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Abstract

Background: During the COVID-19 pandemic, emergency remote teaching (ERT) was implemented in the U.S., and some of the most vulnerable college students struggled to adapt. **Purpose**: The current study sought to understand the experiences and outcomes of undergraduate students enrolled in radiography programs while participating in synchronous online lectures during ERT, especially first-generation students. Specifically, this study focused on students who participated in class lectures that were taught online in a live and synchronous format due to COVID-19 stay-at-home orders. **Methods**: This study utilized a retrospective and longitudinal design where participants were asked to answer a series of questions retrospectively at two points in time with each question forming a pair. Survey participants were enrolled as students during ERT in 2020 through 2021 and participated in class lectures that were taught online in a live and synchronous format due to COVID-19 stay-at-home orders. **Results**: Wilcoxon Signed-Rank and Spearman Rank-Order tests suggest that ERT has affected the experiences and outcomes of students enrolled in radiography programs, with more pronounced negative effects for first-generation students. **Conclusion and Recommendations**: The researchers recommend yearly and preventative planning across three academic and administrative areas to include training, support, and technology as essential strategies for delivering remote education, specifically online synchronous lectures, in the context of ERT situations. Strategies in these three areas will keep the academic success of the most vulnerable and underserved college student populations at the forefront during emergency remote teaching scenarios.

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ABSTRACT

Background: During the COVID-19 pandemic, emergency remote teaching (ERT) was implemented in the U.S., and some of the most vulnerable college students struggled to adapt. **Purpose**: The current study sought to understand the experiences and outcomes of undergraduate students enrolled in radiography programs while participating in synchronous online lectures during ERT, especially first-generation students. Specifically, this study focused on students who participated in class lectures that were taught online in a live and synchronous format due to COVID-19 stay-at-home orders. **Methods**: This study utilized a retrospective and longitudinal design where participants were asked to answer a series of questions retrospectively at two points in time with each question forming a pair. Survey participants were enrolled as students during ERT in 2020 through 2021 and participated in class lectures that were taught online in a live and synchronous format due to COVID-19 stay-at-home orders. **Results**: Wilcoxon Signed-Rank and Spearman Rank-Order tests suggest that ERT has affected the experiences and outcomes of students enrolled in radiography programs, with more pronounced negative effects for first-generation students. **Conclusion and Recommendations**: The researchers recommend yearly and preventative planning across three academic and administrative areas to include training, support, and technology as essential strategies for delivering remote education, specifically online synchronous lectures, in the context of ERT situations. Strategies in these three areas will keep the academic success of the most vulnerable and underserved college student populations at the forefront during emergency remote teaching scenarios.

Keywords: emergency remote teaching, first-generation students, ARRT, radiography, stay-at-home orders, COVID-19

INTRODUCTION

Confirmed cases of COVID-19 emerged outside the United States around the end of 2019, while the first case was reported in the U.S. in January 2020.[1,2] Consequently, as pandemic levels were realized, a national emergency was declared in the U.S. in March 2020.[3] Moreover, during March through May 2020, most states and territories in the U.S. issued degrees of stay-at-home orders (SAHOs) and other mitigation strategies limiting person-to-person transmission of COVID-19.[4]

In alignment with mitigation strategies, institutions of higher education around the world were closing and shifting to online learning.[5] Meanwhile, higher education institutions in the U.S. pivoted to *Emergency Remote Teaching (ERT)*, which is a "temporary shift" from one instructional mode to another during "crisis circumstances."[6] The results of ERT meant that students enrolled in traditional on-campus courses in the U.S. were now participating in online learning environments.

Regional SAHOs in the U.S. remained in place from weeks to months, while other mitigation measures remained active well into 2021. California's social capacity restrictions were not rescinded until June 15, 2021.[7] Concurrently, vaccines and other mitigation measures have offered some assurances to U.S. institutions to pivot from ERT and resume on-campus instruction in Fall 2021.[8] However, irrespective to these aforementioned measures, ERT continues to be an option through 2022.[9]

A consequence of this shift to ERT is that college students in the U.S. have disproportionally encountered barriers to online learning. Specifically, college students began experiencing issues with technology, learning environments, and barriers to learning while participating in online classes, and these issues are particularly noticeable for students of color, first-generation, and those experiencing economic insecurity.[10-16]

Research regarding ERT in response to the COVID-19 pandemic tends to focus on the beginning of this transition during the March 2020 timeframe. Consequently, little is known about the longitudinal experiences of students who were enrolled throughout SAHOs and ERT after the onset in March 2020. Additionally, the current literature does not include many studies about how experiences with technology, learning environments, and barriers during ERT affects college outcomes. Therefore, the current study sought to understand the experiences and outcomes of undergraduate students enrolled in radiography programs while participating in synchronous online lectures during ERT, especially first-generation students. Specifically, this study focused on students who participated in class lectures that were taught online in a live and synchronous format due to COVID-19 stay-at-home orders.

LITERATURE REVIEW

Issues with Technology

College students have experienced issues with technology while participating in online classes during COVID-19 SAHOs.[10-15] For example, more than 50% of college students experienced issues accessing the Internet for learning experiences during SAHOs,[12] which was a major challenge for students.[10] Internet connectivity is particularly difficulty for low-income students where nearly one-third of families earning less than $50,000/year reported not having access to fast and reliable Internet, and for students of color.[17] Moreover, asking these students to solve this issue is unreasonable because these populations also report the financial burdens of Internet as significant costs.[17] For first-generation students, lack of access was compounded by lack of familiarity with online learning technologies, in addition to experiencing financial hardships.[16] These finding are especially problematic not only for online course participation, but also for other meaningful opportunities to interact with faculty and peers from home.

Issues with Learning Environments

College students have experienced issues with learning environments while participating in online classes during COVID-19 SAHOs.[10-12,14,15] Students reported online learning environments during ERT half as effective as face-to-face classes,[18] while 15% of students in one study reported expecting housing insecurity during ERT.[12] When housing is secure, college students reported that concentrating is a substantial challenge while participating in learning experiences from home, and that more household members mean less accessibility to resources used for online learning.[10] This finding is concerning because environments conducive to learning are essential to the learning process, and it appears that college students have had little control over these learning environments during SAHOs. Furthermore, online learning environments were often difficult; students were fatigued by time spent fixated at computer screens and frustrated by lack of school support (e.g., tutoring, library).[10]

Further exacerbating these environmental issues was distractions, privacy, and unsuitable physical workspaces.[12] Similarly, scholars have reported that 71% of students experienced challenges finding quiet physical learning spaces.[18] Moreover, this finding was more pronounced for first-generation students who reported not having a dedicated workspace 84% of the time, while their non-first-generation counterparts reported 57%.[12] Similarly, first-generation students were more likely than their counterparts to lack access to safe and conducive physical learning spaces and attend class sessions punctually.[16]

Barriers to Learning

College students have experienced barriers to learning while participating in online classes during COVID-19 SAHOs.[10-12,14,15] Some of these barriers are related to preferences for face-to-face learning environments when compared to online learning modes.[10] Moreover, researchers have reported that higher preference for face-to-face learning environments led to lower cognitive engagement in online classes.[10] Another major barrier was access to the Internet and to technology.[12]

Issues with technology, learning environments, and barriers to learning while participating in online classes during COVID-19 SAHOs appear to be more pronounced for historically underserved college students. College students experiencing economic insecurity and students of color reported more challenges accessing the Internet and having working technology as it relates to learning experiences during SAHOs.[13,17] A similar pattern has also been reported for first-generation college students who experienced considerable challenges during SAHOs with the availability of conducive learning environments, and access and familiarity with technology for online learning experiences when compared to their non-first-generation counterparts.[16]

Effects on Educational Outcomes

Limited research is available about how participating in synchronous online lectures during COVID-19 SAHOs affects outcomes. For example, college GPA decreased by 0.17 points, 13% of students delayed graduation, 11% of students withdrew from a course, and 12% stated that COVID-19 affected their major choice.[11] In this study, these results were more pronounced for students from underrepresented backgrounds such as low income, students of color, and first-generation. Specifically, students in the lower income range were 55% more likely to expect graduation delays when compared to their higher income peers, and first-generation students 50% more likely compared to their counterparts. Although the findings from this study included "current and expected outcomes," these findings suggest that the COVID-19 pandemic has affected the educational experiences of college students.

Concerns about Education Quality

A few studies in the literature have explored concerns about educational quality when on-campus classes shifted to online during COVID-19 SAHOs. From a faculty perspective, concerns around adjusting course content, missed opportunities to participate in important events on campus, and limited student-faculty interactions have been reported.[19] Furthermore, faculty in this study reported that transitioning to online learning in the context of ERT was not only challenging, but learning was disrupted. Faculty also made changes to assignments (including reading) or exams, and the overall volume of works expected of students.[20] Moreover, these authors concluded that ERT is "not a viable long-term solution."[20]

Students also reported similar concerns. Specifically, although more flexible, students reported decreases in quality, enjoyment, interest, learning, attention, motivation, and cultural content for courses that transitioned to online during ERT.[21] Similarly, students reported 64% decrease in faculty interactions, 87% decrease in peer interactions, and 81% decrease in motivation.[18] Regarding confidence, students reported lower across various types of in-class work, college support tasks, and outside-the-class study habits.[14] Students also reported frustrations due to stress, increased workload, course ambiguity, lower quality education, and successfully completing the academic year.[22] Regarding platform, more than 60% of students disagreed that their learning was improved when using Zoom.[15]

THEORETICAL FRAMEWORK

The input-environment-output (I-E-O) model of college impact guided this study.[23] This model suggests relationships among three distinct variable groups of Inputs, Environments, and Outputs/Outcomes. Inputs represent variables that students bring with them to college such as racial/ethnic identity. Environments represent attributes of colleges such as policies. Outputs/outcomes represent the results of participating in the college experience such as earing passing scores on credentialling examinations. In the current study, this model was incorporated to explain the underlying relationships between independent variables related to participating in online lectures from home, and the dependent variable related to earing a passing score on the credentialling examination in radiography offered by the American Registry of Radiologic Technologists (ARRT).

METHODS

This study sought to understand the experiences and outcomes of undergraduate students enrolled in radiography programs while participating in synchronous online lectures during ERT, especially first-generation students. Specifically, this study focused on students who participated in class lectures that were taught online in a live and synchronous format due to COVID-19 stay-at-home orders. The researchers created and anonymous survey, which was distributed by the Association of Collegiate Educators in Radiologic Technology (ACERT) and the American Society of Radiologic Technologists (ASRT) to participants who were enrolled in radiography programs during ERT in 2020 through 2021. The researchers carefully reviewed and evaluated this instrument to establish face validity.

This study utilized a retrospective and longitudinal design where participants were asked to answer a series of questions retrospectively at two points in time with each question forming a pair. Table 1 describes Time 1 (i.e., onset of ERT) and Time 2 (i.e., most recent experiences with ERT) as framing language for answering each of the nine survey questions. Only participants who reported Time 1 and Time 2 data, and who participated in class lectures that were taught online in a live and synchronous format due to COVID-19 stay-at-home orders were included in the analysis.

Table 1. Time 1 and Time 2 Framing Language

Time 1	Time 2
Your experiences participating in class lectures in your radiography program that were taught online in a live and synchronous format at the beginning of COVID-19 stay-at-home orders in March, April, and May of 2020.	Your most recent experiences participating in class lectures in your radiography program that were taught online in a live and synchronous format due to COVID-19 stay-at-home orders.

Because SAHOs and ERT were implemented across the U.S. at different periods, Time 1 and 2 varied among study participants. Most participants reported March 2020 as Time 1 and May 2021 as Time 2 (see Figure).

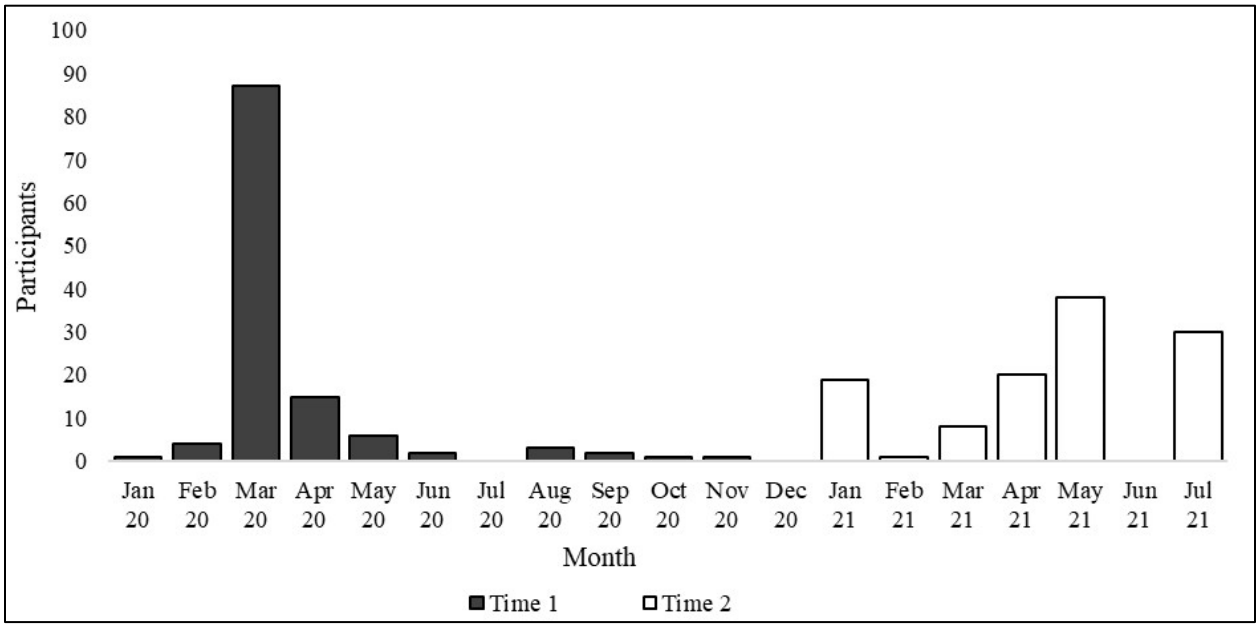

Figure: Time Comparisons

Data Source and Sample

The researchers reviewed the available literature and created a survey about participating in online synchronous lectures during COVID-19 SAHOs and ERT. The final questions about inputs, environments, and experiences were used as independent variables, and the score on the ARRT credentialling examination in Radiography was used as the dependent variable. This credentialing exam assesses cognitive skills such as knowledge, critical thinking, and problem-solving in the discipline and is the gold standard for professional practice. Survey questions asked participants to report the percent of time issues with technology and learning environments were experienced during ERT.

After IRB approval, and on behalf of the researchers, ACERT distributed this anonymous survey via an email message to directors of radiography programs who attended the 2021 annual conference. These directors were asked to send this survey to recent graduates. Similarly, ASRT distributed this survey to members in the Graduate Bridge and Student categories.

This nationwide sample included 122 cases for analysis where approximately 26% of participants represented the South, 24% represented the West and Midwest, respectively, and 22% represented the Northeast region of the U.S. Approximately 60% of participants identified as first-generation students, and 42% reported an annual household income of less than $30,000. Nearly 43% of participants reported being college-age (18-24), while 68% identified as White and 75% identified as female.

Variables

All variables in this study were self-reported. This study incorporated multiple independent variables and one dependent variable. Other than demographics, independent variables were ratings about the percent of time resources were unavailable or issues were experienced while participating in live and synchronous online lectures. The dependent variable was the score on the Radiography credentialling examination administered by the ARRT. First-generation status was operationalized as students whose parents did not earn a bachelor's degree (see Higher Education Act, 1965). Variables for Time 1 and Time 2 were transformed using the formula:

[Variable Pair = Time 1 – Time 2]

Analysis

IBM SPSS Statistics version 28.0 was used for the analyses. Variables were screened, cleaned, and assumptions were checked, which yielded 122 cases for analysis. Descriptive statistics (means, standard deviations, and differences) were calculated based on pairs for each variable for first- and non-first-generation students. Because variables related to participating in online synchronous lectures were not normally distributed, Wilcoxon Signed-Rank Tests were performed to determine if the differences between Times 1 and 2 were likely due to chance. Spearman Rank-Order was utilized to determine correlations between Time 1 and Time 2 variables and the ARRT credential score.

RESULTS

Percent of Time Experiencing Issues at Time 1 and Time 2

The results suggest that first- and non-first-generation students experienced issues participating in online synchronous lectures throughout ERT (see Table 2 in Appendix).

Furthermore, the overall pattern for both groups improved over time, although issues still existed at Time 2. With three exceptions, first-generation students reported higher percentages of time experiencing issues across all Time 1 and Time 2 instances. Regarding overall improvement, first-generation students made greater gains across five pairs, compared to greater gains across three pairs for their counterparts. The gains for Pair 7 were the same.

Table 2 also shows that first-generation students reported noise distractions in their physical learning space at Time 1 (44%) and Time 2 (29%) the highest percent of time. Non-first-generation students reported visual distractions in their physical learning space at Time 1 (42%) and Time 2 (34%) the highest percent of time. Regarding the lowest percent of time experiencing issues attending online synchronous lectures, first-generation students reported no computer/tablet/phone available at Time 1 (13%) and Time 2 (13%). The same variable was also reported the lowest percent of Time 1 (7%) and Time 2 (5%) for their non-first-generation counterparts.

Moreover, Table 2 shows how issues attending online synchronous lectures changed over time. For first-generation students, the largest improvement was related to noise distractions in their physical learning space (14%). For non-first-generation students, largest improvement was related to noise distractions from classmates (12%). It is important to note that first-generation students experience worsening over time related to no computer/tablet/phone available (0.10%).

Correlations on ARRT Exam Score

Each variable at Time 1 and Time 2 was correlated with the score on the ARRT credentialling examination in Radiography to determine effects on this educational outcome. Results of these correlations are presented in Table 3 (Appendix).

For first-generation students, no computer/tablet/phone available was the only Time 1 variable that had a modest and negative correlation. However, three Time 2 variables had modest and negative correlations for this population: no computer/tablet/phone available, problems with your microphone, speakers, and/or headphones, and noise distractions from classmates. Interestingly, the same Time 2 variable no computer/tablet/phone available had a strong and positive effect for non-first-generation students.

LIMITATIONS

Although the findings from the current study contribute to the area about the effects of technology and learning environments during COVID-19 SAHOs and ERT, this study has several limitations. First, this study only included undergraduate participants enrolled in radiography programs, and as a result, these findings might not apply to students in other academic disciplines. Second, the participants identified overwhelmingly as female and White, so these findings might not apply to populations of students who report greater diversity. Third, another limitation is that the two points in time (i.e., Time 1 and Time 2) varied for participants based on regional mitigation measures, so comparisons over time are less precise. Finally, this study incorporated correlation analysis, and it is important to recall that correlation does not suggest causation.

DISCUSSION

The current study sought to understand the experiences and outcomes of undergraduate students enrolled in radiography programs while participating in synchronous online lectures during ERT, especially first-generation students. Specifically, this study focused on students who participated in class lectures that were taught online in a live and synchronous format due to COVID-19 stay-at-home orders. Study findings suggest that students experienced issues participating in learning environments during ERT in cross-section and longitudinally. Additionally, some of these issues negatively affected learning outcomes for first-generation students.

Experiences Related to Technology

Study findings suggest that all participants experienced issues related to technology while participating in synchronous online lectures during ERT, and that these issues typically improved over time. The literature has established that students experienced issues with technology use during ERT,[12,14,18] and the current study expands this area to include students enrolled in radiography programs.

Non-first-generation students experienced technology issues throughout ERT. Specifically, this population continued to experience issues logging in to online lecture platforms, and with microphone, speakers, and/or headphones. First-generation students also experienced technology issues throughout ERT. Except for no or slow Internet connection, this population also experienced issues with logging in to online lecture platforms; and problems with microphone, speakers, and/or headphones similar to their non-first-generation counterparts. Collectively, these two populations experienced similar issues over time. However, the percent of time experiencing these issues at Time 1 and Time 2 vary considerably and overall were higher for first-generation students.

Experiences Related to Learning Environments

Study findings suggest that all participants experienced issues related to learning environments while participating in synchronous online lectures during ERT, and that these issues typically improved over time. The literature has established that students experienced issues with learning environments during ERT,[10,12,16,18] and the current study expands this area to also include students enrolled in radiography programs.

Non-first-generation students experienced issues relating to learning environments throughout ERT. Specifically, these students continued to experience noise distractions from classmates, instructors, and in the physical learning workspace, and visual distractions in physical learning workspace. First-generation students also experienced issues relating to learning environments throughout ERT. Specifically, these students continued to experience the same noise distractions from classmates, noise distractions in physical learning workspace, and visual distractions in physical learning workspace as their non-first-generation counterparts. Collectively, these two populations experienced similar issues over time. However, the percent of time experiencing these issues at Time 1 and Time 2 vary considerably and overall are higher for first-generation students.

Effects of Technology and Learning Environments on Outcomes

Study findings suggest that the technology and environment issues students experienced during ERT had negative effects on learning outcomes for first-generation students. Although the learning outcome included in the current study was the ARRT credentialling examination in Radiography, which is based on cognitive skills in the radiography discipline, it is unclear whether other learning or college outcomes such as grades or persistence were affected. A few studies are available in the literature about how technology and environment issues during ERT affects college outcomes,[10,11] and the findings from the current study expands this area to include students enrolled in radiography programs.

It appears that technology issues during ERT have a negative effect on learning outcomes for first-generation students. For example, not having a computer/tablet/phone available to participate in synchronous online lectures at Time 1 or Time 2 had a negative effect of the ARRT credentialing exam score, with Time 2 having the stronger effect. At both points in time, these students reported computer/tablet/phone availability issues while participating in synchronous online lectures up to nearly three times that of their non-first-generation counterparts (see Table 2 in Appendix). Scholars have reported that first-generation students were more likely to lack the technology and the familiarity with technology during ERT when compared to their non-first-generation counterparts.[16]

Interestingly, this Time 2 variable had a positive effect on the ARRT exam score for non-first-generation students. Perhaps non-first-generation students were less reliant on their computer/tablet/phone to participate in synchronous lectures when compared to their counterparts. Although it seems logical to assume that not participating in synchronous lectures would have a negative effect on learning, perhaps this finding is also related to participation after the fact. In other words, compared to first-generation students, non-first-generation students might have had more opportunities in their schedules to review recordings of lectures subsequently;

thus, making participating more flexible. There is evidence in the literature suggesting that due to scheduling of synchronous lectures during ERT, participation has been a challenge for first-generation students due to limited flexibility.[12,16]

Issues with microphone, speakers, and/or headphones while participating in synchronous online lectures at Time 2 is another technology issue that has a negative effect on learning outcomes for first-generation students. As previously mentioned, this finding suggests that first-generation had inadequate technology resources during ERT, and limited flexibility to participate after the fact.

Regarding learning environments, noise distractions from classmates during online lectures at Time 2 had a negative effect on learning outcomes for first-generation students. This issue appears to be controlled more by class instructors, and the literature includes several studies establishing the concerns about faculty preparation for ERT.[19, 24] Collectively, these findings suggests that first-generation students were more dependent on technology and classroom instruction and on their instructors to mitigate in-class distractions during synchronous lectures during ERT when compared to their non-first-generation counterparts. This combination of factors is particularly problematic for first-generation students who tend to experience more challenges adapting to ERT.[16]

IMPLICATIONS FOR PRACTICE

The findings from the current study can provide higher education leaders in the U.S. with essential strategies for delivering remote education, specifically online synchronous lectures, in the context of ERT situations. We, the researchers of this study, recommend yearly preventative planning to include training, support, and technology. Mitigation activities across these areas help hedge against future ERT scenarios, while keeping the academic success of the most vulnerable college student populations at the forefront.

Institutions of higher education should provide specific and targeted training for faculty across digital mediums, tools, and activities to support online synchronous lectures. ERT has required that faculty become specialists at using technologies such as video conferencing and learning management systems, and peripherals such as webcams and microphone/speaker equipment. This, of course, notwithstanding controlling their physical teaching environments. Because technologies advance and teaching environments differ, we recommend annual competencies in elements that would be used for ERT.

Additionally, students should be provided with annual basic training in the utilization of technologies and equipment, as well as information about preparing learning environments, at some point during campus orientation. Orientation topics should include video conferencing, learning management systems, computer peripherals, and establishing a physical learning workspace in preparation for participating in online synchronous lectures during emergency situations. The most underserved college student populations, especially first-generation students, could benefit from this type of explicit instruction.

We also recommend the ability to scale and triage technology support into a 24/7 operation during ERT. This type of service could assist students in “real-time” with urgent issues preventing their participation in online synchronous lectures, while also providing “offline” assistance for technology issues at times when problems are important but not urgent. Technology support could be a mix of automated (e.g., forms, password management, artificial intelligence bot) and live (e.g., chat, telephone, text messaging) services.

In addition to technology support, higher education professionals should be familiar with governmental and other resources available to help students in the context of ERT. For example, the Coronavirus Aid, Relief, and Economic Security Act (CARES Act) in March 2020; the Coronavirus Response and Relief Supplemental Appropriations Act (CRRSAA) in December 2020; and the American Rescue Plan (ARP) in March 2021[25] are some of those resources. These resources are specifically designed as financial means for institutions of higher education in the U.S. to assist students and learning continuity during ERT. Financial support to students during ERT can be the difference to enable active participation in an online synchronous lecture.

CONCLUSION

ERT is a response to the COVID-19 pandemic, and although institutions and students have acclimated and improvements to teaching and learning have been made, it appears that ERT has affected the experiences and outcomes of college students in the U.S. Moreover, the effects of this response appear to be more pronounced for historically underserved populations, particularly first-generation students. It appears that radiography students lacked the necessary technology resources and had little control of learning environments during ERT, and that first-generation students experienced such issues to greater degrees than their non-first-generation counterparts.

Collectively, these findings are suggestive of an underlying digital divide, which is markedly more significant for first-generation students because it appears to have a negative effect on college outcomes. As a result, yearly and preventative planning across training, support, and technology areas could potentially prepare students and institutions for ERT scenarios, while mitigating the adverse effects of an underlying digital divide for first-generation college students.

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APPENDIX

Table 2. Percent of Time Experiencing Issues Participating in Online Synchronous Lectures

Pair	Questions (abbreviated)	Non-First-Generation Students						First-Generation Students					
		Time	*M*	SD	Δ	*n*	*p*	Time	*M*	SD	Δ	*n*	*p*
P1	No computer/tablet/phone	T1 T2	7.09 5.48	21.58 20.78	1.61	23	.498	T1 T2	12.92 13.03	26.25 28.06	***-.10***	39	.918
P2	No or slow internet connection	T1 T2	25.61 20.52	28.28 25.10	5.10	31	.184	T1 T2	34.87 24.02	27.45 23.93	10.85	47	***<.001***
P3	Problems logging in to online lecture platforms	T1 T2	19.45 13.65	22.27 21.08	5.81	31	***.006***	T1 T2	23.13 19.63	22.19 24.86	3.50	40	***.022***
P4	Problems with microphone, speakers, and/or headphones	T1 T2	21.92 15.24	26.41 19.42	6.68	25	***.031***	T1 T2	22.50 13.42	23.88 21.02	9.08	38	***<.001***
P5	Problems with web camera	T1 T2	11.67 8.29	17.73 16.27	3.38	21	.386	T1 T2	19.26 15.51	25.96 23.95	3.74	35	.179
P6	Noise distractions from classmates	T1 T2	26.13 14.53	29.57 20.78	11.59	32	***.003***	T1 T2	33.63 24.60	29.92 26.61	9.03	40	***.007***
P7	Noise distractions from instructors	T1 T2	21.37 13.57	24.93 23.96	7.80	30	***.010***	T1 T2	28.14 20.34	32.54 25.29	7.80	35	.071
P8	Noise distractions in physical learning workspace	T1 T2	34.75 28.47	26.00 25.47	6.28	36	***.030***	T1 T2	43.55 29.16	34.58 29.41	14.39	49	***<.001***
P9	Visual distractions in physical learning workspace	T1 T2	42.25 33.59	28.62 26.49	8.66	32	***.033***	T1 T2	35.08 26.14	30.64 26.23	8.94	49	***.002***

**p* value extracted from Wilcoxon Signed Rank Text

Table 3. Correlations with ARRT Exam Score

Questions (abbreviated)	Time	Non-First-Generation Students *n*	Non-First-Generation Students ρ_s	First-Generation Students *n*	First-Generation Students ρ_s
No computer/tablet/phone	T1	23	-.145	40	***-.389****
No computer/tablet/phone	T2	11	***.662****	31	***-.418****
Problems with microphone, speakers, and/or headphones	T2	15	-.212	31	***-.455****
Noise distractions from classmates	T2	18	.151	34	***-.382****

**p < .05*