An Assessment of Master's Degree Programs Pre and Post Pandemic

Kuiyuan Li* and Samantha R. Seals

***Abstract*—In this study, graduate "programs of strategic emphasis" at a state university in Florida, USA during the spring semesters of 2019, 2020, 2021, and 2022 were examined. The students' application, enrollment, performance, and graduation data for the four semesters were collected and analyzed. Due to COVID-19, all courses had to be delivered purely online in the latter spring semester of 2020. Facing various challenges and uncertainties, the Graduate School worked with all programs to update their programs and remove admission barriers, including graduate record examination (GRE) requirements. After the onset of the pandemic, the number of applicants increased ($p < 0.001$), the number of students enrolled increased ($p < 0.001$), and the yield rate of enrolled new students compared to applicants decreased ($p < 0.001$). Despite the removal of admission barriers, the undergraduate grade point averages (GPA) of new applicants did not decrease ($p = 0.500$), graduate GPA in the first semester increased ($p < 0.001$), and overall graduate GPA increased ($p < 0.001$). Finally, graduation rates increased after the onset of the pandemic ($p < 0.001$). This study demonstrates that despite challenges due to the pandemic, removal of admission barriers did not adversely affect student outcomes.**

***Index Terms*—Admission, enrollment, performance, pandemic**

I. Introduction

In this study, master's degree programs considered as "programs of strategic emphasis" (PSE) at a regional comprehensive university in Florida, USA are examined. The "Performance Based Funding Model" was approved at the January 2014 Florida Board of Governors (FL-BOG) meeting [1]. The model includes 10 metrics with a total of 100 points that evaluate Florida public institutions on a range of issues. The graduate programs are divided into two groups: PSE and non-PSE by the FL-BOG. Most PSE are those programs in science, technology, engineering, and mathematics (STEM), health care and service sectors, and education technology areas. The list of PSE is updated annually based on the analysis of the job market and workforce demands [2]. In general, the students who graduate in PSE have a higher probability of going into high-paying careers [2–4]. As such, PSE could potentially enhance the local workforce and help the local economy.

Metric eight of the ten metrics measures the graduation rate of graduate students awarded degrees in PSE over the total graduate students awarded annually. If it is 60% or higher for PSE students, the institution will receive 10 points. Thus, the Graduate School at this institute has the responsibility to work with all PSE to adequately support students to increase the graduate rate and maintain it at above 60% in PSE. Clearly, to maintain the rate above 60%, the institute must increase its PSE enrollment. However, COVID-19 outbreak both placed challenges and provided opportunities to the Graduate School.

In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak as a pandemic as the virus had spread to over 170 countries [5]. Like most higher education institutions, all Florida State University System (FL-SUS) institutions ceased face-to-face teaching and learning after the WHO's declaration of a pandemic. At the onset of the pandemic, this regional comprehensive university had less than 30% of students enrolled in online programs and many faculty did not have an online component to their course [6].

Even though online teaching and learning is not new to most universities, unplanned school closures and shifting all courses online raised multiple challenges, especially for most PSE [6–8]. These challenges included availability and cost of IT equipment and both faculty and student inexperience in online teaching and learning.

After switching to remote work, computers and IT equipment at home were in great demand. The right equipment is essential for online teaching, however, both costs and availability were an issue during the onset of the pandemic [7, 9, 10]. Another IT-related issue was the availability of high-speed internet. All traditional face-to-face students were forced to take online courses in the latter half of the 2020 spring semester, but some did not have a reliable internet connection at home [8, 11, 12]. Additionally, some students had to share computers with family members, children who were in school, or spouses working from home, so it was difficult for them to meet deadlines and/or attend a synchronous class [8, 13, 14].

For some faculty and students who were inexperienced with online teaching and learning, the pivot from exclusively face-to-face to online-only was very difficult [8, 11, 12]. Learning both the web conferencing technology and expanding the functionality of learning management system (LMS; e.g., Canvas) pages already designed was a challenge to confront all at once [14].

Attempts at implementing synchronous courses also met challenges. At this institution, some students were intimidated by the online seminar format, especially shy students whose participation in discussions decreased [8, 14]. Others found it difficult to attend synchronous courses after moving home where they faced distractions of family and limitations of workspaces. Faculty found that they needed to be much more flexible to ensure access to content and engagement with course materials [8, 14].

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Asynchronous courses are much more flexible, but they left some students at this institution feeling like they were not getting the same attention and tools as they would in an in-person class [8, 11, 13, 14]. Many students felt they needed a more rigid schedule with clear, live meetings, to get things accomplished. Others needed asynchronous course content so that they could go to work, take care of family, or manage whatever unforeseen barriers emerged. Faculty tried to compromise during the 2020–2021 academic year by offering hybrid courses with optional course meetings or recorded discussions/lectures [8, 14]. By spring 2021, many physical lab-based science programs at this institution returned to meeting almost completely in person while wearing masks and remaining socially distanced.

Taking advantage of the changes imposed by COVID-19, the Graduate School at this institution worked with each of the 35 graduate programs during the 2020–2021 academic year to see if program updates were needed. During the year, most courses were delivered in fully online format. For those face-to-face programs, serious challenges as mentioned above were faced, presenting opportunities for the programs to update the curriculum and program delivery. Some programs removed outdated courses and added new courses and updated the curriculum. Some programs changed from face-to-face to purely online to meet the demands of the pandemic.

The Graduate School also worked with programs to remove admission barriers. During the spring semester of 2019, all programs required GRE scores for admission. Due to COVID-19, it became more difficult for students to take the GRE as most test centers were closed. Although taking the GRE online was an option, some students did not have the required computer equipment to do so. By the end of the 2021–2022 academic year all programs permanently removed the GRE admission requirement for those applicants whose GPA was above a certain threshold beginning in fall 2022.

At any institution, students stopped-out of their programs for various reasons. As the unemployment rate was so high during the pandemic in the USA, the institution under study recognized an opportunity to help some of these students to finish their programs. The Graduate School undertook calling/contacting campaigns after the onset of the pandemic, reaching out to stopped-out students in PSE who were in academic good standing and could finish the program in a semester or two. To assist the students with the financial burden, the institution provided additional financial aid to those students. With these efforts, the institution under study was able to graduate more students in PSE.

To measure the impact of COVID-19 and the move to virtual learning, the data of application, new student enrollment, overall enrollment, student performance, and graduation data for the spring semesters of 2019, 2020, 2021 and 2022 were collected and analyzed. These four spring semesters were selected because each semester had its unique situation. In spring 2019, all courses were taught normally. In spring 2020, all courses were taught normally in the first half of the semester, then all courses were switched to purely online delivery for the second part of spring semester. In spring 2021, some courses were taught face-to-face due to the nature of the subjects while others remained online or were delivered as hybrid. Even though some of the courses were taught online, the delivery methods were amended and improved based on data from the spring and fall semesters of 2020. In spring 2022, many face-to-face courses resumed as they were pre-pandemic, however, some were delivered fully online or synchronously.

The pandemic forced the institution under study to make changes such as curriculum reforms, course delivery methods, admission requirements, enrollment management, and program quality control. The university leadership team would like to know the impacts of these changes so that they can act accordingly. Therefore, the goal of this study is to determine what effects, if any, COVID-19 had on graduate PSE at this regional comprehensive university in the FL-SUS. Specifically, student outcomes pre- and post-onset of COVID-19 are compared. In Section II, the course delivery methods for the four semesters are outlined. In Section III, the research questions are listed. In Section IV, the data and data analysis are provided. In Section V, implications and limitations are discussed.

II. Programs of Strategic Emphasis and Course Delivery Methods

The institution of study offers 35 master's degree programs with 24 designated by the FL-BOG as PSE. Of the graduate programs considered PSE, 11 were offered purely online and four were offered both in person and online, for a total of 15 programs (68%) with some component of online teaching and learning pre-pandemic. In comparison, two (18%) non-PSE programs were offered purely online pre-pandemic with no programs offering both in person and online options.

For the 11 programs offered purely online, lectures were provided asynchronously with assignments submitted via the learning management system (LMS; e.g., Canvas). For the four programs offered both in person and online, only one program was offered synchronously while the other three programs offered a mixture of asynchronous, synchronous, and in person courses.

For the courses which were offered synchronously online, the lectures were delivered from a classroom with either a computer equipped with a sympodium or a tablet PC on which the instructor could write the lecture materials. For each course, some students enrolled as traditional face-to-face students, while others enrolled as distance students and attended the scheduled class via web conferencing, such as Elluminate, Blackboard Collaborate, WebEx, and Zoom. Lectures were live with instruction given simultaneously to both face-to-face and distance students. Each lecture was recorded, and the recorded lecture was posted on the LMS. The LMS was used to supplement with course information, instructor's summaries, homework assignments, recorded lectures, and multiple formats of out-of-class discussions, varying from those made up of small groups to those including the whole class.

In contrast to asynchronous and synchronous online teaching, most lab-based science programs were taught completely face-to-face pre-pandemic. In fact, some faculty

did not utilize the LMS to post course information or assignments. The courses were run as in-person with traditional lecture format and lab courses were taught in the specific laboratories.

In face-to-face programs, all courses had to be moved to fully virtual teaching in diverse ways. Both faculty and students found the move to online courses much more jarring and experimented with diverse approaches, some choosing to have asynchronous classes only while others adopted a hybrid approach using both synchronous and asynchronous delivery. Assignments and interaction were limited for the faculty and/or programs that chose asynchronous delivery only, as many did.

During COVID-19, online programs kept the same teaching methods. Synchronous online programs retained the courses' delivery method, however, there were no face-to-face students. Faculty continued to utilize web conferencing to deliver lectures online at flexibly scheduled times to students in real-time. The students attended the course by logging on to the class at the scheduled time and interacting with the instructor in real time, creating an experience that is like being physically present in the classroom. Additionally, because all lectures were recorded and posted, students could later review them as needed, creating additional learning opportunities for students that are unavailable through other modes of instruction. Group projects and all assignments were easily handled via the LMS, while office hours were set up with web conferencing to accommodate students' needs.

III. Research Questions

To measure the impact of COVID-19 and the move to virtual teaching and learning, the application, new student enrollment, and overall enrollment data were collected for the spring semesters of 2019, 2020, 2021, and 2022. Although some universities in the world may limit admissions to the fall semester, there are rolling admissions at the institution under study. The graduate students' enrollment in spring semester is always slightly higher than those in fall semester at this institute. Because COVID-19 presented during the spring 2020 semester, it makes sense to limit this study to comparing spring semesters only as each of these 4 spring semesters has its unique situation. Spring 2019 was pre-pandemic; spring 2020 was chaotic; spring 2021 was in the pandemic and spring 2022 was considered as post-pandemic. As mentioned in the introduction, the courses delivery methods were totally different in these 4 semesters.

The research questions explored longitudinally, first as a function of COVID-19 and second as a function of updated admissions requirements, are as follows:

1) What, if any, differences exist between the number of applicants and the enrollment of those accepted?
2) What, if any, differences exist between the first semester GPA and overall GPA of those enrolled?
3) In what way, if any, were graduation rates affected?

IV. Data Analysis and Results

The number of PSE applicants and PSE enrollment rates were compared using the chi-squared goodness of fit test while PSE yield and PSE graduation rates were compared using the chi-squared test for independence. GPAs of PSE applicants, PSE new student performance in the first semester, and overall PSE student performance was compared using the Wilcoxon rank sum test. R version 4.1.3 was used for all data management, analysis, and graphing. Statistical significance was defined a priori as $p < 0.05$.

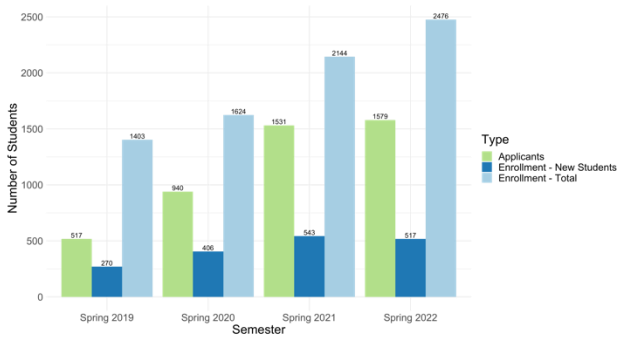

Fig. 1. Application and enrollment in PSE.

Fig. 1 shows the number of applications, number of newly enrolled students, and number of total enrollments in the 4 semesters. Both applications and enrollment in 2021 and 2022 went up significantly compared with the pre-pandemic in 2019 and 2020 (both chi-squared $p < 0.001$).

TABLE I: Yield Rate (Ratio of Number of Newly Enrolled Students and Number of Applicants)

Academic Year	Yield Rate
2018–2019	270/517 (52.2%)
2019–2020	406/940 (43.2%)
2020–2021	543/1531 (35.5%)
2021–2022	517/1579 (32.7%)

Table I shows the yield rates over the 4 semesters. The yield rate is the number of new enrolled students over the number of applicants. The yield rates in 2021 and 2022 compared with 2019 and 2022 are significantly lower (chi-squared $p < 0.001$).

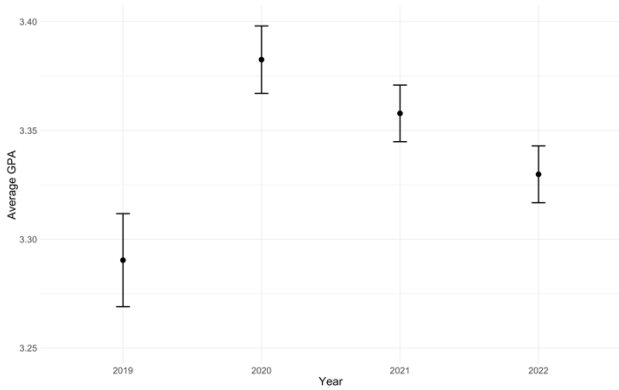

Fig. 2. Average undergraduate GPA of applicants, plotted as mean ±standard error.

Fig. 2 shows the applicants' average GPA of the 4 semesters. The combined average GPAs in 2021 and 2022 were not significantly different from 2019 and 2020 (3.35 vs. 3.34, respectively; Wilcoxon rank-sum $p = 0.500$).

Fig. 3 shows the average GPA of newly enrolled students by the end of their first semester. There were 270, 406, and

543 new students in spring 2019, spring 2020, and spring 2021, respectively. The average GPA in 2021 was significantly higher than those combined in 2019 and 2020 (3.70 vs. 3.49, respectively; Wilcoxon rank-sum $p < 0.001$),

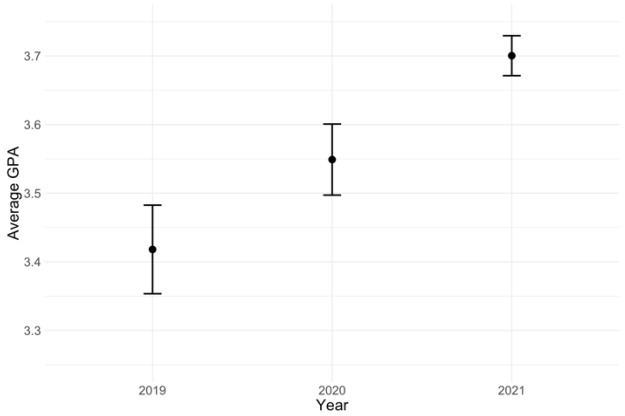

Fig. 3. Average GPA of newly enrolled students by the end of their first semester, plotted as mean ± standard error.

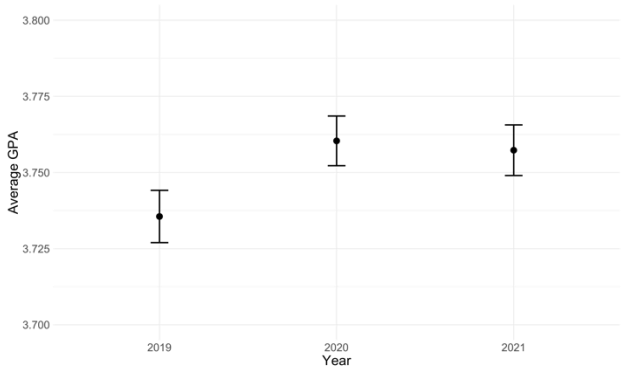

Fig. 4. Average accumulated GPA of all enrolled PSE students, plotted as mean ± standard error.

Fig. 4 shows the cumulative GPA of 1403, 1624, and 2144 PSE students enrolled in spring 2019, 2020 and 2021, respectively. The average GPA for all enrolled PSE students in 2021 was statistically significantly higher than those combined in 2019 and 2020 (3.76 vs. 3.75, respectively; Wilcoxon rank-sum $p < 0.001$), however, this small difference is not meaningful in practice.

TABLE II: THE ARRANGEMENT OF CHANNELS

Academic Year	Graduation Rate	Metric 8 Points
2018–2019	563/980 (57.4%)	8
2019–2020	696/1095 (63.6%)	10
2020–2021	737/1113 (66.2%)	10
2021–2022	810/1126 (71.9%)	10

Table II shows the number of students graduated in PSE, PSE rate, and Metric 8 points earned in each academic year since the institute submits the academic year reports to FL-BOG annually. The PSE graduate rates were higher in 2021 and 2022 combined than 2019 and 2020 combined (69.1% vs. 60.7%, respectively; chi-squared $p < 0.001$).

V. DISCUSSION

Pre-pandemic, most face-to-face programs at this institution delivered their courses in the traditional way. Many faculty at the institution under study did not use the LMS to supplement with course information, instructor's summaries, homework assignments, recorded lectures, and multiple formats of out-of-class discussions. Although the Center for Teaching, Learning, and Technology at this institute created Canvas shells for each course, many faculty did not use them. Now, supplementing via the LMS has become a normal practice in almost all courses at this institution.

Changes in instruction due to the onset of COVID-19 and updating admission requirements did not negatively affect student outcomes. Removal of the GRE requirement led to an increased applicant pool, allowing admissions committees to be more selective when choosing the students to be admitted. This is shown with the increased enrollments yet lower yield rates.

Because the GPA of new graduate students in the first semester was significantly higher in spring 2021, it is hypothesized that the increased applicant pool allowed programs with enrollment caps to raise their admission standards and recruit higher quality students. Continued follow-up is needed to determine if the cohorts admitted under the new admissions standards perform better than previous cohorts. The cumulative GPA is not significantly different between springs of 2020 and 2021, however, spring 2021 includes a high proportion of students admitted before spring 2021 under old admissions standards. If the institution continues to recruit higher caliber students, the cumulative GPA should continue to increase.

This study has limitations that should be considered when generalizing implications outside of the institution of study. First, it should be noted that the institution under study is a predominantly white, regional comprehensive university in the Florida State University System, servicing a large military and veteran population. It should also be kept in mind that the FL-SUS uses metrics-based funding to adjust yearly budgets to each university. Although other states also use metrics-based funding, the specific metrics used for funding should be considered before generalization.

Next, this study did not stratify analyses by program or adjust for field of study. There may be inherent differences between programs and fields that lead to different student outcomes. This study also does not account for unobservable factors, such as grading differences by instructor. Due to the large number of programs and instructors, a larger sample size would be necessary to extract meaningful results when adjusting for program, field of study, or instructor, hence the necessity for continued study.

Finally, this study was not designed to examine causality. A future study would benefit from a qualitative exploration into inherent differences between student populations among the different programs, as well as the effects of updates to programs, teaching modalities, and admission requirements. That, coupled with more information on the student, would allow exploration into the quality of the student.

VI. CONCLUSIONS

Based on this study, it is suggested that some graduate level programs can be successfully offered purely online using the synchronous and/or asynchronous instruction at any time. With more access to high quality programs, this

mode of instruction may be a viable means in the future. However, for the lab-based science programs, asynchronous instruction with occasional synchronous discussion may work better for some courses, because some lab courses must be taught face-to-face in laboratories on campus. Purely online lab courses may not work well, even with sophisticated and advanced software as it does not properly simulate working in a laboratory environment.

It showed technology played an important role in teaching and learning during the pandemic at this university. The possibilities are endless when technology is brought into classrooms. However, educators should not only know how to use the tools, but also have to know what and why students want and need.

Adding high demand, low share programs, especially online programs will attract more academically excellent students and increase enrollments. Updating the programs periodically and removing admission barriers will make the programs more attractive to applicants. When the applicant pool is larger, programs can be more selective. This will not only increase the students' chance of success, but also enhance the programs and make them stand out against competitors.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

KL, Dean of the Graduate School, initiated this study, collected the data, and led manuscript writing efforts.

SS, Assistant Professor in Statistics, analyzed the data, created graphs, and assisted with manuscript drafting and editing. Both authors approved the final version.

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