

COVID Impact on Higher Education Classrooms

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Abstract

The COVID-19 pandemic has created many problems in our society today from psychological, political, economic and educational standpoints, just to name a few. This is a generational event that we will look back on as creating “the new normal” for our society.

In March of 2020, Purdue University transitioned from teaching students in a traditional face-to-face format to an online format. Over Spring Break of that year, faculty and staff worked tirelessly to create an online environment that served over 40,000 students in thousands of classes to complete the spring 2020 semester. The following semesters have led to additional changes as we have eased back into the classroom.

In this paper we are going to focus on how this pandemic has influenced the classrooms over the last two years at our regional campus in Columbus. While we hope to get back to the way things were done in the classroom before the pandemic, some things are going to change permanently. The good news is, some of these changes are positive for our campus. We will take a look at what we think will be the permanent impact on our higher education classroom environments. In our presentation, we would also like to hear from you and learn what your thoughts are on how the teaching processes and techniques will be affected in the years to come.

Introduction

The COVID-19 pandemic has created many problems in our society today from psychological, political, economic and educational standpoints, just to name a few. This is a generational event that we will look back on as creating “the new normal” for our society. In this paper we will take a look at the timeline of events at Purdue and other institutions and how it affected the university. Some of the effects were temporary, but others will have a permanent impact on our campus and more broadly on higher education. The good news is, some of these changes are positive for our campus and higher education.

The start of the pandemic

In late November 2019, COVID-19 had broken out in Wuhan, China. Early in January 2020, the United States Center for Disease Control and Prevention (CDC) became aware of cases in China, and on January 21st the CDC announced the first confirmed case in the United States, of a 35-year-old male from Washington state. Events moved quickly, and by late February there was growing awareness of the coronavirus across the U.S.

The first confirmed death in the U.S. was on February 29th. Confirmed cases in the U.S. continued to rise, and on March 6th the state of Indiana reported the first confirmed COVID-19 case of an Indianapolis man who returned from travel to Boston. At this point in March, major changes started to occur as more states reported cases and deaths, with states declaring the state of emergency, school districts closing, and sports leagues such as the NHL, NBA and MLB suspending their seasons, and the NCAA cancelling all postseason tournaments for the winter and spring season.

Spring and Summer 2020 - Surviving the Semester at Purdue University

On March 10th as Purdue was about to embark on Spring Break, administration announced that faculty were to move their courses online and be prepared to continue as long as needed. A few days later Purdue announced classes would move online for the remainder of the spring 2020 semester. Over Spring Break, faculty and staff worked tirelessly to create an online environment to serve over 40,000 students in thousands of classes.

At our Purdue Polytechnic Columbus site we resumed classes online after Spring Break. Faculty used different methods to deliver classes in the online environment, some teaching asynchronously and most delivering classes synchronously to students. Faculty had the option to use different tools to host the online environment, with WebEx the standard along with Zoom, Teams and Purdue's course management systems — Blackboard and Brightspace.

The results by all accounts was a successful transition. One of the major fears was that the system would not be able to handle the increased load of all Purdue students online. The IT staff made a few changes and upgrades, and for the most part it worked flawlessly. Support was available for faculty to assist in using what for some were new tools.

Outside of the classroom on campus in the spring, all on-campus activities, such as advising and meetings, were moved online, and activities that could not be moved online, such as recruiting events, graduation, or travel, were cancelled for the spring and summer.

We will share some of our personal experiences from teaching this semester. Professor Swanson was teaching 5 classes (one an overload at the Anderson campus) in the spring 2020 semester. Three classes were hybrid and two were asynchronous online classes. The online classes were asynchronous with recorded lectures, readings, assignments and quizzes on Blackboard. Both classes had virtual office hours using WebEx and having used this from the beginning of the semester it was not different than earlier in the semester. Exams were scheduled to be taken in person on the local campus (either Anderson, Columbus or Kokomo) and students had just finished midterms when classes went online. The only major change was after classes moved online the final exam was delivered in Blackboard. The hybrid classes all were being delivered in a flipped format so the lectures were recorded, quizzes and assignments were on either Blackboard or Brightspace and class time was used for in class exercises, team projects and discussions. Like the online classes, the exams were developed in either Blackboard or Brightspace. The transition involved moving the in-class meetings to WebEx. During the meeting time, we used WebEx for the discussions, questions and exercises. When students were doing team project assignments, they would use their own WebEx room (each student at Purdue has access to their own WebEx personal room) and the instructor would drop in to each group's room (another option was to use WebEx breakout rooms). There were minor technical issues in the hybrid classes. Many of the students were not familiar with WebEx, and many errors were operator errors. These usually centered around audio issues where the class could not hear the instructor, or vice versa, or individual connection problems. There were a couple students that lived in rural areas where high speed internet access was an issue. The only other issue for the in-

structor was Purdue was transitioning from Blackboard to Brightspace and having volunteered to test Brightspace in one of his classes, Professor Swanson was trying to learn how to use Brightspace features with limited support while transitioning all classes to the online environment. The one thing Professor Swanson did in all his classes was send out a letter to students to try and ease their minds. This was a very stressful situation for everyone, with many students unable to work, worrying about their health and families' health, being isolated and all their classes transitioning to an online environment. In the letter, Professor Swanson wanted to reassure them that they were not alone and we were all trying to get through this together, both students and faculty. The instructor told the students that we would be flexible in assignments and grades, but we would try to maintain the format and structure of the class and that he was there for them if they need to talk. A small gesture, but Professor Swanson had several students tell him they appreciated the letter that gave them some reassurance in the middle of their world turning upside down.

Professor Gusev taught four courses, all of which started with traditional face-to-face delivery. The abrupt transition to online delivery proved the hardest for the CNIT 242 System Administration course, because it is loaded with hands-on labs, a major portion of which could not possibly been done by the students under the newly imposed restrictions on physical access to the AMCE building that houses the networking lab. With remote help by Professor Phil Rawles and the system administrator from West Lafayette, Labs 2 and 3 were reworked to form one lab assignment that the students could complete via remote connection after the instructor reconfigured the lab, completed the portions of the original lab assignments that could not be done remotely, and enabled remote connectivity to the lab computers. Even that ad hoc solution worked only partially, due to slow Internet connections of some of the students.

CNIT 270 Cybersecurity Fundamentals had labs that utilized virtual machines (VMs) set up for us by the system administrator in West Lafayette, and this factor proved to be a major advantage that has simplified transition to remote delivery of the course a great deal. The other two courses were on software development, so they transitioned gracefully.

2020-2021 School Year - Being Flexible at Purdue University

After the spring semester, Purdue announced the fall academic calendar that allowed face-to-face instruction and eliminated fall breaks and ended face-to-face instruction before the Thanksgiving break with the last week and Final Exams offered online. This was incorporated to minimize student travel during the semester. The Protect Purdue Plan was introduced, a plan to keep the campus and community safe by limiting the spread and included the Protect Purdue Pledge that students were required to agree to. Along with that all faculty and staff were required to complete COVID-19 Employee Safety Training and all students were required to be tested before attending classes in August. The fall schedule at the main campus in West Lafayette offered a fully online option for students who could not or chose not to come to campus. At our Columbus campus this was not an option, although some classes were converted to hybrid and WebEx was used in the class to allow for flexibility. For classroom safety, students were required to wear masks, shields in lab classes where the instructor circulated, no in-class group work, wipe down computers before and after use, hand sanitizer was provided in all classrooms and occupancy was reduced to approximately 50% in each classroom. A liberal attendance policy was imposed and faculty were to work with students that tested positive or quarantined to allow students to make up work. Our department Computer and Information Technology (CIT) has many lab classes using licensed software that in many cases is cost-prohibitive for students to purchase for their own laptops. Purdue's IT support set up connections so students could remotely access the lab (and the software on the lab machines) and did not have to purchase the software.

Outside of the classroom in the fall many faculty and staff were working remotely when possible. On campus activities were still cancelled, including on-campus recruiting events and meetings, and advising was still completed remotely.

For the spring 2021 semester, the same rules were in effect from the fall semester, including student testing before being allowed in classes. In an effort to minimize mass travel by students, the semester was started a week later than normal and Spring Break was eliminated and substituted with “reading days” interspersed throughout the semester. Also, the main campus offered a fully online option and the Columbus used a mixture of hybrid and WebEx to accommodate students.

Outside of the classroom in the spring semester, all on-campus activities like advising and meetings were moved online, and activities that could not be moved online were cancelled for the spring. The commencement ceremony was held after being cancelled the previous year. The event was held outdoors in a spacious courtyard on campus. Recruiting events were cancelled. This was very troubling, because in the best of times it is a struggle to recruit students, and without events it was almost impossible.

Sharing some of our personal experiences from the 2020-2021 school year. Professor Swanson again taught five courses (one overload in Anderson) in the fall semester. Of the five classes, one was an asynchronous online course, two were hybrid classes and two were face-to-face courses. The asynchronous online course met two times in person and the hybrid courses met once a week all using the precautions put in place by Purdue University. The regular face-to-face classes were scheduled to meet twice a week, with one day being a lab session.

Over the summer, there were concerns about if we would be able to make it through the semester without going back to a fully online format as we had done in the spring semester. In anticipation of that possibility, Professor Swanson recorded lectures for the two face-to-face courses. During the semester, we met one day via WebEx and would answer questions about the lecture and work on team exercises and a team project in groups, and on the second day we physically met in the computer lab to work on labs. Overall, the courses worked well as the instructor and students got more accustomed to using safety measures and became more technically savvy with using WebEx on a regular basis. The most alarming part was the enrollment. Typically a freshman class would have eight to twelve students. Our campus typically gets many students late in the process, accepting new students up to August. We would normally have several recruiting events late in the spring semester, but because of Covid they had all been cancelled. Our freshman CIT course had two students enrolled. Besides our freshman group it appeared some students had decided not to return or to delay returning. Two other classes had enrollments of two and three students.

In the Spring 2021 semester, Professor Swanson taught five courses (one overload in Anderson). Of the five classes, two were asynchronous online courses, and three were hybrid classes that met one time a week in person. As in the fall semester, classes worked well using the safety measures and available technology. Throughout the fall and spring semester several students were out with either Covid or being exposed to someone with Covid. Students who had been infected were required to report it to Purdue and encouraged to work with the faculty to make up lost work. Most students did a good job of communicating with the instructor and they were able to make up for any lost work.

In the fall of 2020, Professor Gusev taught three courses, as he was given an opportunity to develop the spring 2021 offerings of CNIT 315 Systems Programming with emphasis of parallel programming / concurrency in C++17 and CNIT 381 Introduction to Game Development Technology using Unreal Engine 4, instead of its competitor Unity. Two of the courses taught in the Fall involved software development in C# and Java and went

well, including the joint projects with Professor Swanson's CNIT 272 that involved development of C# apps that accessed Oracle databases designed and built in Professor Swanson's course. The other course, CNIT 340 UNIX Administration, which is de facto UNIX/Linux administration, benefited greatly from use of UNIX/Linux VMs.

Professor Gusev's spring 2021 semester proved very challenging, even though the two freshly developed courses were delivered without a glitch, including the online offering of CNIT 381. Unfortunately, the delivery of the other two courses — CNIT 242 and CNIT 270 — was hampered by such factors as some students going online due to the liberal COVID-19 policy and not contributing enough to team work in the lab, old and slow lab equipment for CNIT 242 not keeping up with the needs for speedy software downloading and installation, as well as with support for new versions of VMware virtualization software on the part of the old chips built for the infamous Windows Vista, and, in the case of CNIT 270, by poor setup of the VMs by a new system administrator, further compounded by the stressful COVID-19 situation and particularly by many students' lack of prior familiarity with command-line interface (CLI) Linux environment. The location's leadership was forced to take swift corrective action by hiring a very capable lab assistant mid-semester to help the students in those two courses deal with the challenges, and this decision helped remedy the issues in CNIT 270 to a great extent. In CNIT 242, the students were allowed to write "lessons learned" team reports for extra credit. In those reports, the students explained the issues that prevented them from completing most of the lab work and how this work could have been completed if the lab equipment worked as intended.

2021-2022 School Year - Getting Closer to Normal at Purdue University

With the development of the vaccination for COVID-19 in late 2020 and rolling out in 2021 there was growing hope that the university could get back to a more normal environment on the campus in the 2021-2022 school year. Intended changes for fall 2021 included:

- Return all campus spaces to full density.
- Welcome back visitors.
- Reinstate pre-pandemic attendance policies for academic courses.
- Return to fall break and in person classes throughout the semester.
- Little or no use of face masks. However, before the start of the semester this was changed to require face masks in all indoor spaces regardless of vaccination status.

As the fall semester began, 79% of the faculty staff and students at Purdue University were vaccinated. Those that were not vaccinated were subject to routine surveillance testing (possibly as often as once a week) and those vaccinated were excused from routine surveillance testing and did not have to quarantine after high-risk exposure to the virus as long as they remain symptom-free, avoiding possibly disrupting their studies and work duties. The online only option at the main campus was eliminated and on our campus we were not required to deliver the class in person and via WebEx (although some faculty chose to still offer that option). Remote access to Purdue's computer labs and the software in the labs that was provided in the previous year was removed.

Outside of the classroom in the fall semester, most faculty and staff were working on campus. On campus activities were restarted, including on-campus recruiting events and meetings and advising. The SAT and ACT scores were not required for admission. With the lack of outside recruiting events last year our numbers continued to struggle with only four incoming freshmen in CIT.

In the spring semester, there was a continuation of the fall semester practices. The calendar for the spring restored the typical semester start date, spring break, and graduation. Midway through the semester the mandatory mask requirement was lifted.

Sharing some of our personal experiences from the 2021-2022 school year. Professor Swanson taught four courses in the fall semester. Of the four classes, one was an online course, one was a hybrid class and two were face-to-face classes. The WebEx component was gone in all courses and face-to-face meetings other than mask wearing were back to normal with students allowed to work in groups in class and regular attendance policies in place.

Professor Swanson taught three courses in the spring semester. Of the three classes, one was a hybrid course that met once a week, and two were asynchronous online classes. The only difference between these classes and pre-pandemic was in the online classes prior to the pandemic Professor Swanson was present at each site for the midterm and final exams. In the spring 2022 semester the exams were offered in Brightspace using Lockdown browser and Respondus monitoring system. Talking with students during the past year, most students were glad to get back in the classroom. The instructor didn't hear any students say they preferred completely online classes. Some did say they liked the flexibility of the hybrid class where they still had the face-to-face interactions with the faculty and students and many said they would prefer the regular face-to-face format. Professor Gusev taught four courses in the Fall 2021 semester (two of them face-to-face and two online) and earned the Certificate of Practice in College Teaching for his work on CNIT 325 Object-Oriented Application Development with Professor Dennis Owen as mentor. The online delivery of CNIT 40500 Software Development Methodologies for the first time under informal mentorship by Professor Rick Homkes proved a success as well.

In the Spring of 2022, Professor Gusev taught three courses, including online delivery of CNIT 425 Software Development for Mobile Devices II to students at our Anderson location.

Lasting effects of the COVID-19 in the higher education classroom

It is two years later and, in many ways, it seems like a lifetime ago. Stepping back into the classroom at the end of this semester, it looks very much like it did prior to March 2020. The question is, are there lasting effects of COVID-19 in our higher education classrooms?

First of all, we know that as long as students, faculty and staff have access to the internet that we can, if necessary, offer our classes remotely. Some people say it is not if this will ever happen again but when. Having said that, it is important to take a look back and perform a "lessons learned" and determine what we did that worked and what didn't work. This is something we have not had to go through before.

At our Purdue Polytechnic Statewide locations, where we offer our CIT programs – Anderson, Columbus and Kokomo — we have gradually been incorporating more online classes. In the past there have been issues with internet access of students, software and, in some cases, a reluctance to move to online classes. In some cases, it has been the philosophy that we prefer not to offer online classes, for instance, freshmen classes where we want students on campus, with our instructors and fellow students. Also, some classes in the curriculum tend to work better than others online. With upgrades to infrastructure it is more viable today. We don't expect to move all classes online, but many upper-level classes will be candidates to offer online. With a limited number of instructors at each site, they can be shared by offering the classes online. This moving from the traditional environment to digital environment in education has been occurring for a while, but COVID-19 has acted as a cata-

lyst (Tam & El-Azar, 2020). In 2019, global investments for the digitalization in education was \$18.66 billion. It has been estimated that digitalization in education will reach \$350 billion in 2025 (Li & Lalani, 2020). This will require efforts to make sure that students and faculty alike are literate in the skills needed to succeed in this growing environment.

Purdue is not requiring the SAT or ACT for incoming freshman in the fall semester. Our website states that we are test flexible, which means that we prefer the student take one of the tests, but it is not required. If you take a look, you will see that schools like Purdue, Indiana University, Harvard, Northwestern, Yale, and many more are not requiring the SAT or ACT this fall, they are test optional. Other universities are adopting a test-blind policy, which is different from a college going test-optional, which many campuses have done in recent years due to COVID-19. Test-optional colleges, such as Arizona State University, Texas A&M University, and Drexel University, will consider ACT and SAT scores when selecting a student — but only if the student chooses to submit them. Test-blind colleges completely ignore exam scores when assessing a student's application, placing more emphasis on the person's high school GPA, admissions essay, and other factors.

According to Margeurite Dennis, universities will embrace online recruiting methods and certain cohorts may increasingly look to stay closer to home (Dennis, 2020). Dennis said this is true with foreign students, especially Asian students.

Bonnie Kristian with *The Week* suggested that we will see colleges close permanently as economic pressures grow. Up until now, it has been mainly small colleges, but even in larger schools, she states, there will be a trend toward cutting less profitable majors. Bianca Quilantan in *POLITICO* warns of the coming cliff stating high school graduates will peak in 2026 at 3.6 million, but then will decline to 3.3 million by 2030. At Purdue we have run into that at our Statewide locations with several degree programs being put on hold and not accepting new students next fall.

Quilantan goes even farther based on discussions with university leaders. One idea is going from one centralized campus to an entirely location-agnostic hybrid model with no dependence on a centralized campus. This could be the type of innovation needed to succeed in today's economic and educational environment while maximizing all of our physical assets. Quilantan continues it citing a report from "The Hybrid Campus" that doing away with physical campuses won't be the norm, but they will need to rethink how to best utilize their physical space and incorporate technology into it.

Conclusion

We have traced the Purdue events and policy changes related to the COVID-19 pandemic from its beginning and through the spring of 2022 as they impacted our delivery of CIT courses at Purdue Statewide locations in the face-to-face, online and hybrid formats. We have discussed the lessons learned and posed an open problem of how we should solve the Statewide undergraduate student recruitment challenge under the current circumstances and limitations. Finally, we have reviewed the diverse opinions on the lasting effects of the COVID-19 in the higher education classroom.

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