman College is a private, historically Black college for women dedicated to academic excellence in the liberal arts and sciences and the intellectual, creative, ethical, and leadership development of its approximately 2150 students. In spring 2019, our Chemistry and Biochemistry Department commemorated 40 years as a Department, prompting us to reflect on our charge to empower women of African descent to become global leaders and change agents.[1] In that year, a Department charter was created to define our 21st-century Department with guiding principles that promote student learning by *fostering an intellectual community of scholars, providing an innovative and rigorous curriculum and a competitive research environment*. Spring 2019 was also a critical juncture because the Department was transitioning—junior faculty outnumbered senior faculty, new staff had been hired, and our generation Z population of students required a transformative type of pedagogy. One year later (spring 2020), we encountered a different type of profound change: a global pandemic due to a novel coronavirus, COVID-19. So when COVID-19 "happened" to our Department, we as scholar-teachers at the number one historically Black college and university in the country[2] immediately felt like the character "Heimdall" from the Marvel comic Thor, the sole protector against destruction and mayhem. As instructors venturing into unprecedented territory to protect our learning environment from the disruptions and stress of COVID-19, would our faculty "superpowers" prevail in the face of a global pandemic?

This communication outlines the different phases our Department traversed as we completed the semester remotely. Phase I introduces our initial strategies and plans for lecture and lab redesign, as well as the initial concerns voiced by students and faculty. Phase II describes some of the challenges

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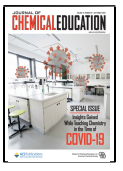

that began to emerge as the pandemic progressed and course revisions were fully implemented, along with some reflections on the unanticipated benefits of the revisions.

PHASE I: PLANNING AND COURSE REDESIGN

Instructional Redesign

On March 12th, during Spelman's spring break, faculty received the College's notice to cancel face-to-face (F2F) instruction and extend spring break for 1 week, during which time we transitioned our classes to emergency remote instruction (ERI). Faculty recognized that our normal F2F learning environment could not be replicated in a remote instruction platform. We also acknowledged the potential challenges and limitations inherent to remote learning, particularly in the laboratory courses. To address these challenges, we communicated weekly as a Department and in subgroups. Those in the Department who were considered more tech savvy offered to serve as "Tech Buddies", to assist colleagues or serve as go-betweens with Spelman Technology Services. Additional guidance was sought from the American Chemical Society (ACS), online chemistry pedagogy groups,[3,4] and feedback from student surveys aimed to gather information on students' well-being, home life, concerns, and available resources. In total, these avenues of support and guidance allowed faculty to adapt syllabi, assignments, and laboratory experiments for ERI.

Lecture

A mixture of synchronous and asynchronous instruction was adopted, depending on the lecture course. To provide flexibility for students who were unable to attend, lecture sections on Zoom would be recorded and posted on our learning management system, Moodle. Faculty planned extra office hours, and the Chemistry Learning Center (CLC), which employs student tutors for General and Organic Chemistry, was moved online. Several courses also reduced the number of assessments and/or assignments, extended due dates for other assignments, and modified the frequency or style of test offerings.

Laboratory

Perhaps the most extensive changes in ERI redesign were proposed for the laboratory classes, which needed to accommodate the learning needs of 220 students in General Chemistry and 113 students in Organic Chemistry. The General Chemistry laboratory course planned synchronous sessions at the original F2F times, whereas Organic Chemistry opted to move to an asynchronous format. The Department evaluated two simulation platforms—the free Merlot Simulation Collection and the subscription-based Labster Virtual Lab Simulations—as a possible means of adapting our laboratory curriculum.[5,6] For General Chemistry, a mixture of Merlot and Labster simulations were selected for use,[7−11] and for Organic Chemistry only Labster simulations were used.[12] For laboratory topics where no suitable simulation could be found, worksheets, "lab scenarios" (a series of videos and questions regarding appropriate experimental protocols), dry laboratories, and/or mock data were provided to students. These plans represented an overall shift from hands-on technical skills to a focus on applying chemical concepts, analyzing data, and improving scientific writing.

Initial Concerns and Anticipated Challenges

The College administered a Student Instructional Continuity Survey early in the transition to remote learning. Of the 1,919 respondents, 79% had not taken an online course. The comments from this survey also revealed that many of the students were concerned about professors' ability to operate technology for remote learning, Internet connectivity, financial challenges, and the path forward in laboratory courses. These concerns mirrored the initial student survey responses collected by individual faculty in our Department.

Faculty concerns largely aligned with those of our students. We felt challenged with proficiently learning several new software platforms in a short time span, concerned about the availability of student access to online resources, and pressured to quickly restructure lab courses. In addition, we were also considering how ERI would alter the scholarly communities that had been created on campus. Would the *Spelman Difference*[13] become obsolete in the remote learning space? Could we find ways to engage students effectively both synchronously and asynchronously with potential drops in attendance? How would we evaluate our students while maintaining rigor and integrity? Would our "superpowers" be enough to battle these challenges?

PHASE II: EMERGENCY REMOTE INSTRUCTION

Emerging Challenges

Following the extended week of spring break, March 23rd marked the official start of ERI. Putting our instructional redesign from phase I into practice, we soon realized which of our original redesign policies worked well and which needed adjustment and "re-redesign". In particular, the disruption of the COVID-19 pandemic revealed that our students were not immune to the wider forces and dynamics (inequities) that shape the experiences of Black students in academia. During ERI, we as faculty gained awareness of these serious challenges, with respect to student well-being, engagement, and workload.

Student Well-Being

African Americans are known to be at disproportionate risk of contracting COVID-19 due to various systemic racial inequalities,[14] and the impact of this risk was felt keenly in our Spelman community. Many of our students lost family members to the disease or (in several cases) contracted COVID-19 themselves.

In addition to its impact on the physical well-being of our community, the COVID-19 crisis and the transition to ERI had significant repercussions on the mental well-being of our students. As revealed by an anonymous in-house survey (Tables 1 and 2) given to two General Chemistry II lectures at the end of the semester, with approximately half (N = 38) of the number of students enrolled responding, a large fraction of students self-reported frequent symptoms of anxiety and depression. The free responses to the survey indicated that a major source of students' anxiety and stress came from challenges experienced in their home environment: intermittent Internet access, a lack of quiet study space or desk, the absence of peer support, and/or increased responsibilities (caregiving, chores, a second job, etc.) while at home. The survey also indicated that a second major contributor to student anxiety and stress was the perceived increase in workload during ERI compared to F2F. Though many faculty in the Chemistry and Biochemistry Department made a

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Table 1. Survey Responses on Student Well-Being, N = 38[a]

Please Rate How Often You Have Felt during the Last Several Weeks since the Outbreak of COVID-19 in Your Country	Mean (Std Dev)	% Never/Rarely (N)	% Often/Always (N)
I have felt bothered by nervousness or "nerves".	4.00 (1.00)	5.26 (2)	68.42 (26)
I have had or felt a lot of energy or vitality.	2.42 (0.96)	60.53 (23)	10.52 (4)
I have felt downheartened and blue.	3.63 (1.09)	15.79 (6)	55.26 (21)
I have been emotionally stable and sure of myself.	2.66 (1.03)	36.84 (14)	18.42 (7)
I have felt cheerful, light-hearted.	2.63 (0.87)	36.84 (14)	13.58 (5)
I have felt tired, worn out, used up, or exhausted.	4.34 (0.87)	2.63 (1)	78.95 (30)

[a]Survey administered to two General Chemistry II lectures at the end of the semester. Survey Scale used: 5 = always; 4 = often; 3 = sometimes; 2 = rarely; 1 = never.

Table 2. Survey Responses on Student Performance, N = 38[a]

Statement	Mean (Std Dev)	%Agree/Strongly Agree (N)
It is more difficult for me to focus during virtual teaching in comparison to on-site teaching.	4.29 (1.02)	76.32 (29)
My performance as a student has changed for the worse since on-site classes were canceled.	3.61 (1.29)	52.63 (20)
I think I have adapted well to the new teaching and learning experience.	3.03 (1.09)	31.58 (12)
Overall, since on-site classes were canceled, how satisfied have you been with the organization of your chemistry lectures?	4.05 (1.02)	78.94 (30)

[a]Scale used: 5 = strongly agree/very satisfied; 4 = agree/satisfied; 3 = neither agree/satisfied nor disagree/dissatisfied; 2 = disagree/dissatisfied; 1 = strongly disagree/very dissatisfied.

conscious effort to *decrease* student workload during the COVID-19 crisis, typically by reducing assignments and assessments, clearly this effort did not translate to a perceived reduction in overall workload for students. For all of the above reasons, balancing the mental health of our students with our "normal" course objectives and standards was quite challenging.

Student Engagement

Student engagement was also a substantial challenge throughout the semester. During virtual Zoom class time, many students elected to turn off their webcams. This gave faculty far less opportunity to engage in informal methods of formative assessment, such as observing student facial expressions and body language during a lesson. Especially in asynchronous environments, professors had few ways to track whether or not students were following the lectures and engaging with course material, aside from graded course assignments, thus limiting opportunities for beneficial faculty intervention. In the cases where faculty were able to monitor and quantify student engagement, such as with attendance and/or Moodle activity logs, some professors noticed a substantial decrease in attendance and engagement.

Faculty's perceptions of decreased student engagement matched students' self-reported levels of engagement, based on both quantitative (Table 2) and qualitative data collected from the General Chemistry II end-of-semester survey. Most students (76%) self-reported difficulty with maintaining focus in the virtual setting. From qualitative data, students frequently attributed their trouble concentrating to a lack of physical separation between work and leisure spaces, especially for the many students that were forced to work in their bedrooms and on their beds. Students also felt decreased performance and motivation due to a lack of accountability from peers and/or instructors.

Addressing Challenges: Instructional "Re-redesign"

As a result of the challenges faced by students during ERI, and as faculty awareness of students' transitional experiences increased, faculty sought to make additional changes to their instructional methods and classroom practices. This process of course re-redesign led to modified assessment strategies and learning objectives, methods for increased student engagement, and more instructional flexibility. Re-redesign also paved the way for unanticipated opportunities and benefits for students that we aim to continue in future semesters and in our online summer courses, which our Department is offering for the first time in summer 2020.

Increasing Academic Flexibility

As faculty gained awareness of student challenges, a number of policies were put in place to protect student well-being and decrease academic stress. On a college-wide level and with strong support from all faculty, Spelman instituted a voluntary "pass−fail" system, applicable to both major and nonmajor courses, and extended the date for course withdrawal. For students in crisis, faculty were willing to postpone deadlines and consider incompletes for courses. For all students, faculty sought to offer flexible deadlines for work completion, made select assignments/assessments optional, and sought student input on course workload. As a Department, we felt that being flexible and responsive to student needs under these extraordinary times would help produce more adaptable learners.

Increasing Student Engagement and Support

While initially seen as a burden, faculty increasingly found ways to utilize online technologies to engage students. Success was found in replacing lengthy lectures with bite-sized conceptual vignettes (recorded on Zoom for students to watch later) and moving to a more "active-learning" model. Class time was increasingly used for working example problems, responding to instantaneous student feedback via Zoom's polls and/or emoji features, and utilizing online forums for peer−peer and peer−instructor communication. Faculty were also able to increase engagement by reducing the number of content learning objectives, in order to focus more in-depth on skills-based learning objectives. In addition to engagement, providing quality support to students is integral to Spelman's mission. Spelman maintains a dynamic culture of supporting and mentoring students, and our successful curricular innovations and "best practices" for support and retention of Black women STEM majors can be found in prior work.[1,15] Recreating this paradigm of mutual engagement and empowerment during

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ERI was both a challenge and of critical importance. Over time, faculty found ways to support students online by offering and advertising extensive "Zoom office hours" to individuals or small groups. These sessions led to increased problem-solving confidence and improved conceptual application. Zoom office hours also saw new student attendees compared to F2F office hours, suggesting that some students saw virtual office hours as more accessible/approachable. Spelman serves a sizable commuter population (34% of the student body prior to ERI),[16] and our Department fully intends to better utilize virtual office hours in future semesters as a tool for more equitably supporting our off-campus students.

Modifying Laboratory Objectives

During ERI, the Organic Chemistry laboratories narrowed their focus to reinforce skills in technical writing, lab techniques, and spectroscopy analysis. On the basis of student feedback and performance, students were more confident interpreting and predicting both NMR and IR spectra as well as identifying the proper glassware/equipment to use in laboratory scenarios. As for technical writing, some students felt that the mock/simulation data were too abstract and difficult to connect to the conceptual knowledge required of the corresponding mock lab reports. Thus, many felt these mock reports were more time-consuming compared to writing reports based on data they collected themselves. Nevertheless, faculty recognized an important opportunity for students to focus on raw data analysis and plan on retaining several of the ERI elements in future semesters.

The Physical Chemistry Laboratory course was also restructured to focus on technical writing skills. Using several experiments the class had already completed prior to ERI, the instructor hosted writing workshops in which students reanalyzed their original lab reports and used peer review to create polished lab reports, with clear connections to concepts learned in Physical Chemistry lecture.[17] By the end of the semester, students expressed improved feelings of confidence with technical writing.

Modifying Assessment and Examination

Assessments and examinations were modified to increase student engagement by incorporating "real-world" connections to course material. The Organic Chemistry lecture included discussions of potential COVID-19 treatments, as discussed in a separate article.[18] As another positive example of modifying assessment, the traditional final exam in Physical Chemistry II was replaced with a final project in which students were asked to select a topic and/or researcher in physical chemistry and write an essay on how the topic/researcher connected to concepts learned earlier in the Physical Chemistry sequence. The results of the final project were a highlight of the semester, as students were able to explore career opportunities in physical chemistry, connect physical chemistry to issues of global relevance (e.g., the kinetics of climate change), highlight ways in which physical chemistry can be used to solve problems of particular relevance to people of color (e.g., understudied genetic factors for African Americans with regard to Alzheimer's), and in several cases articulate the revolutionary physical chemistry contributions made by women of color (e.g., Dr. Hadiyah-Nicole Green). On a more personal level, many student essays sought to use physical chemistry to explore and understand the COVID-19 pandemic. One memorable student, who lost a family member to COVID-19 midsemester, wrote an impassioned essay on the use of X-ray crystallography to understand the impact of pre-existing conditions on the relative binding affinity of SARS-CoV-2 and, hence, to explain the disproportionate rates of COVID-19 infection among African Americans. "I didn't [previously] realize it", she remarked when giving her final presentation, "but spectroscopy is *everywhere*".

CONCLUSION AND OUTLOOK

Teaching chemistry in the time of COVID-19 at a Black women's college has brought new perspective to what it means to be an outstanding faculty "superhero". Particularly at the no. 1 HBCU in the country, there is immense pressure to present "the most ordered faces possible to the world",[19] and as Spelman faculty, we entered this ERI era in anticipation of shielding our students from the wrath of COVID-19 and preserving a semblance of the F2F learning environment we had created on campus. Slowly, however, we learned to embrace a sentiment of "productive disorder".[19] As faculty, we teach best when we honestly acknowledge the pain and uncertainty our students are experiencing in the time of COVID-19. Rather than keeping the topic of COVID-19 out of our classrooms, we found that students wanted to actively engage and connect their learning to the crisis unfolding around them and bring COVID-19 to the forefront of their educational experience. Being a faculty "superhero", it turns out, means allowing students to rise to the challenge of creative expression and critique even in unconventional times.

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Notes

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