

Work in Progress : Faculty Perceptions of STEM Student and Faculty Experiences during the Covid-19 Pandemic: A Fall 2020 Qualitative study.

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Dr. Andrea Nana Ofori-Boadu is an Associate Professor of Construction Science and Management with the Department of Built Environment within the College of Science and Technology at North Carolina Agricultural and Technical State University. Her passion is to utilize her God-given talents to advance sustainability in construction materials, processes, and workforce development. Andrea has over 20 years of occupational experience, with her most recent experience being in teaching, research, and service. Dr. Ofori-Boadu is a dedicated instructor, advisor, mentor, and role model who has served over 1,500 undergraduate and graduate students. Andrea has received almost \$2M from funding agencies to include the National Science Foundation (NSF), the Engineering Information Foundation (EIF), the National Association of Home Builders (NAHB), the National Housing Endowment (NHE), and East Coast Construction Services (ECCS). In 2019, she received her prestigious NSF CAREER grant to construct substantive theories that explain professional identity development processes in undergraduate architecture, engineering, and construction (AEC) women in the United States. In 2020, Dr. Ofori-Boadu received a National Science Foundation (NSF-RAPID) grant award to gain insights into undergraduate STEM student decision-making processes during pandemics. Through seed funds from North Carolina Agricultural and Technical State University's Department of Education (Title III) and Center of Product Design and Advanced Manufacturing (CEPDAM) grants, she investigated the utilization of agricultural waste bio-chars for partial cement replacement resulting in a patent (U.S. Patent No. 11,104,611; August 31, 2021). Her research work has resulted in numerous citations, publications, presentations, and website references such as on the International Bio-char Initiative website. In 2021, Dr. Ofori-Boadu was chosen by the NC A & T Center of Excellence for Product Design and Advanced Manufacturing (CEPDAM) to showcase her research work in a promotional video series named "Women in Design and Manufacturing" during the Women's History Month. Andrea has received several teaching, mentoring, and research excellence awards to include the 2021 Outstanding College of Science and Technology Faculty STEMInist Mentoring Award, the 2020 National Association of Home Builders (NAHB) Outstanding Educator Award, the 2020 NC A & T Junior Faculty Teaching Excellence Award, and the 2019 NC A & T Outstanding Young Investigator Research Excellence Award. Dr. Ofori-Boadu is currently the Director of the year-round Professional Development Program for undergraduate Architecture, Engineering, and Construction women and the STEAM ACTIVATED! Program for middle-school girls at NC A & T. Andrea is married to Victor Ofori-Boadu and they are blessed with three wonderful children.

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ABSTRACT:

COVID-19 is a continuing global pandemic causing significant changes and modifications in the ways we teach and learn here in the U.S as well as around the world. Most universities, faculty members, and students modified their learning system by incorporating significant online or mixed learning methods/modes to reduce in person contact time and to reduce the spread of the virus. Universities, faculty and students were challenged as they adapted to new learning modules, strategies and approaches. This adaption started in the Spring of 2020 and has continued to date through the Spring of 2022.

The main objective of this project was to investigate faculty perception of STEM student experiences and behavior during the Fall 2020 semester as compared to the Spring 2020 semester as COVID-19 impacts were prolonged. Through a qualitative methodology of zoom interviews administered to 32 STEM faculty members across six U.S. Universities nationwide and a theming scheme, the opinion and narratives of these faculty members were garnered in a round one and round two sets of interviews, in Summer 2020 and then in Spring 2021 (following the semesters of interest).

Some of the main new themes that were detected in faculty interviews during the Fall 2020 semester and which reflect faculty perceptions are represented as follow: COVID-19 impact on student and faculty motivation, COVID-19 impacts on labs and experiential learning, COVID-19 impact on mental health, COVID-19 impact on STEM students' involvement in STEM experiential learning opportunities and research. Other previous themes detected and which are revisited to analyze major differences with those themes obtained during the Spring 2020 are presented and not limited to: extra efforts from professors, student cheating behavior, cheating factors and prevention, student behavioral and performance changes, student struggles and challenges, University response and efforts to the COVID-19 pandemic. We explored the differences in these themes between the semesters to look at noticed adaptations and modifications.

Presented will also be recommendations to improve student and faculty motivation along with strategies to enhance the student learning experience during the COVID-19 pandemic. We report on common findings and suggest future strategies.

Introduction:

The emergence of the Corona Virus disease (COVID-19) has instigated the world into an unparalleled public health crisis. With the closure of academic institutions, the need for a swift and bold transition from physical learning to the electronic platform of learning emerged [3]. Within a short period, teaching and learning had to be adjusted to mostly digital and online formats [6]. Both private and academic life, have been considerably affected by the implications of regulations for reducing social contacts and increasing hygiene practices. Online learning become a viable alternative to conventional in-person learning. In some cases, students were

rapidly dislodged from their dormitories and were expected to continue studying remotely without prior appropriate readiness [10]. Due to the remarked variability in levels of preparedness and experience in the use of online course delivery, groups (i.e., administrative staff, faculty, students) struggled and diverse outcomes were realized with the transitions to online learning [9].

Recent research on COVID-19 has demonstrated that this rapid transition had a negative impact on the mental health of college students with symptoms ranging from minor irritability into excessive anxiety and panic attacks [8], [5], [2]. Additionally, various studies demonstrated some student's preference for in person learning rather than online learning [1]. This was mainly due to multiple drawbacks that online learning presents. Some of these drawbacks include but are not limited: poor community development and peer interaction, an overall weaker sense of belonging, difficulty in online tool usage, and challenge in maintaining coherent and consistent motivation among students [4]. Some institutions and children may have demonstrated more resiliency than others through this COVID-19 impacted period

The main objective of this study is to investigate the impacts of COVID-19 on STEM students and faculty experiences during Fall 2020 semester through an interview thematic investigation with faculty and represents a follow up on the previous investigation performed during Spring 2020 [7]. This will enable us to address solutions and remedies if needed and enhance the preparedness of STEM students via faculty and administrative support. This work is part of a larger study funded by the National Science Foundation (NSF) to address the decision-making process in STEM students during COVID-19 through the lens of students, faculty, and administrators at various institutions.

Methods:

The following study is a qualitative research project and represents a follow-up to a Spring 2020 study focused on Faculty Perceptions of STEM Student Behavior and Performance, along with their own experiences during the COVID-19 Pandemic [7]. Common recurring and new themes were identified through first and second-round interviews with 32 faculty members from six universities around the country. The faculty interviewed across these universities consisted of 4 professors of Asian Race, 17 professors of White Race, 7 professors of Black or African American Race and 2 identified as other Race. Furthermore, in terms of sex, 20 professors were male and 10 were female. In addition, 10 professors were teaching at Historically Black Colleges and Universities (HBCU), 17 belonged to Predominantly White Institutions (PWI) and 3 served at Minority-Serving Institutions (MSI).

This study was approved through the North Carolina Agricultural and Technical State University Institutional Review Board (Approved Human Subjects Protocol # 19-0198).

The first round of interviews consisted of 10 questions which were more targeted to understand changes in student behavior, functioning, and learning performance amid the pandemic [7]. The second-round interviews, on the other hand, consisted of a series of 16 questions, 10 of which were used for the first round of interviews and 6 additional new questions to analyze and comprehend the various changes/modification that occurred Fall 2020 semester. Table 1 depicts the full list of these questions along with interview rounds in which they were used. The first-round interview questions, more specifically, enabled researchers to recognize the

faculty perspective on various changes in student behavior and the early impacts of COVID-19 on the experiences of students [1], [7]. The second-round interview questions, on the other hand, addressed new adaptations, changes in motivations, and an overview of the mental health state among students and faculty alike as learning institutions further adjusted to the COVID-19 learning framework.

The new questions in Round 2 are indicated in Table 1 and include those related to motivation such as “Explain how the COVID-19 pandemic affected faculty motivation to teach STEM courses and students' motivation to learn in STEM courses during the Fall 2020 semester”. Other new questions were related to changes in student performance such as “Explain how COVID-19 impacted students' performance in Fall 2020 courses that require pre-requisite courses that were taken Spring 2020?”, and “Describe how the structure of your institution’s laboratories has changed since Spring 2020”. The full list of interview questions is described in the following table:

Table 1: Questions in First and Second Round Interviews

Question No.	Question
Q.1 (Round 1 & 2)	Tell me about yourself and any important COVID related experiences you had during the Fall 2020 semester.
Q.2 (Round 1 & 2)	Explain how and why COVID impacted the functioning and behavior of your STEM students during the Fall 2020 semester.
Q.3 (Round 1 & 2)	Explain how and why COVID impacted the performance of your STEM students during the Fall 2020 semester.
Q.4 (Round 1 & 2)	Explain how and why you responded to changes in STEM student behaviors and functioning during the Fall 2020 semester.
Q.5 (Round 1 & 2)	Explain how and why you responded to changes in the performance of your STEM students during the Fall 2020 semester.
Q.6 (Round 1 & 2)	Explain how and why COVID pandemic impacted your institution during the Fall 2020 semester.
Q.7 (Round 1 & 2)	Explain how and why your institution responded to changes in student behavior and functioning during the Fall 2020 semester.
Q.8 (Round 1 & 2)	Explain how and why your institution responded to changes in student performance during the Fall 2020 semester.
Q.9 (Round 1 & 2)	To what extent, were these institutional strategies effective in maintaining good student performance during the Fall 2020 semester.
Q.10 (Round 2 only)	Explain how the COVID-19 pandemic affected faculty motivation to teach STEM courses and students' motivation to learn in STEM courses during the Fall 2020 semester.
Q.11 (Round 2 only)	Explain how COVID-19 impacted students' performance in Fall 2020 courses that require pre-requisite courses that were taken Spring 2020?
Q.12 (Round 2 only)	Describe how the structure of your institution’s laboratories has changed since Spring 2020.

Q.13 (Round 2 only)	Explain how and why COVID-19 impacted STEM students' involvement in STEM experiential learning opportunities.
Q.14 (Round 2 only)	Explain important differences that you observed between the Spring/Summer 2020 and Fall 2020 semesters.
Q.15(Round 2 only)	Recommend and explain strategies that can be used to improve STEM student functioning, behavior, and performance during future pandemics.
Q.16 (Round 2 only)	Is there anything else that you would like to share with me?

The zoom communication software was utilized as a comprehensive tool enabling both recording and transcription of responses. The faculty members are also given the chance to end their interviews at any moment in time or redo responses from the final analysis. A process of both inductive and deductive coding was then established as means to analyze themes and commonalities observed across multiple interviews [5], [7].

First, raw zoom transcriptions were compared to recordings for error correction. Responses were then used to extract previously established research themes. Additional themes were also detected using the NVivo Software which allowed establishing commonalities in phrasing and words to assess present themes [3], [7]. All themes were discussed and organized in team research meetings, given the interrelatedness of themes. For the new themes determined in the Fall 2020 semester below, raw quotes are provided from faculty members.

Results and Discussions:

These results represent an aggregation of various themes that were detected across all interviews as having commonality in meaning and significance and thus are presented as well as organized in different thematic categories. Old recurring common themes are shared between Round 1 and Round 2 interview sets for both Spring and Fall 2020 semesters. New themes, alternatively, were encountered in Round 2 interview sets only, which enabled us to understand the significant changes that occurred within the academic framework for both faculty, students as well as institutions alike in the Fall 2020 semester. For better clarity, the following table lists these recurring common themes present in both spring and Fall 2020 semesters, along with new themes detected during the Fall 2020 semester only:

Table 2: List of Recurring and New Themes detected in Faculty Interviews

Recurring Common Themes (Spring and Fall 2020 Semesters)	New Themes (Fall 2020 Semester only)
Extra Efforts from Professors	COVID-19 Impacts on Student Motivation
Student Cheating Behavior, Contributing Factors, and Prevention	COVID-19 Impacts on faculty Motivation
Student Behavioral and Performance Changes	Impacts on Mental Health
Universities Responses and Efforts	Impacts on Labs and STEM Experiential Learning

Recurring Common Themes between Spring and Fall 2020:

Extra Efforts from Professors:

Comparably to reported results obtained during the Spring 2020 interviews, the majority of faculty members during Fall 2020 continued to provide extra support to their students enabling new ways to help them succeed in their curricular studies either due to the online formats or due to COVID-19 challenges in the students lives (e.g., family illness). In some cases, hybrid (combination of in-person and online methods) or in-person teachings were provided as additional options, while safety measures were put in place.

Some of the new efforts for Fall 2020 included an increase in the creation of discussion boards and breakout rooms to interact with students, a thorough design of lecture videos as well as lecture notes in a new more simplified, and easier format for students to digest, a reduction in homework difficulty as well as weekly check-ins with students to monitor progress. Other professors also reported demonstrating leniency toward students by extending deadlines, giving extra or partial credits, and modifying general course content.

Continued efforts of professors from both Spring 2020 to Fall 2020 semesters included the provision of extra virtual and in-person office hours, grade curving, and recoding of zoom sessions to allow for an enhanced asynchronous learning experience. Faculty members also remained open to dropping the lowest grades for struggling students and encouraged students to keep their cameras on to enhance class participation.

Student Cheating Behavior, Contributing Factors and Prevention:

Comparably to the Spring 2020 results, Fall 2020 interviews also revealed that student cheating behavior remained present across universities. However, the degree and rate at which cheating behaviors occurred was not as high as when the pandemic first started. This reduced rate of cheating can be attributed to the new efforts instituted by faculty and universities during the fall 2020 semester.

To reduce cheating, multiple faculty members reported implementing new strategies for exams such as introducing questions that required more individual critical thinking and were more difficult to extract from online resources. Other techniques included the use of lockdown browsers, a requirement for mandatory face recording, and randomization of questions. Lastly, multiple faculty members also reported using empathy as means to help understand their student cheating behavior and try to reduce as much as possible using persuasion techniques.

Student Behavioral and Performance Changes (Including struggles and Challenges):

Contrary to the Spring 2020 in which most if not all universities remained in an online teaching setting, the Fall 2020 saw combinations fully online, hybrid or full face-to-face communication. Some universities saw delays and transitions across these platforms. Some faculty felt that returning to a fully face-to-face format had a positive effect on some student behaviors enhancing their willingness to engage in learning and observing among students their

strong desire to be part of a social group. However, multiple faculty members reported low attendance due to continued concerns of COVID-19 spread or family challenges, where the online format may have better supported their challenges. Still, burnout and low participation were reported in the online format. In general, faculty members noted that most students were severely challenged with time management given the COVID-19 challenges, regardless of course format. However, other faculty members noted that some students remained diligent throughout their course and struggled less than others.

Similarly, to the Spring 2020 semester, faculty reported that students continued to exhibit multiple struggles and challenges during the Fall 2020 semester with some more prominent than others. For example, students continued to experience difficulty with internet connectivity and bandwidth when attending online classes or even conducting some assignments online. Students continued to struggle with signs of depression and anxiety, also exhibiting fatigue from constant zoom meetings. Others reported not having proper study accommodations at home (i.e., dedicated room and privacy), and losing internships that affected their economic situation.

Universities Response and Efforts:

Contrary to the mediocre efforts remarked and performed by universities during the spring 2020 semester, the Fall 2020 interviews revealed that multiple universities across the U.S stepped up their preparation efforts to accommodate the academic needs of their students for Fall 2020. Indeed, faculty members reported that various universities provided more counseling services and mental health support, they encouraged faculty to be more understanding towards their student's situation and implemented new financial assistance programs to help students that are in distress. Additionally, multiple professors noted that universities offered mid-semester surveys as well as generated student forums to give students a chance to express their concerns. One faculty even reported their university creating virtual "Happy Hours" where students could get together and do activities to help boost their confidence and academic skills.

Some of the efforts that were previously implemented by universities during the spring 2020 semester and remained present during fall 2020 included the implementation of grade policy changes offering pass/fail options for struggling students, asking faculty to be more lenient, as well as the provision of enhanced communication and increased reactivity to encountered issues.

New Themes for Fall 2020:

COVID-19 Impacts on Student Motivation:

Student motivation to learn in the COVID-19 environment was a new detected theme for Fall 2020, where faculty reported both positive and negative variations in student motivation. Some students had increased motivation given the clarity and organization of coursework for both online and hybrid teaching for Fall 2020. This reveals that universities (faculty and leadership) enhanced communication with both students and faculty about what to expect and provided resources for improving coping mechanisms. Some students were motivated to improve

their grades due to lost scholarships and opportunities affected by Spring 2020 performance. In addition, the empathy expressed by multiple faculty members towards their students during the Fall 2020 semester encouraged students to get motivated again towards learning. Alternatively, some faculty reported reduced motivation among students due to the continued adoption of an all-online learning environment they deemed not suitable for their learning style. In addition, challenges with internet connectivity as mentioned previously, and insufficient provisions for online learning further reduced their motivation to learn. Some students were overwhelmed with workload affecting their motivation to learn.

Faculty Quote: "I think that student motivation took a hit, like I said, some students were in class and they're logged on, but again sometimes their cameras weren't on or if they were on, they were doing something, you know, like they're doing their hair or they're laying down in their car. Sometimes, like I said, I asked them to put some feedback in the chat and not everybody was responding. I know that students communicated to me that they were not only frustrated with the online format and not meeting face to face, but also had multiple difficulties in their daily lives and coursework, like saying I'm just having a hard time managing everything, I'm having a hard time focusing, I'm having a hard time with my family."

COVID-19 Impacts on faculty Motivation:

The impact of COVID-19 and challenges to learning negatively affected faculty motivation to teach in this environment. Some faculty expressed that it was challenging to provide the same quality of education to students in an online setting, especially when dealing with analytical and STEM classes which require a hands-on application. Consequently, this decreased their motivation to lecturing and enabled a more reactive rather than proactive methodology of teaching. A decrease in faculty motivation was also remarked due to the lack of funding at some universities where budget restraints resulted in some staff or faculty being cut from consistent pay or paycheck being reduced which negatively affected faculty members moods, especially during the COVID-19 pandemic period where various learning and teaching resources are much needed. Other faculty members also missed the immediate feedback from students in the classroom settings, which decreased their enthusiasm for teaching. Furthermore, various faculty members also described difficulties in time management, especially when transitioning to the Fall 2020 semester where the COVID-19 regulations remained unclear. This motivational challenge remained more prominent as some universities were still lacking behind in providing adequate training and support to faculty members concerning online teaching.

Few faculty members, on the other hand, reported positive motivation to teach especially for those members who were provided more flexibility in teaching modes and were allowed to transition to face-to-face teaching in some of their classes.

Faculty Quote: "So, while we're all dealing with a downside motivation from the pandemic. We're now getting emails that this funding stream and the other is cut off and we're going to have to be doing things differently in the future. And so, while you're already at a motivational low you're getting kind of cut off at the knees about being able to do any

professional development or job growth or that kind of stuff. So it's just double overwhelming for us as professors and faculty members."

Impacts on Mental Health:

During the faculty interviews, COVID-19 had some significant impacts on the mental health of faculty as well as students alike and thus is an essential theme that must be reported. Indeed, faculty members reported increased high levels of stress among students, where tiredness, anxiety and irritability reduced learning performance. Students also experienced difficulties in keeping up with their assignments and exams, especially in the online format, and this was not made easier by the subsequent illness, along with financial and social stress encountered in their daily lives as reported by faculty members. In addition to students, Faculty members also experienced a decrease in morale during the Fall 2020 period with no subsequent end to the pandemic insight and many struggled in balancing the pandemic life and keeping up with consistent online work ethic as reported in several interviews.

On the other hand, faculty members who adopted face-to-face class format tended to report decreased stress levels and anxiety among their students mainly due to the enhanced social factor and group work that face-to-face classes enabled. Some faculty members also sustained reduced stress levels when they taught in the face-face format in specific universities which adopted this policy, as opposed to when they encountered a sense of fatigue during the preparing of online lectures during the spring 2020 semester.

Faculty Quote: "I mean, I even realized that I'm sometimes very irritated, you know, because of this pandemic situation. I mean all of a sudden it happened, so you still have to adjust. So, I tried to encourage my students but they are sometimes very, very irritated. Seems like they are irritated because of this whole situation which includes a lack of social gathering, lack of physical exercise, lack of participation, lack of class attendance due to online classes all which seems has taken a toll of their mental health"

Impacts on Labs and STEM Experiential Learning:

During Spring 2020, all labs moved online and some were dramatically shortened. During Fall 2020, faculty members reported significant changes in lab structures. Some labs improved content for online delivery, utilizing at-home science kits, as well as recorded in-person labs to be then loaded within online learning platforms. On the other hand, for universities that utilized face-to-face labs, several regulations were implemented such as decreasing classroom size and making sure students work individually. Reduced class sizes had the advantage of increasing faculty-student engagement, but resulted in increased time and teaching needed for faculty to deliver the learning material. Overall, faculty viewed online labs as being less effective, but necessary at times for safety reasons.

Faculty Quote: "All the labs moved online, and I just think it's just a much negative learning experience because students are doing it primarily by themselves as opposed to in

collaboration with their peer's colleagues that they're sitting next to. In my opinion, I think that so much of the learning happens by interacting with one's peers in the, in real-time, as opposed to online."

Proposed Strategies to Enhance Student and Faculty Motivation

Faculty were able to propose strategies aimed at enhancing the student and faculty motivation following their further experiences in Fall 2020. This included the necessity for social groups to help alleviate the isolation of both students and faculty to keep them motivated with the inclusion of cohort social groups. Additionally, faculty members also recommended that there was still a need in increasing faculty training for online teaching delivery during the Fall 2020 semester. Faculty interviews also revealed that faculty members were keen in encouraging a reduction in frequent faculty budget cut-offs, especially during prominent periods where increased faculty time and commitment were required. Other strategies also included in the interviews were the necessity in promoting both synchronous and asynchronous learning in the online format to accommodate faculty and student preferences, along with a requirement to implement enhanced framework strategies to enhance the mental health of students and faculty members alike. These reported strategies were meant as means to increase motivation and inclusivity within institutions of higher education in the U.S during the COVID-19 pandemic period.

Conclusion & Future Work

To sum up, this qualitative research study shed a light on the general differences and commonalities COVID-19 had on students and faculty members transitioning from Spring 2020 to the Fall 2020 semester. Some of the main new themes that were detected within faculty interviews during the Fall 2020 revolve around the negative mental health toll that COVID-19 had on students and faculty alike, the lack of labs and hands-on STEM experiential learning, as well as a general feeling of wanting to return to normality and face to face learning. Another important new theme detected was both student and faculty motivation and how it was affected by the persistence of COVID-19 over the year. Recommendations and strategies to enhance motivation were proposed (e.g., creation of groups, implementation of other innovative online teaching methods ...). In addition, several themes remained consistent and recurring from Spring 2020 to the Fall 2020 semester. Future work will involve quantitative analysis of Spring and Fall 2020 results to better understand the statistical implications of observed themes across both faculty characteristics (i.e., sex, race..) and university type (HBCU, PWI ...).

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