COVID-19 Impacts on AEC Educators

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To alleviate the impact of COVID-19 on academia, numerous countries transitioned to electronic or online methods for education delivery. Within the US, during March and/or April 2020, numerous institutions transitioned to Online Learning Environment (OLE). However, very little is known about how the transition to OLE impacted the educators. Thus, the research aimed to determine the impact of OLE transition on AEC educators as per the academic ranks and gender. The study utilized an online survey method with the study emailed to 1,880 educators across the US during May-August 2020. The study presents the findings of 179 educators. The study found that with the transition to the OLE, proficiency with online content delivery was reported to have increased considerably. The majority of the respondents indicated that the transition to an OLE negatively impacted their productivity. Different faculty ranks perceived productivity impacts on "Research," "Service," or "both research and service" differently. Tenure-track balance faculty indicated that the "Research" productivity was negatively impacted, whereas part-time faculty and full-time non-tenure-track faculty indicated the "Service" productivity to be impacted negatively. Transition to an online environment also resulted in negative productivity across educator genders, with men reporting slightly higher negative productivity impacts than women.

Key Words: COVID-19 Impact, Online Learning Environment, Faculty Rank, Gender

Introduction and Background

As of January 6th, 2021, approximately 20.06 million COVID cases were identified within the US (CDC, 2021a). The COVID-19 pandemic continues to have a global impact with significant implications for academia. In response to COVID-19 impacts, numerous strategies were implemented by countries across the globe to ensure that quality education is imparted to the students without putting university stakeholders (students, educators, upper administration, staff, and others) at risk of infection (The World Bank, 2020; DfE, 2020; CDC, 2020b). Numerous countries such as Egypt, Finland, France, India, Indonesia, Italy, and others utilized electronic or online methods to deliver education (The World Bank, 2020). The Center for Disease Control (CDC) has issued guidelines for

reopening educational institutions in the *lowest, some, medium, higher, and highest risk* categories (CDC, 2020b). The lowest risk is associated with learning activities conducted in an online environment. The risk increases as interactions between the university stakeholders become in-person, and the recommended strategies for hygiene, social distancing, and others are ignored (CDC, 2020b). During the initial impact (March/April 2020), numerous institutions transitioned to the Online Learning Environment (OLE) within the US. However, very little is known about how the transition to OLE impacted educators. Further, minimal information is available that assesses faculty's expertise in creating and delivering online content within the US, especially with educators associated with Architecture, Engineering, and Construction (AEC) programs.

OLE existed before COVID-19. Its emergence can be traced to the early 1990s and was expected to grow substantially, even before COVID-19 (Deming et al., 2015; Hosie et al., 2005). Numerous benefits, such as the convenience to the learner and educator (Arbaugh, 2000; NEA, 2001; Shea et al., 2005), economics and scalability (Deming et al., 2015), increased higher education access (NEA, 2001), and higher levels of student learning (NEA, 2000, Shea et al., 2001), and others could be attributed to the success of online education. Even within the AEC education, numerous researchers have depicted how online education can be delivered effectively (Gao et al., 2009; May and Brady, 2003; Ahmed et al., 2016; Kelting et al., 2016; Xie et al., 2006). At the same time, online content development and delivery can prove to be challenging for instructors, especially with the pandemic. For example, the OLE goes beyond merely transferring the course content to a Course Management System (Alungbe et al., 2008). Reduced student interaction (Kinney et al., 2012) and maintaining the academic integrity of the education delivered (Tabas et al., 2012) are additional areas of concern that can impact educators. Faculty delivering courses that integrate or rely on laboratories (lab), studios, or computer software are another area of concern for the faculty. Additionally, administrative support can also impact an online environment's success (Han et al., 2018).

Along with the challenges associated with the new teaching paradigm, educators are also impacted by externalities. Indications exist of COVID fatigue among educators (Education Week, 2020; TABS, 2020). Some of the identified symptoms with the COVID fatigue and quarantine of people in response to COVID-19 include reduced work performance, exhaustion, fear, isolation, emotional distress, and others (UAB, 2020; Brooks et al., 2020). Given the challenges educators face at the professional level (with new work paradigms, including teaching in OLE) and personal levels (with constrained lifestyle and impact of family life), it is critical to determine the impact of the current work paradigm on educator ranks associated with the AEC programs.

Thus, the research aims to assess the COVID-19 impacts on AEC educator ranks within the US, based on academic rank and gender.

Method

To assess the COVID-19 impacts on educator ranks, a survey methodology was used as it allowed the researchers to ascertain the impact of COVID-19 on the academia and educators' perceptions for the transition in response to the pandemic. The survey method was selected as it allowed trend identification among the population at a given point in time (Gable, 1994). Among various methods of conducting the survey, the online method was selected as most of the US population has access to the internet (Sheehan, 2001), and there was a higher likelihood that the educators would have an email account. Further, electronic surveys tend to generate a quick response (Flaherty et al., 1998), and the value generated by the method outweighed other survey methods. In addition, since the study was conducted during the pandemic, it was assumed that the online method allowed researchers to obtain a

higher response rate. The online instrument was designed on Qualtrics and had numerous sections, including- multiple-choice (single answer & multiple answers), Likert scale, and short and long essay type questions. The instrument was pilot tested for aesthetics, instrument reliability and validity, and grammatical errors, and Institutional Review Board (IRB) approval was obtained. Educators affiliated with AEC programs across the US were identified as the study population. The study population was purposively selected due to the program's ability to encompass the fields associated with engineering, science, arts, and design. The educators' contact information was obtained from publicly available information sets and email listservs such as the Associated Schools of Construction and American Society of Engineering Education. The survey link was emailed to educators and administered during the months of May-August of 2020. The study was emailed to approximately 1,883 AEC educators within the US. Approximately three educators in the initial list responded that they had retired, which reduced the sample population to 1880. After the initial email, one reminder email was emailed, and the survey was closed after a few weeks of the reminder email.

Results

Approximately 258 educators responded to the study. Given that the article focused on assessing the COVID-19 impacts on educators within the US, filters were applied to the data compiled. The applied filters included survey completion and the geographic location at which the responding educator was affiliated (the US in this case). With the application of the filters, the total number of respondents reduced to 179. The subsequent section provides an overview of the respondent demographics.

Respondent Demographics

The majority of responding educators identified themselves as male (78%), had a Ph.D. (70%), were tenured (44.1%), and had more than 20 years of total teaching experience (31.3%) (Figure 1- 4). Further, the study received responses from educators geographically located in forty-six US states, with 8.4% of the respondents indicating that they were from California and Texas, respectively, followed by 6.7% of educators from North Carlina. For the respondent department/program affiliation, the top three were programs to which the respondents affiliated were Construction Management (37.7%), followed by Civil Engineering (21.5%), and Construction Science Management (9.5%). The responding faculty also identified program/department affiliation with Architecture, Building Construction, Building Science, Civil and Architecture, Civil and Environmental Engineering, and other AEC technology programs.
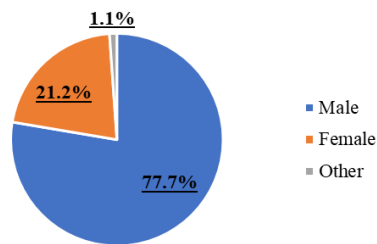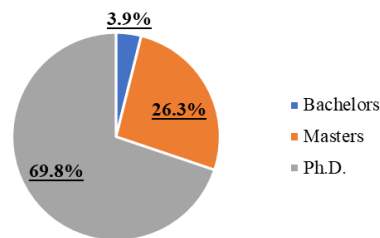

Figure 1: Respondent Gender (n=179)

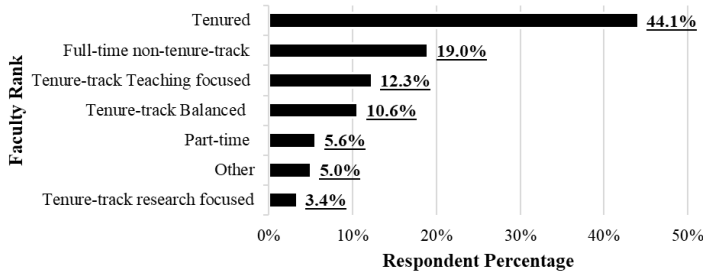Figure 2: Respondent Highest Education (n=179)
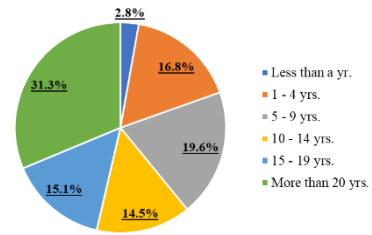
Figure 3: Respondent academic rank (n=179)

Figure 4: Respondent total teaching experience (n=179)

COVID-19 Impact on Educators

The section discusses how faculty across multiple academic ranks transitioned to the OLE in response to the COVID-19. To determine the transition, the researchers first determined a baseline with information about the online teaching experience before January 2020. About 92.4% of the responding faculty indicated the face-to-face delivery method, followed by 5.1% responding educators indicated the hybrid delivery, and 2.2% of responding faculty indicated online delivery as the primary method for content delivery within their department before January 2020 (Pre-COVID). Simultaneously, most of the responding educators (70.9%) indicated possessing teaching experience using an online method before the COVID-19 impact. When reviewing the information from the academic rank perspective, 80% of the "part-time faculty" indicated having some experience using the online delivery method, followed by 70.9% of the "tenured faculty" indicating experience (Figure 5).
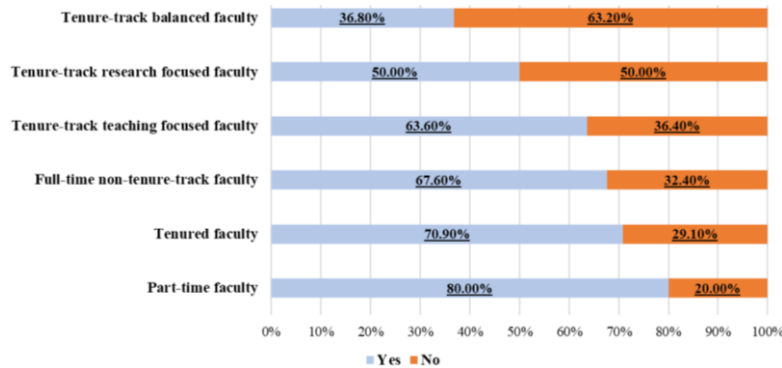

Figure 5: Experience using the online method based on Academic Ranks before COVID-19 Impact

With the transition to the online environment in response to COVID-19, the researchers aimed to determine the changes in proficiency levels with online education delivery among the educators associated with AEC programs. The majority of the respondents indicated a proficiency increase in the categories for "Competent and Proficient" from the perspective of "proficiency with online content delivery." For the "Never Interacted" category, the academic ranks of "Part-time" and "Tenure-track balanced" observed a substantial decline. For the "Competent" category, the academic ranks of "Part-time, Tenure-track teaching" and "Full-time non-tenure-track faculty" observed the most considerable proficiency improvements. For the "Proficient" category, the academic ranks of "Tenure-track research" closely followed by "Tenure-track teaching" and "Tenure-track balanced" observed the most considerable proficiency improvements. All educator ranks observed significant proficiency increases in the category of "Proficient." To summarize, the proficiency levels with online teaching among the
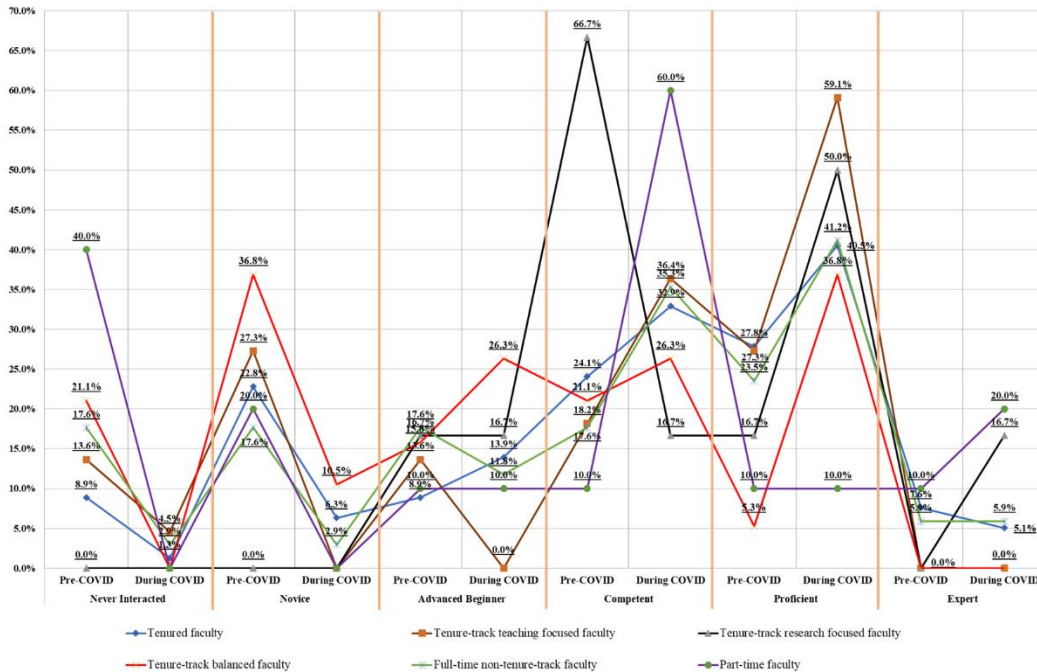
responding educators increased.

Figure 6: Online teaching proficiency based on academic ranks before and during COVID-19
(n=170, not including respondents selecting "other" as academic rank)

The researchers also aimed to measure the impact of the transition to OLE on the responding educators. Approximately 53.6% of the respondents indicated that the transition to an online environment negatively impacted their productivity. When analyzing the negative productivity from academic ranks, tenure-track teaching-focused faculty (59.1% of the rank) identified as most impacted, followed closely by tenured and tenure-track balance (Figure 7). When analyzing the data from the perspective of gender, a nominal difference was observed, with Males reporting slightly higher negative productivity with the transition to OLE (Figure 8).
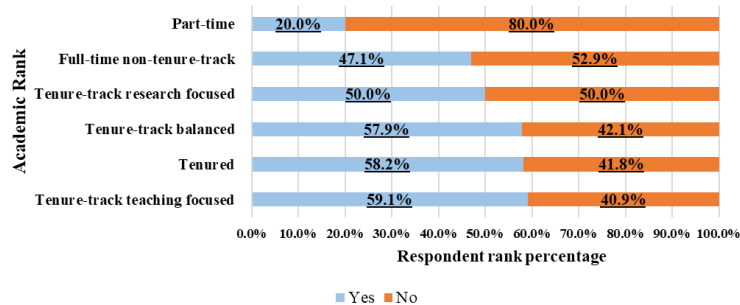

Figure 7: Negative productivity impact with the transition to OLE, as per respondent academic rank
(n=170, not including respondents selecting "other" as academic rank)

The researchers aimed to determine which aspect apart from teaching was impacted for the educators that indicated a negative productivity impact due to transition to an online medium. For this, two

categories of "Research" and "Service" were created with the option to select either or both the categories. Data indicates that different faculty ranks perceived productivity impacts on "Research," "Service," or "both research and service" differently (Figure 10). For the category of "Research," Tenure-track balanced faculty identified productivity being impacted negatively. For the category of "Research and Service," Tenure-track research focus closely followed by Tenure-track teaching focus identified productivity impacted negatively. For the category of "Service," Part-time faculty and Full-time non-tenure-track faculty identified productivity being impacted considerably.
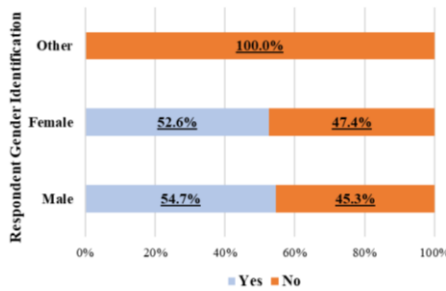

Figure 9: Negative productivity impact with the OLE transition, as per respondent gender (n=179)
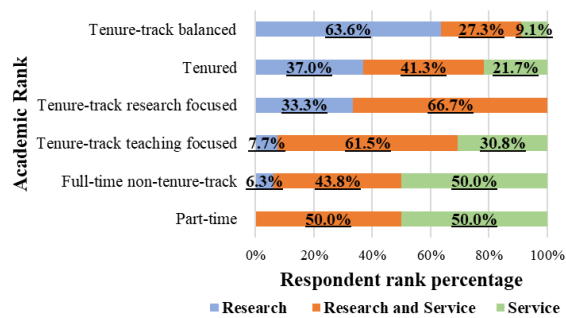
Figure 10: Negative productivity impact on areas as per the faculty rank

Further, to determine the reasons that could be attributed to productivity decline, the research team developed a set of ten statements that could be attributed to productivity loss (Table 1). The statements were shared with a panel of external reviewers to determine the viability. Based on the recommendations, the "other" option was added. For the respondents that indicated a productivity decline, respondents were asked to identify the reasons that could be attributed to the decline, with the ability to select multiple statements. The top five statements selected by the respondents, reflecting the productivity decline, in the order of importance were:

1. I spend more time developing content for the classes (S_1).
2. I spend more time communicating with students enrolled in the classes (S_3).
3. I spend less time on research (S_5).
4. I spend more time delivering the class content (S2).
5. My interactions with students conducting research with me are reduced (S_{10}).

For the respondents that selected the "other" category, reasons impacting productivity were attributed to- 1) personal (Children at home or managing children), 2) less positive class interaction, spend more time coordinating with adjunct faculty and colleagues, inability to hire international students due to travel ban, and inability to effectively see if my students are comprehending the lessons.

When analyzing the information set from the academic rank, the following top three statements attributed for impact on productivity on each academic rank were:

1- *Tenured educators* and *Tenure-track balanced educators* identified "S_1, S_3, and S_5" as the top three reasons impacting productivity. The educator had groups indicated to be impacted by higher time in content development, less time on research, and mandatory training(s) required by the institution.

2- *Tenure-track teaching-focused educators* identified "S_1, S_5, and S_7" as the top three reasons impacting productivity. Responding educators from the group indicated higher time spent on content development, lack of resources, and support.

3- *Tenure-track research-focused educators* identified "S_1" followed equally by "S_2, S_3, S_4, S_5, and S_8" as the top reasons impacting productivity. More than three reasons were provided here as the faculty group provided equal weightage to them. The faculty group indicated to be impacted by higher time on content development, lack of resources (human and technical), support, and mandatory training (required by the institutions).

4- *Full-time non-tenure-track educators* identified "S_1, S_3, and S_2" as the top three reasons impacting productivity. The faculty group indicated to be impacted by higher time in the content development, delivery, and communicating with the students.

5- *Part-time educators* identified "S_1, S_2, and S_4" as the top three reasons impacting productivity. Thus, the faculty group was impacted by higher time in the development and delivery of content and mandatory training that have been reported to have increased.

Table 1: Attributes for impact on productivity as per the faculty rank

Statement (S_n)	Faculty Academic Rank					
	Tenured	Tenure-track teaching-focused	Tenure-track research focused	Tenure-track balanced	Full-time non-tenure-track	Part-time
I spend more time developing content for the classes (S_1)	64.6%	52.4%	40.0%	78.6%	65.2%	50.0%
I spend more time delivering the class content (S_2)	43.1%	19.0%	20.0%	28.6%	39.1%	50.0%
I spend more time communicating with students enrolled in the classes (S_3)	49.2%	38.1%	20.0%	57.1%	60.9%	25.0%
I spend more time in the mandatory training (S_4)	16.9%	14.3%	20.0%	7.1%	17.4%	50.0%
I spend less time on research (S_5)	49.2%	42.9%	20.0%	64.3%	21.7%	25.0%
I do not have access to lab equipment that would allow me to conduct research (S_6)	13.8%	19.0%	0.0%	35.7%	13.0%	0.0%
I do not have access to resources (S_7)	15.4%	42.9%	0.0%	7.1%	4.3%	0.0%
I do not have access to research equipment (S_8)	13.8%	19.0%	20.0%	28.6%	13.0%	0.0%
I am unable to interact with my graduate students (S_9)	9.2%	14.3%	0.0%	21.4%	0.0%	0.0%
My interactions with students conducting research with me are reduced (S_{10})	32.3%	23.8%	40.0%	35.7%	13.0%	25.0%
Other (S_{11})	4.6%	4.8%	0.0%	14.3%	8.7%	0.0%

Across all faculty ranks, S_1 (spending more time developing content for the classes) was identified as the most common attribute impacting the faculty productivity. When reviewing the information from the perspective of tenure-track/tenured faculty in comparison to non-tenure-track faculty, some of the following observations were made with regard to the negative productivity impacts:

1- *Spending less time on research (S_5)* was consistently identified as the most common statement by responding educators identifying themselves as tenured or tenure-track (all ranks- teaching, research, or balanced).

2- *Spending more time developing content for the classes (S_1)* and *delivering the class content* (S2) was consistently identified as the most common reason by responding to educators identifying non-tenure-track.

Conclusion

The research aimed to determine the impacts of COVID-19 and the current work paradigm on educators associated with the AEC programs. With the transition to an OLE, it was a mixed bag for the academic ranks. On the one hand, considerable proficiency improvements with online content delivery were reported, but on the other hand, a decline in productivity was reported across the academic rank and genders. The study found that before COVID-19, even though an overwhelming majority of responding educators indicated face-to-face delivery as the primary content delivery method, at the same time, nearly 70% of the responding educators indicated possessing some experience teaching in an online environment. The transition to OLE saw substantial proficiency improvements across all academic ranks. Considerable proficiency improvements were observed among the majority of responding educators in the "*Competent*" and "*Proficient*" categories. While the teaching proficiency improved, the majority of the respondents indicated a decline in productivity. Different academic ranks perceived productivity declines differently. For example, Tenure-track balance faculty indicated the "Research" productivity, whereas part-time faculty and full-time non-tenure-track faculty indicated the "Service" productivity to be impacted negatively. The productivity impacts were observed across the gender, with Males reporting slightly higher productivity decline than Females. On an overall basis, the productivity decline could be majorly attributed to spending more time developing class content, more significant time communicating with the students, and increased mandatory training. Simultaneously, when the data was dissected across academic ranks, there was a clear distinction for reasons that impacted the tenured or tenure-track compared to ranks identifying as non-tenure-track. For tenured or tenure-track (all ranks), spending less time on research was a significant reason, whereas for "non-tenured," spending more time developing and delivering content resulted in productivity decline.

Future Research

This study is one of the first few studies within the US that assess the impact of COVID-19 transition to the OLE. Although this study analyzed the impacts on educators, the students and upper administration are integral stakeholders whose perspective is equally important and needs to be assessed. Detailed studies need to be conducted from the perspective of the continuation of OLE and how it has impacted the student learning outcome. Given that academia in the future will continue to be prone to the ecological (natural disasters such as floods, severe storms) and pandemics, a continued discussion needs to occur about how programs, including AEC, can be resilient to the future impacts irrespective of times and geographic locations.

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