COOPERATIVE LEARNING IN A PANDEMIC SETTING:
HOW LEARNING HAS BEEN AFFECTED BY COVID-19

By

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Abstract:

The current pandemic of COVID-19 has caused major upheaval to the world and to the field of higher education. Specifically, we examined how these changes affected collaborative learning practices. Based on a literature review of collaborative learning, it has been established that the benefits of using collaborative learning practices is significantly better than traditional methods. However, research has not been fully described on the effects of a pandemic on education or collaborative learning. The current environment offers ample resources to tackle such a question. We used SurveyMonkey to send questionnaires to undergraduate students to learn what they thought about the online modality as well as to gather student testimonies about various topics. Students shared common sentiments regarding wanting to return to regular schooling, however some students shared how they prefer the new modality due to increased convenience and freedom. Many students even requested that semesters following the pandemic continue to be offered in the online modality. These findings indicate that the pandemic may cause lasting changes in the field of education, and that society as a whole might have a new normal after the COVID-19 pandemic has passed. Possible areas of growth include offering a more robust online educational experience and sociopolitical changes that make fighting a future pandemic easier and more effective.


**Introduction**

The damning characteristic of once in-a-century disasters is that it’s recent enough to remember what it was, but far enough to have forgotten what it feels like. The COVID-19 pandemic of 2020 is one of a growing list of major pandemics that have rocked the way of life throughout human history. One thing that epidemiologists and historians alike can say with confidence is that the pandemics aren’t going anywhere. Pandemics are entwined with human existence, now more than ever with globalization (16). Human history and pandemics share a common timeline and have since the first civilizations. Plagues tend to occur once enough people are in close enough proximity; add some domestication to increase those odds. However, a pandemic requires globalization, and with the world more connected than ever before, the global stage is brimming with opportunity for a pandemic to spread. In 2015, Bill Gates predicted that the next disaster that humanity will face is not a war, nor a national disaster, but rather a pandemic (50). He predicted that an influenza outbreak similar to the 1918 Spanish Flu would spread through the modern world very quickly, and that our current infrastructure is not prepared for such an event. Needless to say, his warnings were not taken to heart by the nations of the world, and everyone suffered. Since the current COVID-19 pandemic is such a novel and current topic, this paper will also flesh out what COVID-19 is, the timeline, as well as how it affects the body.

In the interest of being fair, it would be harsh to judge our past decisions with the benefit of hindsight, for we don’t really know that we are dealing with a pandemic until we are in the thick of things. The fog of the future prevents us from knowing what the best plan of action is, and with little to no information about the virus, we did not have luxuries of knowing: where it came from, how it affects us, how contagious it is, or how long it would stay with us. Even at the
time of writing this paper, the World Health Organization (WHO) is still investigating the origin of the virus. However, that is not to say that humanity has not created a robust compilation of literature regarding COVID-19. Research has been put forth comparing the strategies employed by different nations in the effort to combat the pandemic, this use of hindsight is very useful as it allows future generations to learn from our successes as well as our mistakes to act in the best possible manner, if and when the need arises.

The last comparable situation to the current pandemic was the Spanish flu of 1918 (19). Although the viral strains were different and the political climate much worse then, there are still many similarities between the pandemic of old and COVID-19. One such similarity is the controversial topic of face masks. The similarities are as humbling as they are frustrating; we see similar arguments for similar issues being made over a century apart. It is a testament to the nature of humanity but also demonstrates how little we learned from the experience.

A group from 1918 wearing masks made of linen and cheesecloths (20)
In the earliest days of the pandemic, nobody could have predicted that the seemingly innocent surprise extension for spring break would have stretched over 18 months into the future. First, the parties were postponed, then flights cancelled, reunions called off, and before we knew it, the bustle of life had slowed to a halt, society was frozen, and the concept of normalcy faded. The whole world was shut down, and this includes higher education.

Education in general was hit extraordinarily hard by COVID-19. The communal nature of traditional schooling made for high risk of transmission, and with that, schools were forced to swap to virtual learning and online teaching modalities. Fortunately, the United States is technologically privileged enough to support having nearly the entire education system go online. However, online schooling is difficult, not only for instructors, but students as well. Online learning lacks characteristics that traditional learning offers in the classroom. Online learning lacks the hidden social cues of interaction-based education. The two-dimensional interface that it offers creates a barrier between participants, demonstrating a marked drop in quality of interpersonal interactions as compared to in person. Even just removing the typical
schedule that traditional learning has had for generations lead to dramatic decreases in student efficacy, accountability, responsibility, and discipline (24). Aside from the consequences of moving to online being difficult, disposition towards online learning is predominantly negative. The overwhelming majority of students reported having suffered declining mental health, focus, discipline, and grades (23). Students have reported feeling depressed recently, and that they lack to motivation that they had prior to switching to online (61). And it is not just the students who complain about the difficulties of online schooling, instructors across the board take issue with the new modality. Some professors have described the difficulty in assessing class understanding through the online interface. Multitasking (i.e., checking a phone, searching another site, or even talking to a friend or roommate) during online lectures or exams is easier than ever before and leads to difficulty in ensuring academic integrity is being upheld. Student participation in class is lower than ever, class attendance is dwindling, and unless the camera is on (most students prefer to have the camera off) the teacher cannot really tell if anyone is there or not (52). All of these factors can lead both teachers and students to view the online learning environment as ineffective and “not real school”.

There is something to be said about possible confounding factors of a worldwide pandemic having effects on the disposition and motivation of students, and unfortunately, we cannot separate the two to gain a more objective observation of online learning. The majority of the negative emotions could be a consequence of the rest of society shutting down in tandem with online education. However, in order to assess student perception and disposition most accurately regarding classes, a SurveyMonkey survey was sent out to undergraduate physiology course students at the University of Arizona, asking about what was affected and how they feel about the class, online learning, and what’s to come. One overwhelming sentiment that is echoed
across the responses is that people grew to be good students in a non-COVID-19 era (61).

Students have been working their entire lives to perform well and achieve with the in-person modality of schooling, so comparing the results of in-person schooling to the results of online schooling can cause unnecessarily harsh judgments for, and by, the student. This sentiment was also seen in students attempting to parse out the reasons as to why they are doing less well in their classes during the pandemic.

Online learning modalities make traditional teaching and education a challenge, and one form of traditional learning that is affected the most, albeit a more modern addition, is collaborative learning. Collaborative learning is “the educational approach of using groups to enhance learning through working together. Groups of two or more learners work together to solve problems, complete tasks, or learn new concepts” (65). Collaborative learning requires key components that current online university infrastructure simply lacks. This has an effect on not only how well students learn the material, but also how well students learn to work as a team and how to hone cooperative skills that will be used in their professional everyday lives (34). This paper will go in depth on the effects of COVID-19 on collaborative learning, as well as the academic field as a whole.
COVID-19 Timeline

This pandemic was unlike anything most people have ever experienced in their lives. According to the CDC, there are only 11 people still alive who lived through both the Spanish influenza pandemic of 1918 and the COVID-19 pandemic of 2020 (3). Due to faster promulgated news in the current day and age, we have the modern privilege of faithfully cataloging the progression of this new virus so that we have more information on how to deal with situations like this in the future. One particular finding that is particularly important regarding the timeline is that the pandemic had demonstrated to the world just how connected we all are.
History of COVID-19 from December 1, 2019 to April 16, 2021

This timeline focuses on the United States, Arizona, and the University of Arizona

Data recorded from: Firsthand accounts, AJMC, CDC, NPR, COVID-19.arizona.edu, Daily Wildcat, WHO and The Lancet (25,26,27,28,29,30,31)

______________________________________________________________________________

**December 1**

Patient zero for COVID-19, an older gentleman who suffered from Alzheimer’s, in Wuhan, according to Chinese scientists.

**Jan 20, 2020**

CDC China in conjunction with the NHC announced that the coronavirus is categorized as a class B infectious disease but will be taking class A disease precautions.

South Korea reports first case

**Jan 21**

United States reports first case of COVID-19

Hong Kong and two other countries have their first case

**Jan 23**

WHO meets and decides not to call COVID-19 a “Public Health Emergency of International Concern”

**Jan 27**

15 countries have now confirmed their first case

**Jan 30**

20 countries confirmed their first case

The WHO declared COVID-19 as a “Public Health Emergency of International Concern”

**Jan 31**

Travel bans against China start to be implemented across the globe
February 2

United States confirms 11 cases of COVID-19

February 5

Planes from Wuhan land in California, Texas, and Nebraska

February 6

Chinese Authorities order Wuhan officials to carry out house-to-house searches and forcibly quarantine all infected individuals

First American death to COVID-19

Status as of Feb 7

Total Countries with Confirmed Cases: 25

Total Cases Confirmed Globally: 31,484

Total Deaths Worldwide: 638

Deaths Outside of China: 2

February 9

COVID-19 deaths surpass SARS epidemic of 2002

Feb 10

Trump Administration released a budget proposal that would sharply cut funding for WHO and global health funding

Death Toll for COVID-19 surpasses 1,000

Feb 13

CDC director says that the coronavirus will likely remain beyond this season

Deaths Outside of China: 3

Feb 18

Additional travel bans against China are implemented

Death toll surpasses 2,000

Feb 23

Travel Bans begin to target other countries than China, and South Korea raises alert level to red (highest level)

Feb 26

50 Countries confirmed first case
Status as of March 6

Total Countries with Confirmed Cases: 90
Total Cases Confirmed Globally: 100,481
Total Deaths Worldwide: 3,408
Deaths Outside of China: 366

March 10

Every EU member states have COVID-19 cases

United Nations states that approximately 20% of all students are not in school due to COVID-19

WHO declared the Coronavirus outbreak a pandemic

Many countries around the world start to close schools

March 11

Arizona declares a state of emergency

March 21

Arizona records first death

Many countries close borders and begin lockdown

March 29

One third of the world’s population is under COVID-19 restrictions

April 6

United States passes 10,000 deaths

China issues first mask mandate

April 9

17 million Americans have filed for unemployment due to businesses closing down

Hydroxychloroquine is deemed ineffective as a treatment against the coronavirus.

April 28

United States hits 1,000,000 COVID-19 cases

May 10

Global cases reach 4 million

May 18

Trump endorses Hydroxychloroquine despite it being proven to be ineffective
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 27</td>
<td>COVID-19 deaths in USA hit 100,000</td>
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<tr>
<td>June 6</td>
<td>Countries begin to reopen as new cases are beginning to decrease</td>
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<tr>
<td>June 8</td>
<td>New Zealand lifts all lockdowns, declaring itself to be virus-free</td>
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<tr>
<td>June 11</td>
<td>US exceeds 2 million cases</td>
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<tr>
<td>June 24</td>
<td>United States reports highest daily total of new COVID-19 cases, 70,000 cases in a day</td>
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<td>July 5</td>
<td>Scientists from 30 countries call on the WHO to direct attention to the evidence that COVID-19 is airborne</td>
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<tr>
<td>July 8</td>
<td>ICUs in in Arizona’s hospitals fill up due to surges in COVID-19 hospitalizations</td>
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<tr>
<td>July 12</td>
<td>Trump makes his first public appearance with a face mask</td>
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<tr>
<td>August 13</td>
<td>WHO reports that COVID-19 has cost the Global economy 375 billion per month</td>
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<tr>
<td>September 9</td>
<td>The US states it will no longer screen from international arrivals</td>
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<tr>
<td>September 25</td>
<td>More than 500,000 kids have been diagnosed with COVID-19</td>
</tr>
<tr>
<td>September 25</td>
<td>US passes 7 million cases</td>
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<tr>
<td>October 27</td>
<td>Trump White House lists ending COVID-19 pandemic as an accomplishment despite 80,000 new cases a day.</td>
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<tr>
<td>October 27</td>
<td>United States reports record for daily new cases every day since September 8</td>
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<tr>
<td>December 24</td>
<td>Travel Bans against the UK due to concerns about a new variant</td>
</tr>
</tbody>
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December 29

United States records first variant case

Jan 8, 2021

United States reports 300,000 new cases in a single day.

Jan 10

Biden Plans to Rapidly Release Most COVID-19 Doses of Vaccine by ordering and accelerating shipments of first doses.

Jan 22

United States new cases decrease for the first time since September

Status as of Feb 17

Number of countries with cases: 214

Total Cases Confirmed
Globally: 110,000,000

Total Cases Confirmed in the United States:
27,800,000

Total Deaths Worldwide: 2,420,000

Total Deaths in the United States: 488,000

Feb 26

50 million vaccinations in the US

March 19

United States Administers 100 Millionth Vaccine

April 6

UK COVID-19 Variant Detected in All 50 States

April 16

The U.S. reaches the milestone of 200 million vaccines administered.
Graph data from *The New York Times, CDC* (32, 3)

1. **(January 21)** The United States reports its first case of COVID-19

2. **(January 30)** COVID-19 has spread to 20 different countries causing the WHO to declare COVID-19 a Public Health Emergency of International Concern

3. **(February 6)** The United States reports the first casualty from COVID

4. **(March 10)** 20% of students around the world are not in school. Grocery stores across America begin to empty. President Robert Robbins (President of the University of Arizona) declares that the rest of the spring semester U of A will be online on March 18.

5. **(March 20)** First death reported from COVID-19 in Arizona. Doug Ducey (Governor of Arizona) issues stay at home order. Convocation and Graduation for the U of A are cancelled

6. **(April 6)** The United States passes 10,000 COVID-19 related deaths and travel bans are implemented across the globe

7. **(April 28)** United States hits 1,000,000 cases

8. **(June 11)** United States hits 2,00,000 Cases
9. (July 8) ICUs across Arizona hit full capacity as hospitals struggle to keep up with the surges of COVID-19

10. (September 1) Cases start to rise at the U of A

11. (December 19) U of A releases COVID-19 vaccine distribution plan

12. (December 24) Travel bans start to return with the new United Kingdom variant

13. (February 14) The United States begins administering 1.5 million vaccines daily.

14. (March 9) The United States administers the 1,000,000th vaccine. The U of A announces in-person graduation plans

15. (March 31) CDC expands travel guidelines in the midst of a vaccinated populous. Pfizer reports that its Coronavirus vaccine is extremely effective in adolescents ages 12-15 years old

16. (April 8) The United Kingdom variant is now the dominant variant in the United States. Hospitals report higher infectivity but not higher virulence. Dr. Fauci claims that booster shots will realistically be needed in the next year

At the time of writing this paper (April 20, 2021)

Worldwide COVID-19 Cases: 140,849,925

United States COVID-19 Cases: 31,602,676

Worldwide deaths due to COVID-19: 3,013,217

United States deaths due to COVID-19: 565,613

The United States accounts for approximately 5% of the population, yet accounts for 23% of all cases, and 19% of all deaths.
**What is COVID-19**

The original name for the virus that caused “coronavirus disease” was “2019 novel coronavirus”. The name for the virus has now been changed to represent the virus more accurately: “severe acute respiratory syndrome coronavirus 2” otherwise known as SARS-CoV-2 (22). This change in name, which occurred on February 11th, 2020, was due to the sequencing of the viral genome demonstrating its relation to another coronavirus that is responsible for the SARS outbreak from 2003. At the time of writing this paper, the current literature will name the virus as SARS-CoV-2 and the disease that it causes Coronavirus disease, otherwise known as COVID-19 (3).

The origin of SARS-CoV-2 is still unclear to researchers around the world. Current knowledge states that it originated from the Chinese city, Wuhan. Many theories surround the origin of the virus, however, even at the moment of writing this the WHO is still investigating what was the probable point of origin for the SARS-CoV-2. The current best theory, and the ones held by the majority of scientists in the world is that the virus is probably zoonotic in nature and that it made the jump to humans somewhere in the wet markets from Wuhan (18). One theory that circulated in the beginning of the pandemic was that COVID-19 was an engineered virus from a lab in Wuhan. Most people who heard these kinds of arguments classified it as a conspiracy theory, however it gained substantial traction when former president Donald trump supported the idea (17). The WHO refuted the idea, saying that the “laboratory incident hypothesis is extremely unlikely to explain the introduction of the virus into the human population, therefore, [it] is not in the hypotheses that we will suggest for future studies” (18).

COVID-19 did not become the center stage of global attention by only being contagious, it is a serious disease that has taken down even the healthiest of people. COVID-19 Infection
begins when viral load, either from inhalation of virus-laden droplets or from contaminated surfaces, somehow enters the nose or throat. The virus ends up interacting with specific cells that are rich in a certain cell-surface receptor called angiotensin-converting enzyme 2 (ACE2), which is a key point of entry for viral particles making those tissues vulnerable to infection. Once the virus is inside the cell, the virus can then hijack the cell’s machinery and force the cell to create copies of the virus. These viral copies then spill out into the body and infect millions of new cells (4).

Since the lungs are a relatively delicate organ, an all-out war between the immune system and the viral invaders with the lungs as the battleground can damage the lungs quite significantly. Inflammation, leaky blood vessels, and pus, which are all normal aspects of the immune system working as intended (6), can create big issues with normal lung function, and can even prevent oxygenation of the blood that is passing through the lung tissues; this is the pathology of pneumonia. As bad as pneumonia is, it is not even the number one reason of death from COVID-19; that title belongs to septic shock and multi organ failure (5).

COVID-19 can affect the body in a plethora of ways, and the virus, or the body’s response to the virus can damage organs all over the body (4). **The brain:** COVID-19 patients can present with strokes, seizures, confusion, or even brain inflammation. **The eyes:** COVID-19 patients also present with Conjunctivitis, a condition where the membrane that lines the front of the eye and inner eyelid becomes inflamed. **The nose:** A prevalent symptom is the loss of sense of smell. Scientists speculate that the virus may move up the nose’s nerve endings and damage cells. **The lungs:** Close inspection of the lungs show cells of the immune system crowding an inflamed alveolus, or air sac, whose walls break down during attack by the virus, diminishing oxygen uptake. Breathing becomes difficult, patients begin to cough and develop fevers. **The**
**heart and blood vessels:** The infection of cells likely includes those lining blood vessels, by binding to ACE2 receptors on the cell surface. Infection can also promote blood clots, heart attacks, and cardiac inflammation. **The Liver:** Up to half of hospitalized patients have enzyme levels that signal a struggling liver. An immune system in overdrive and drugs given to fight the virus may be causing the damage. **The kidneys:** Kidney damage is common in severe cases and makes death more likely. The virus may attack the kidneys directly, or kidney failure may be part of whole-body events such as plummeting blood pressure. **The intestines:** Patient reports as well as biopsy data suggest the virus can infect the lower gastrointestinal tract, which is rich in ACE2 receptors. Some 20% or more of patients have diarrhea which can lead to dehydration. In summation, this disease is quite severe, and with new patient information coming in about the long-term effects of COVID-19, the effects on the body could be even worse (53).

However, similar to the Influenza of 1918, COVID-19 does not affect everyone equally. COVID-19 causes the most severe of symptoms to those who are considered “high risk” (35). Although all ages can become infected and develop symptoms from COVID-19, the highest risk of severe disease are individuals over the age of 85. This is particularly dangerous for nursing home residents in which there is not only congregate living, but to those infected may already have other health issues. This danger is verified by the reports of nursing homes reporting high rates of mortality after COVID-19 spreads at the facility (54). Since one of the main organs that is affected are the lungs, it comes to no surprise that having pre-existing lung issues would increase the risk of contracting COVID-19. Some lung issues include Chronic Obstructive Pulmonary Disease (COPD), Lung cancer, Cystic fibrosis, Pulmonary fibrosis, and Moderate to severe asthma. Another major at-risk population are those with moderate to severe heart problems. There are many types of heart issues that can increase risk of developing severe
symptoms, such as Cardiomyopathy, Pulmonary hypertension, Congenital heart disease, Heart failure, and Coronary artery disease. Other risk factors include diabetes, obesity, cancer, weakened immune system, kidney disease, and liver disease.

With all of the comorbidities listed above, an unchecked COVID-19 pandemic could have infected millions and overwhelmed the current medical infrastructure and caused countless deaths. The decision to lockdown was not unanimous, and some people will still claim that it was the wrong thing to do, but politics aside, the virus was too contagious, and it was going to overwhelm the hospitals to the point that previously preventable deaths would no longer be preventable. Even with lockdown and preventative measures, hundreds of hospitals across the country reached at or near full capacity (8). Although the overwhelming majority of patients with severe symptoms are not college students, the virus can still spread through the community and reach those who are not as fortunate. Studies showed that counties that had colleges within them saw disproportionately high spikes of COVID-19 when compared to other counties in that state (9).
Another aspect of university living are dorms and fraternity houses. Both are classified as congregate living spaces which, according to the CDC, are places of higher risk, as the chance to spread the virus to other individuals is significantly higher (36). On top of living arrangements, student behavior was a huge factor in the spread of COVID-19. Greek life was an issue across many different college campuses, including at the UA. Many Greek life fraternities and sororities resumed business as usual. Frequent parties alongside the lack of any preventative measures listed out by the CDC was the perfect environment for the spread of COVID-19. Fraternities and Sororities would frequently host public gatherings, sometimes amassing over 100 people indoors with no social distancing and no masks (15). Many students who do not participate in Greek life acknowledged this issue and would discuss the juxtaposition between the obviously negative impact these parties would have on a COVID-19 safe campus and the precautionary measures that were implemented. Many students would bring up how the University of Arizona was not enforcing any of their policies regarding COVID-19 safety towards the fraternities and sororities, bringing up the argument of whether or not the public statements about COVID-19 safety were simply performative.

Regardless of university relations with Greek life, the University of Arizona went above and beyond with research into COVID-19, in particular, into testing capacities. The University of Arizona’s research departments were way ahead of the curve with the creation of a rapid antigen test that was one of the first tests available. It was an antigen swab test where the individual would insert a swab into their nasal cavity to detect COVID-19 antigen (38).
The University of Arizona even allocated large rooms such as gyms and classrooms on top of the Campus Health offices to become testing centers so they could increase testing capacity greatly. When the school needed to further increase the amount of testing, they invented another test, with higher levels of fidelity. The new test was the Saline test and was considerably less difficult to execute and the higher level of fidelity meant that students could be confident in the negative (or positive) test results.

The University of Arizona included also included safety measures such as COVID-19 dorms, into which a student that tests positive would be moved and would have a mandatory 2-week quarantine period enforced. The school would take care of groceries and food, basically allowing the student to spend 2 weeks in the dorm without going outside. However, the unfortunate consequence of this well-meaning plan is that it ended up causing fewer people to want to test, just in case they did end up becoming positive, and with almost 30% of known cases
being completely asymptomatic (37), the University of Arizona was going to need a different strategy in order to get the student body to test frequently. At the beginning of spring 2021 semester, President Robins issued a requirement that students must test twice a week. The way that they enforced this change is to restrict access to U of A Wi-Fi to those who did not adhere to the new testing guidelines (55). This was seen as an overstep by the university by some students, but it ended up being the kind of move that was needed in order to get the student population testing in higher numbers. The number of daily tests doubled from the previous semester as now any student who wished to access the university Wi-Fi had to test every week (56).

The University of Arizona was also active on another front of the war against COVID-19, vaccinations. Governor Doug Ducey announced on February 10th that the University of Arizona would be the first state vaccination site in southern Arizona (57). With that announcement, the University of Arizona took its job very seriously, converting the mall (a large grassy area running throughout the campus) into a 2,000-foot-long drive-through vaccine distribution center (2), as well as turning the Ina Gittings building (a converted gymnasium) into a sit-down vaccination center. The University of Arizona was only able to do so with the generous help of the Tucson public volunteering at the vaccine centers; the UA POD (Point of Distribution) requires around 300 volunteers daily (58). At the time of writing this paper, the University of Arizona has administered over 200,000 vaccines to Pima County (59). And aside from the clear benefits that being vaccinated has, the University of Arizona offers even more incentives such as removing the requirement to test 2 times a week for Wi-Fi access, or for the possibility of attending the end of the year commencement ceremony.
Why this matters

So now that we have discussed what COVID-19 is, how it affected society, and specifically how it affected education, we can discuss why it matters to education, and particularly, online education. Online education is defined as “education that uses one or more technologies to deliver instruction to students who are separated from the instructor and to support regular and substantive interaction between the students” (10). Online learning is the form of learning that takes place over the internet. It is most valuable as a form of a workaround to an impediment that would prevent individuals from attending in-person classes, whether it be distance, time related, or for this instance, due to a pandemic. Online learning can offer a substantial and robust learning experience with the implementations of new technologies; however, educational practices have not yet well acquainted themselves with the online modality as well as the in-person counterpart, and thus the learning experience is drastically different.

One way in which online learning is dramatically different from traditional learning is how little it is compatible with collaborative learning. “Collaborative learning” is an umbrella term for a variety of educational approaches involving joint intellectual effort by students, or students and teachers together. Usually, students are “working in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product” (12). Key elements that distinguish collaborative learning from traditional learning are: “face to face interaction with other students, individual accountability through peer evaluation and assessment, group processing through reviewing group skills to make decisions as a group, positive interdependence through group goals and tasks, learning goals and rewards, and interpersonal skills such as communication, conflict management, trust, leadership, etc.” (11).
Although collaborative learning has been proven to be an effective method of education, its implementation in school and higher education has been slow (39). However, the classrooms around the country that do utilize collaborative learning can attest to how much it benefits the students (13). Collaborative learning has been shown to improve student grades, many students and teachers report seeing an increase in average grades while applying collaborative learning practices. It creates an environment that facilitates student engagement; having small groups to discuss opens many students up to share ideas that they wouldn’t have otherwise due to the atmosphere of a large lecture hall or large audience. Teachers report a marked increase in student retention and responsibility. Students that share and discuss the topics with their peers are actively boosting the consolidation of the knowledge so they will be more likely to remember the material. Another aspect to consider is that, since there is an expectation for the students to discuss the topic with others, the student will go through the materials themselves so that they can contribute to the discussion, this practice develops personal responsibility. Students demonstrate more refined oral communicative skills; due to the discussions between students, the skills necessary for oral communications are aptly challenged and developed. This does not solely include how to become a better speaker, but also how to become a better listener (40). Students are exposed to and develop deeper understandings of diverse perspectives. Since the discussions are often going to be between people of different backgrounds, having exposure and understanding to new perspectives is crucial in the development of a culturally competent participant in society. It is not just curriculum that is taught with collaborative learning methods, social skills that will be important in everyday life are formed. This kind of education makes the students well prepared for real life social and employment situations.
With all of these benefits, it comes to no surprise that professors lament the fact that collaborative learning is not as effective in the online modality. The collaborative learning exercises that do so well in person don’t carry over as good online exercises. The physical distance decreases the feel of being a group which is a crucial aspect of the collaborative learning process. When a group meets to do discussions and other collaborative learning exercises, the physical isolation, combined with the potential that students might be unable to see each other creates a sort of social barrier. The beneficial aspects of group work are not gained when the social barrier prevents natural and fluid collaboration and cooperation between groupmates.

Another thing that can hinder the educational process and thus interrupt collaborative learning is how the student views the coursework and schooling as a whole. Many students share the sentiment of not enjoying online schooling (61). Most complaints surround the feeling that it’s not “real school” and that motivation drops to the bare minimum (41). The drop in motivation and enthusiasm can be seen across the virtual campus. Attendance is extraordinarily low, with instructors struggling to engage students (42). Even getting students to turn on cameras can prove to be a feat (60). It appears that the academic environment due to the pandemic is not conducive for collaborative learning. With the entire world basically shut down, schedules and routines came to a halt, and with many student’s academic performance being tied to that sense of routine, collaborative learning could not offer the benefits it can in a traditional setting. One could look at collaborative learning as an optimized modification to a functioning educational system. Collaborative learning can really only thrive with a stable system to work on. Since many aspects of the online modality are dysfunctional or in repair, collaborative learning cannot find the same foothold to offer the same level of educational benefits as it would in person.
Although collaborative learning is greatly hindered, there are a few tools that the online modality offers that can be used to facilitate collaborative learning. These features are from the widely used video calling platform ZOOM that rose to popularity to meet the world’s need for a robust platform that can handle upwards of 200 participants in a single call. Breakout rooms are a new development in video call/conference education. This feature allows for the instructor to place the students in small “rooms” of a few people, here is where the small groups can discuss. The instructor can place one preceptor in each room to help facilitate the conversation.

The issue with breakout rooms is that since the lead instructor is sending out the students to private rooms, the instructor can really only see how it is going in one room at a time. If the instructor has no preceptors or TAs, then many groups can just sit in silence waiting for the breakout rooms to time out. One very common sight would be people who are in a lecture but not actually at the computer, this could be for any number of reasons; bathroom, parents walk in, student has drifted off. However, the difficult aspect of this is that the other group members are often left to wonder if the person is either absent, ignoring them, having technical issues, or any other problem. Some students might try to call for the individual to see what is going on, but most students choose to just leave it be and accept the fact that the person might be gone.

The negative affect of this is inversely proportional to the number of students in the breakout room. For example, if there are two people in the breakout room and one person is MIA, then the collaborative activity flops and is not helpful. However, if there are three people, then there is a chance that the two people have a collaborative discussion without the other group member. And with every person that is present, the chance that the collaborative activity can continue increases. However, there is one factor to mention regarding students who don’t participate or who don’t look like they are participating, the contagious aspect of a lack of
motivation. If a student hops onto a breakout room and sees that 2 other people in the zoom are not participating, it could increase their chance of not participating too. Many breakout rooms that I have been a part of end up being students with their videos turned off. The odd breakout room will have someone who unmutes themselves to ask if the group wants to work, and those times you get a higher chance of success for the collaborative activity.

Private chat is another feature that is offered through ZOOM that has the potential to benefit students. Occasionally students will forego asking questions due to feeling like it is not a good question, feeling like they might get judged by their peers for asking, or simply not wanting to interrupt the professor to ask. The private chat allows students to send questions directly to the professor so that students can directly communicate about a private issue or to ask a question that can be answered later. Of course, this can be abused like any system and can also be a distraction as students could also use this as a form of secret communication during class. However, this can be restricted so that the only chat messages can be sent to the professor. Another aspect to ZOOM calls that can prove to be beneficial is the screen sharing aspect of the call. The instructor can show all the students exactly what they need to see. This comes as a benefit due to the classroom or lecture hall that is large enough to have some people sitting at locations that are less than ideal. This has normally been circumnavigated in the classroom via paper handouts, but simply screensharing the worksheet can save the instructor the hassle of printing the papers and passing them out to all the students.

With all of the differing aspects and dispositions towards online education and schooling through the pandemic, we decided to send out a SurveyMonkey Survey before fall semester 2020, at the end of fall semester 2020, and in the middle of spring semester 2021. The students were asked questions regarding: their preference on modality for classes, the effect of the pandemic on
academic performance, dispositions regarding certain adaptations to the new modality, and what they would like to see in the future.

A quick note about potential biases within the survey answers. Although the surveys were anonymous, there always exists a surveyor bias where people may not share their true disposition if it will be recorded. Furthermore, these surveys were all directed towards the courses taught by Dr. Zoe Cohen. Dr. Cohen is a highly decorated and well-renowned professor at the University of Arizona. She is known for developing close bonds to her students and has won several teaching awards such as the Five-Star faculty award, the Undergraduate STEM Education Teaching Excellence Award, and has been the Physiology professor of the year for 4 years in a row. This is necessary to bring up as it is obvious that such a professor would receive higher than average reviews as her resume precedes her. Also, having taken her course during the online modality, I can say that they are definitely more well-structured and more tailored to student success than my other classes.

With that in mind, the data from the surveys is as follows.

Survey #1 (June 23\textsuperscript{rd}, 2020) Survey #2 (November 11\textsuperscript{th}, 2020) Survey #3 (March 19\textsuperscript{th}, 2021)
DISPOSITION OF STUDENTS FOR QUALITY OF SCHOOLING

Survey #2 | Survey #3
---|---
 Poor | 14.76 | 7.55
 Average | 28.52 | 28.3
 Fair | 56.71 | 64.16

DISPOSITION OF STUDENTS ON WHETHER OR NOT TO KEEP CHANGES TO THE COURSE FOR NEXT SEMESTER

Survey #2 | Survey #3
---|---
 Keep Some Changes | 92.8 | 90.57
 Go Back To Old Ways | 2.11 | 0
 Not Sure | 5.02 | 7.55
Aside from numerical analysis, another part of the survey was written testimonials. These testimonials have been used to gauge student thoughts shared throughout the paper, however, one interesting thing that showed up in both the testimonials as well as the graphs is the significant increase in the percent of students who wanted to continue online education rather than revert to in person. There is a larger increase in people who wish to return to online, however that is to be expected, the increase in students who desire online schooling is novel and merits particular interest. An unfortunate aspect of the data shows that a significantly higher number of people were uncertain in the earlier survey as there were in the later one. The reality could have been that the majority of the people who were uncertain would have picked online if they had to choose, but unfortunately, we cannot conclude either way.

Before Fall 2020, only 27% of students wanted to have fully online classes, the other 73% either wanted fully in person classes or a hybrid of in person and offline. Looking towards the future for Fall 2021, out of the students who were certain, 47% of students wanted to be fully online while 53% preferred to go back in person. The marked increase seems to be due one of two factors, a growing fear of COVID-19, or growing accustomed to online university.

Some representative comments from the survey:

**Fear of COVID-19**

“I would do whatever is in the best interest of the general public. If most people are not vaccinated and COVID-19 and its variants are still killing mass amounts of people, I think we should stay online.”
“Obviously, I want to go back to campus more than anything. I want to have the "normal" college experience, BUT I cannot see a safe way of doing that. Would it be selfish if I said let's return to class? Maybe we can downsize the numbers (that helps but all you need is one COVID-19 positive case to ruin it all again). Wearing masks is very effective, but not the many who can't mentally handle a mask for hours in. This is life now though, we need to adapt, right? Move forward? I believe a zoom convention where students can attend with the head people that make the decision to go back or not could help better form an opinion maybe. It also depends on what teachers are willing to go back as well. Not calling anyone old, but teachers tend to be older than the college students, so they may have a different take.”

“I would rather stay online. Even though it is predicted that we will achieve herd immunity by then, I do not feel comfortable being around that many people so soon.”

I despise the online learning and had a much better time in person... but COVID-19 exists still, so we can’t be sure. I would love to come back if it’s safer. Then again, I’m graduating, so it doesn’t matter too much for me.

**Growing Accustomed to Online Learning**

“At this point I have spent more time online than I have in person and I enjoy it considerably more than in person classes.”

“I think online is less stressful and provides more time to study without having to travel to school and walk to classes.”

“Virtual learning has worked out amazing for me and I am not quite ready to go back in person. I really hope that classes have a fully online option, and we are not forced back into the classroom.”
“If there was a fully online version, I would likely stay online. It really depends, if I have to be on campus for other classes anyways, then I'd want all of my classes to be in person. If I have to keep on moving between in person and online, it's a bit harder.”

This interesting phenomenon of preferring the non-traditional style of education after more than one year of it could be from a plethora of potential perspectives. The main two dispositions we saw in the surveys were from people not understanding what online learning was during the earlier surveys and had developed a negative idea of it without knowing what it was really. These people may be the kinds of individuals who prefer to have online schooling given the experiences they’ve had over the past year. The other disposition was from people who fear the virus and want to do as much as possible to prevent the spread of COVID-19 through campus. These are very valid thoughts and concerns, and it is perhaps due to the upheaval of what is normal that some individuals find what kind of education style works best for them.

Through discussions with several students, it can be seen that some people actually prefer the schooling system as opposed to the traditional methods. The overarching rationale that the students discuss is how much more convenient online schooling is. During the last year of the pandemic, perhaps many students have gotten accustomed to the more relaxed and laid-back environment of higher education. There are many aspects of online university this year that are very much more laid back than in previous years.

A huge factor of student stress is exams, and with this year’s tests being online, it was significantly less robust of an examination. For example, there are very few ways to deter cheating. Most professors acknowledge that students have the capacity to easily cheat online and
therefore make the tests “open note” or “open lecture” to potentially combat the desire. Many courses opted to have these changes, even though it substantially decreases the difficulty of the exam, and potentially undermines the student’s academic growth. Many students could even be in a video call when taking exams. Online modality makes it harder to do nontraditional testing methods for some classes such as drawing structures for organic chemistry or labeling body parts for anatomy. As a result, more tests ended up becoming either multiple-choice, or short answer. Many students talk about how much easier multiple-choice questions are as opposed to the alternative testing methods (43). Another aspect to online testing is that teachers could be opting for easier tests. This could be either because the instructor no longer has the reliable ability to tell where the class is in regard to understanding a topic and could elect to make the exam easier as a break for their students.

Another aspect of online convenience is lecture attendance and recordings. With lectures being online or being posted to Panopto, a lecture recording website used by teachers to upload classes, students have much more freedom to do as they please. This disincentivizes attendance at the lecture as now the student can watch the lecture video whenever they want. Students can go weeks without actually attending a course if it doesn’t take attendance because they know that the class videos will be online, and they can watch them before a test. Online videos can also be sped up so that the amount of time in class is reduced, thus allowing for more free time.

Furthermore, instructors have been generous with deadlines for assignments this year. This factor comes into play more so with the pandemic online learning where instructors want to be considerate and accommodating for student struggles. Unfortunately, this can be taken advantage of with students using this leniency to its maximum potential. In some cases, the
instructor is so lenient that all the assignments are due by the end of the semester and not on a regular schedule.

Many of the student testimonies, from both those who wanted to stay online and to return to in-person, talked about how nice it was that there was no longer a mandatory commute. Students would now be able to attend lectures from bed and not even have to prepare to leave the house. This, to the standard college student, is like a luxury. Time that was considered wasted by either walking from class to class or driving to the university are now given back to the student. This is even more influential if you consider how some students used to have 45+ minute commutes both ways. Commuting is arduous and has even negative health effects on the mind and body (62). Also, this opens up the potential for students to not even need to be in the same place as the university. With many of the students returning home for the pandemic, the family can save a lot of money by not having to pay additional room and board. All of these factors could persuade students to prefer the online modality over the standard modality. One interesting point to add is that many of these luxuries will probably be reclaimed as the online modality becomes a more formal and acceptable form of education.

One fear that has been echoed by many students is that they feel like they aren’t learning anything from online schooling. This can be seen as a concern for students that are planning ahead and acknowledging that learning the curriculum now is going to benefit them in the long term and missing out on that education puts them at a disadvantage. Another group of students could simply be more focused on the difficulties of the present and see the relative ease of online schooling as a preferential option to the harder and less convenient alternative of traditional schooling. One thing is for certain though, the various benefits of collaborative learning are unavailable as of now to those who elect the online modality.


\textit{The Silver Lining}

Like most things in life, the situation with COVID-19 is a mix of good and bad. Although there was a hefty loss in many areas, some areas grew, and our adaptations ended up being more preferable to the traditional alternative, like those who found they preferred the online modality more. As previously discussed, there are some students who claim to like the online modality more than the traditional method, and perhaps students like this are more able to succeed in the online environment. A situation like COVID-19 would have made them move out of their comfort zone and helped them to realize that online learning is better for them. Introverts are another demographic that have more or less thrived in the pandemic setting. Online testimonies discuss how much happier they are without the mandatory social interactions and how much more productive they are in an isolated setting (44).

The potential for more inclusivity through the process of making the online learning modality more robust and more well suited for a larger population. Universities pride themselves on being very inclusive institutions, however, there are still some barriers of entry that can be insurmountable for some people. The commute, price, or even time commitment to traditional education could be too much for some people who don’t have those luxuries. This experience could possibly chip away at some of those barriers and allow college education to be more attainable to more of the population, bettering all of society (63).

As stated at the beginning of the paper, hindsight is best used moving forward; so, what lessons have we learned that can hopefully prevent something like this in the future. We can hope that the government will learn from this experience and will take precautionary measures in order to stop the spread of new viruses in the future. We saw (and continue to see) how some countries acted and how it benefited them or wounded them. A hefty reliance on science has
been the United States’ best plan of action against this virus. Also, depending on how soon the next pandemic will be, our collective experience could be to make it a lot more bearable of a situation by knowing what to do. Mass hysteria, emptying of the grocery stores, and starting conspiracy theories did not help anyone. This is something that we are going to have to learn and learn well, humanity will always be under the threat of the next pandemic.

At the university level, there are many things that we have learned to do better in a pandemic setting. The University of Arizona’s plan for deterring the spread of virus by changing the course modalities can be done better next time, and with a more robust support system for all options. Offering 4 different course modalities was a useful starting point: Live in person, Hybrid, and online/flex, Live online (with attendance both mandatory and not), and I-Course. These new modalities not only helped the University ease both students and faculty into the “new normal”, but it can help prepare for another disaster. It also forces the university outside of its comfort zone into a newer age, one where there could be real merit to online learning with the new technologies at our disposal. For example, online capacities have been dramatically enhanced with Zoom. Zoom has changed the field of online education forever, and the future of online learning is at a potential inflection point. Maybe in the future instructors will learn how to properly facilitate collaborative learning online.

Times of extreme change allow one to step back to look at all the things that are different. What is better now that it has changed? What did we find we had taken for granted? I can say without a doubt that online schooling was dramatically improved. Having taken classes online before the pandemic and then during the pandemic, it is clear that the online modality that was offered by the pandemic is significantly more robust and is more dedicated to offering a wholistic learning experience. There is a decreased emphasis on I-Courses as the live online
(attendance and not) offered a more tailored education that succeeded to do more than simply just offer curriculum. The drawback with I-Courses is that they are self-paced and lack the critical aspect of education that comes from student-teacher interactions. Another education benefit I saw during the pandemic was that library access via the web was more aptly promulgated allowing for more people to use it as a resource than before as physical books are becoming less needed in the modern age. A few of the classes I was in took the time to show people how to use the school library and other online amenities that the university offered.
Conclusion/Appendix

As this paper concludes, I would like to share some thoughts about the situation, how I see the future of collaborative learning in schools, and where this research can grow from here. My reason for delving into this ever-evolving rabbit hole of a topic is that I have been hit really hard by the modality change and am finding it extraordinarily hard to do simple tasks I used to do pre-COVID-19. Researching this not only gave me comfort that I am not alone in my experience, but also sparked curiosity about how this could be done better. It quickly became apparent that this pandemic had potentially unearthed another side to university education, hidden due to comfort and technological barriers. It was also very interesting to see how the social perspective evolved over time. The very early days of the spread, before it even was considered a national emergency, I recall seeing students and teachers alike making light of the situation, not knowing how it would eventually affect us all. I still cannot believe how quickly everything changed, how society went into a standstill, how the word “normal” lost its meaning, and then gained a new meaning in a new age. Points of self-realization came in small moments: the last time I went to lunch with friends, seeing grocery stores hang “MASK UP” signs across the windows, watching Santa talk to kids between a plexiglass wall, seeing people build vaccine centers on the university mall, rather than setting up Spring Fling.

The future of online learning already seems brighter than it was before. More classes are offered by the U of A that are online. Either live online options or I-Courses. Before there was only one PSIO course offered online, but now there are several that are offered as of right now. Additionally, some professors might even give students the freedom to stay home due to the level of uncertainty for how it’s going to be when we go back to school regularly.
One question I am very curious about is what aspects of life are most probably going to be revised upon return to normalcy? Mask wearing might become more popular as it has been more incorporated into daily lives. Previously wearing a mask in public was seen as weird and not normal, perhaps with the passing of this pandemic, people who do not feel well might elect to put on a mask so that they feel less bad about going around and that way they can prevent more people from getting infected. However, I do think masks will no longer be worn as much as they are now, and people will feel comfortable about going about their daily lives unmasked. As I write this, the CDC announced that those who are fully vaccinated can go outside without a mask, to me this dictates the beginning of the end for masks in the general public (64).

There might be some aspect of social distancing that might last into the foreseeable. Many people I have spoken to have shared the sentiment about how it’s crazy how they never used to think about particles from other people’s breath being breathed in by them and that this new education makes people less eager to get into crowded areas. Some people look back at videos of crowds where people are shoulder to shoulder and comment on how uncomfortable that makes them to think of a crowd that packed right now. Again though, I think the majority of social distancing practices will be forgotten, restaurants will return to trying to pack as many guests in as possible and concerts will still try to sell as many seats as possible.

Handwashing was already a common practice that everybody did daily, however I do think that the pandemic definitely saw more people handwashing more frequently and using hand sanitizer. This might lead to more people being more conscientious regarding public germs. The only downside to this that I can see if that parents or new parents that had a child in the beginning of the pandemic might have made the environment too sterile and practiced so much
safety precautions against COVID-19 that the baby’s immune system has become naïve for other things and that might cause some immune related difficulties down the line (45).

One thing that I noticed that was very nice was the amount of people that would go outside as a leisure activity. For all the years I’ve been on campus, I had never seen more people playing frisbee, sunbathing, or just sitting on the grass outside and talking. This practice, I think, is very healthy for the mind and body as research has shown benefits to going outside (46). This is something that I hope does not go away as kids already get very little time outside as it is (47).

Another thing that the pandemic did offer for many people was the opportunity to cook for themselves and their families. Since restaurants were closed, people gravitated to two different solutions. Some individuals elected to order from third party delivery apps like Grubhub. There is a mountain of information and potential research in the evolving nature of the restaurant business due to the surge of third-party delivery systems (48). The other path that people took was to learn how to cook and to experiment in the kitchen. Trends like the sourdough bread craze (49) demonstrated how time in the kitchen can be fun and a bonding experience with the family. These ramifications could lead to less dining out and more time spent at the home. Although not all of these factors are directly related to collaborative learning, they could potentially become a part of American culture and it could change how college culture is as well.

I end my paper with some questions I wish I had asked but did not have the ability to. These would be a wonderful starting point for further research on this topic and are all valuable in their own manner.
Do students feel as if they are as good of a student on the online modality as opposed to traditional schooling?

How has the pandemic setting affected students academically? Motivation wise? Attention span? Discipline?

Have students noticed a change in their mental health during the pandemic?

To the students that managed to thrive during the pandemic, what factors do they think helped them manage where others couldn’t?

How many online courses did universities offer pre and post pandemic?

How do professors feel regarding student behavior during the pandemic?

How do professors feel about collaborative learning exercises in the online modality?

What do people think is going to return to normal and not be something that will stay with us even after COVID-19?

Could a potential bias be that some people who did not want to experience COVID university simply did not attend? This could increase the percentage of the student population that either enjoy or don’t mind online learning and that could have a factor between the first and third survey.


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