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Factors That Impacted Biology Student Performance During the Covid-19 Pandemic

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by

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ABSTRACT

This thesis aimed to discover factors that affected academic performance and determine if there was any significant change in student performance before the Covid-19 pandemic (Spring, Summer, and Fall 2019) and during the Covid-19 pandemic, specifically the Spring and Fall 2020 semesters. Data was collected from Georgia State University undergraduate biology students who completed three foundational courses: Principles of Biology I, Principles of Biology II, and Molecular Cell Biology. Student resources were identified via survey, while academic performance was measured via iCollege grades and engagement data. Independent samples t-tests comparing the final grades between 2019 and 2020 revealed an increase in grades for Principles of Biology I & II. Spearman correlations revealed a weak positive relationship between grades and engagement data for 2019 and 2020. While student grades increased during the pandemic, the impact on student performance will not be seen until students have completed upper-level courses.

INDEX WORDS: Principles of biology, Molecular cell biology, Online learning, Pandemic, Student engagement, Student performance

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DEDICATION

This thesis is dedicated to my family and friends who have supported me through this academic journey.

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I want to acknowledge my Georgia State instructors for teaching me, my committee members for guiding me, and the Research Data Services department for assisting me with my data management and analysis.

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LIST OF ABBREVIATIONS

BIOL 2107 or 2107 – Principles of Biology I

BIOL 2108 or 2108 – Principles of Biology II

BIOL 3800 or 3800 – Molecular Cell Biology

CETLOE – Center for Excellence in Teaching, Learning & Online Education

1 INTRODUCTION

In March 2020, the Covid-19 pandemic brought about drastic life changes worldwide. People were falling ill, losing loved ones, and adjusting to working and learning virtually, both asynchronous and in real-time. Paralleling national and international trends, this transition was difficult for most students and instructors at Georgia State University, as some had little to no experience with online learning. Students were not strangers to technology as they were comfortable using social media applications and websites for leisure. However, during the pandemic, students and instructors alike required a new level of proficiency.

Technology has been in the classroom for decades, pushing education forward and making it more engaging and accessible. The internet has allowed instructors to obtain the most up-to-date research to ensure students get accurate and peer-reviewed information. With programs like Microsoft PowerPoint, instructors could give their students information in a new way that would keep them interested and encourage them to participate (Goggin et al., 1997). Today instructional tools and programs used in the classroom, like Wolfram Mathematica, ChemDraw, Kahoot, Perusall, and iClicker, are used in higher education for these same reasons: they allow students to participate in their learning.

Programs like computer-based simulations have also been used to help students learn individually. Goggin et al. (1997) reference one of these simulations used at the University of North Texas for a health class. Students could take the health class through the computer program, get the same information they would in a traditional lecture, and perform at or above the level of students who took the traditional lecture. Teaching materials like Labster, Pearson MyLab, and McGraw Hill have taken this to the next level, where students can access their textbooks, supplemental materials, quizzes, and assignments online. Many of these resources

also have adaptive learning components that allow and encourage students to repeat and interact with the material they need more practice with.

As technology has advanced, it has become vitally integrated into higher education. While this has many benefits, there are some disadvantages. Computers and internet access have become mainstream but are still a luxury. Some students might be unable to spend hundreds of dollars on classes, fees, books, computers, and other necessary materials. While some of these materials were available on campus (e.g., computer labs and textbooks in the library), students were left with whatever resources they had at home when the pandemic hit. If they did not have reliable internet access or devices, they could not be successful in their courses. Another issue that arose during the pandemic was how to teach complicated material in a virtual format. Instructors did not have the same freedom to write or draw out examples for students to see in real time, and some concepts are difficult to learn from just watching an online lecture video or looking at 2-dimensional figures. STEM subjects such as Anatomy, Biology, and Chemistry have complex concepts that often require in-depth explanations and visual aids for students to grasp the material thoroughly.

A previous study by Brown & Peterson (2021) compared the performance and engagement of Anatomy and Physiology students taking an asynchronous online lab to that of students taking the traditional in-person lab. Students, in-person and online, had access to the same content and materials and had all the same assignments, quizzes, and exams. Brown & Peterson found that the traditional in-person course students outperformed the online students in two out of three course exams and all practical laboratory exams. One thing they discuss is the ability of students to come in and work with the 3-dimensional cadavers. While the opportunity to work with the cadavers was extended to both online and in-person students, little to no online

students took advantage of the opportunity. The exams and assignments only contained 2-dimensional figures. However, the in-person students who worked with the 3-dimensional cadavers in the classroom performed significantly better (Brown & Peterson, 2021).

In a 2015 study by Adams et al., researchers compared students' performance in a traditional versus hybrid Introductory Microbiology course. Students were separated into two groups: hybrid or in-person. The students in the hybrid group would watch online lecture videos on day 1 of the week but come in person for class activities on day 2. Hybrid section students would take a pre-class quiz to confirm they watched the material before coming to class on day 2; both the hybrid and traditional section students would take a post-class quiz after day 2. When the final grades for both sections were analyzed, the researchers discovered that the students in the traditional section performed significantly better than those in the hybrid section. This difference could be due to student study habits. An anonymous survey conducted at the semester's midpoint revealed that some hybrid students were not taking lecture notes or using the audio component of the lecture videos (Adams et al., 2015). When students are left to engage with the material independently, some take advantage of their resources, and some do not. Outside the classroom, staying focused on the material becomes difficult, especially when students have distractions or other responsibilities at home.

In a study by Murphy et al. (2020), students at a liberal arts college were surveyed to see how they felt about this sudden transition from a traditional classroom structure to virtual learning. The questions focused on how students thought instructors handled the transition. Students talked about instructors using their Learning Management System (e.g., iCollege) to communicate important information and upload resources and using platforms like Kahoot or Socratic to help students engage with the material and their peers. Some students even expressed

a desire for professors to continue to use technology by having class meetings on Zoom or recording lectures.

After the pandemic, a lot of research focused on student experience and the impact of the abrupt transition on the students and their performance. One study by Supriya et al. (2021) looked at grades from students during the pandemic. They compared the Spring 2020 grades of undergraduate biology students who transitioned (started in-person and switched online due to Covid-19) and those who were solely online. They found that grades increased for both groups of students in Spring 2020 compared to Spring 2018 and 2019 grades. Survey responses from instructors seemed to explain the increased grades with flexibility and changes in assessments. While more recent studies focus on students' feelings about the transition or student engagement, not many have focused on how student grades changed during and after the pandemic.

This thesis aims to understand how students performed during the early semesters of the pandemic (Spring and Fall 2020) and to use findings to inform future actions. By obtaining student grades and engagement data from 2019, 2020, and 2021 academic years and student responses to a 27-question survey, we can discover factors that contributed to student performance, like access to reliable internet and devices, personal learning strategies, and use of GSU resources. We expect student performance declined from Fall 2019 to Spring 2020 due to the abrupt changes in class structure and the students' distractions and challenges.

2 METHODS

2.1 IRB Approval

This study was approved by the Georgia State University Institutional Review Board on February 17, 2022.

2.2 Data Collection

2.2.1 Student Survey Data

A 27-question survey (*see Appendix A.1 Survey Questions*) was created and curated to answer one of the two main research questions: (1) What factors impacted student performance before and during the pandemic? The Murphy et al. (2020) study was used as a basis for writing survey questions about students' age, major, classification, and communication with instructors and peers outside of class time. Additional questions about students' access to resources were created based on information from Georgia State's Center for Excellence in Teaching, Learning & Online Education (CETLOE). Open-response questions were written to identify possible challenges students faced and learning strategies that were useful for students.

This survey was distributed by the Director of Undergraduate Studies to all undergraduate biology students during the Spring 2022 and Summer 2022 semesters via an anonymous email list (listserv). An invitation to participate in the survey was sent six times during the two semesters.

2.2.2 CETLOE Grades and Engagement Data

In addition to the student survey, deidentified grades and engagement data for 2019, 2020, and 2021 academic years were provided via CETLOE for Principles of Biology I (2107), Principles of Biology II (2108), and Molecular Cell Biology (3800). Student engagement was defined as the time (in minutes) students spent in the course via the Learning Management

System (Georgia State University uses D2L Brightspace branded as iCollege). This data allowed for analysis of student performance before and during the pandemic to answer the research question: How did students perform before and during the Covid-19 pandemic?

2.3 Data Analysis

2.3.1 Student Survey Data

Thirty-eight survey responses were received and reviewed for completion and consent. After review, only responses where students reported taking at least one course during the pandemic were kept. The remaining 24 responses were analyzed to determine the significance of the data. Cross tabulations and Chi-square analyses were used to identify significant associations between factors.

2.3.2 CETLOE Grades and Engagement Data

The grades and engagement data were managed and cleaned in Microsoft Excel. Final grades were used for analysis as these grades are an average of student performance in the course. Total time spent in content and progress percentage (completed course content divided by required course content) were used to determine the number of minutes students spent engaging with content in the course. Grades were available for 2,318 students, and engagement data were available for 2,358 students. The Kolmogorov-Smirnov Test was used to determine if the data followed a normal distribution.

Clustered bar charts were made to visualize the difference in means for final grades (*see Figures 1, 2, and 3*), total time spent in content (*see Figures 4, 6, and 8*), and progress percentage (*see Figures 5, 7, and 9*) for all three courses. 3 Independent Samples t-Tests were conducted to discover any statistically significant difference in final grade means between 2019

and 2020 for all three courses. An ANOVA and Welch Test were conducted to identify statistically significant differences in final grade means between the three courses.

Scatter plots were created to visualize the relationship between final grades and total time spent in content for 2019 and 2020 (*see Figures 10, 11, and 12*). Spearman Correlations were run to determine the nature of those relationships. All analyses were done in IBM SPSS.

3 RESULTS

3.1 Student Survey Data

A table (*see Table 1*) was made to see the diversity of student answers to demographic questions (*see questions 1-9 in Appendix A1*). Cross tabulations with Chi-square analyses did not identify significant associations among these factors.

3.2 CETLOE Grades and Engagement Data

The Kolmogorov-Smirnov Test was used to determine if the grades and engagement data followed a normal distribution. The grades were not normally distributed for 2019 ($D(830) = .128$, $p < .001$) or 2020 ($D(1264) = .160$, $p < .001$). The total time spent in content and the progress percentage data were not normally distributed for 2019 ($D(1259) = .221$, $p < .001$; $D(1259) = .060$, $p < .001$) or 2020 ($D(1987) = .215$, $p < .001$; $D(1987) = .058$, $p < .001$).

Independent Samples t-Tests revealed statistically significant differences in 2019 versus 2020 final grade means for 2107 ($t_{679} = -4.945$, $p < .001$) and 2108 ($t_{745} = -3.841$, $p < .001$) with mean differences of -7.27 and -4.67, respectively. No significant difference was revealed for 3800 ($t_{662.260} = -0.846$, $p = 0.200$) with a mean difference of -1.18.

An ANOVA revealed a statistically significant mean difference between 2107, 2108, and 3800 ($F(2,2091) = 4.683$, $p = .009$, n=2,093). Tukey Post Hoc Tests identified the significant differences specifically between 2107 and 2108 ($p = .041$) and 2108 and 3800 ($p = .014$). No significant difference was identified between 2107 and 3800 ($p = .921$). A Welch Test revealed a statistically significant difference between 2107, 2108, and 3800 ($F(2,1375.23) = 4.827$, $p = .008$, n=2,094). Games-Howell Tests identified the significant differences between 2107 and

2108 ($p = .036$) and 2108 and 3800 ($p = .015$). No significant difference was identified between 2107 and 3800 ($p = .926$).

Spearman's Rho Correlation determined a weak positive relationship between final grades and progress percentage ($r(1662) = .19$, $p < .001$, $n=1,664$) and final grades and total time spent in content ($r(1662) = .20$, $p < .001$) for 2019 and 2020.

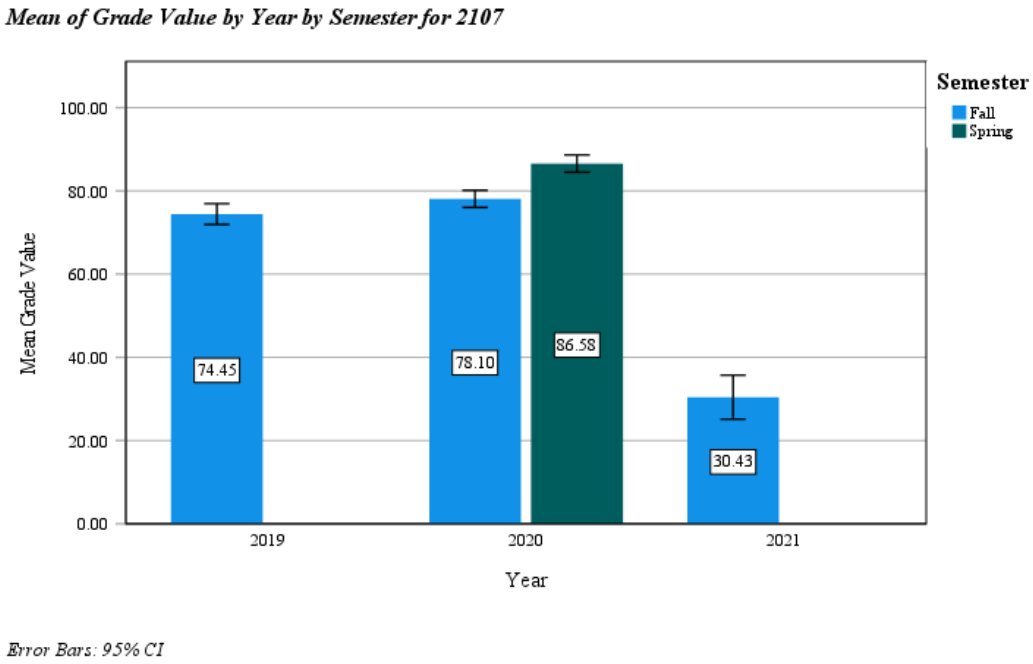

Figure 1 Mean of Grade Value by Year by Semester for Principles of Biology I

The clustered bar chart depicted above was created with the final grades for Principles of Biology I (2107). These grades are separated by year (2019, 2020, and 2021) and clustered by semester (Spring and Fall). The white boxes depict the average final grade for each semester in each bar. Total grades across all bars for Principles of Biology I n = 904.

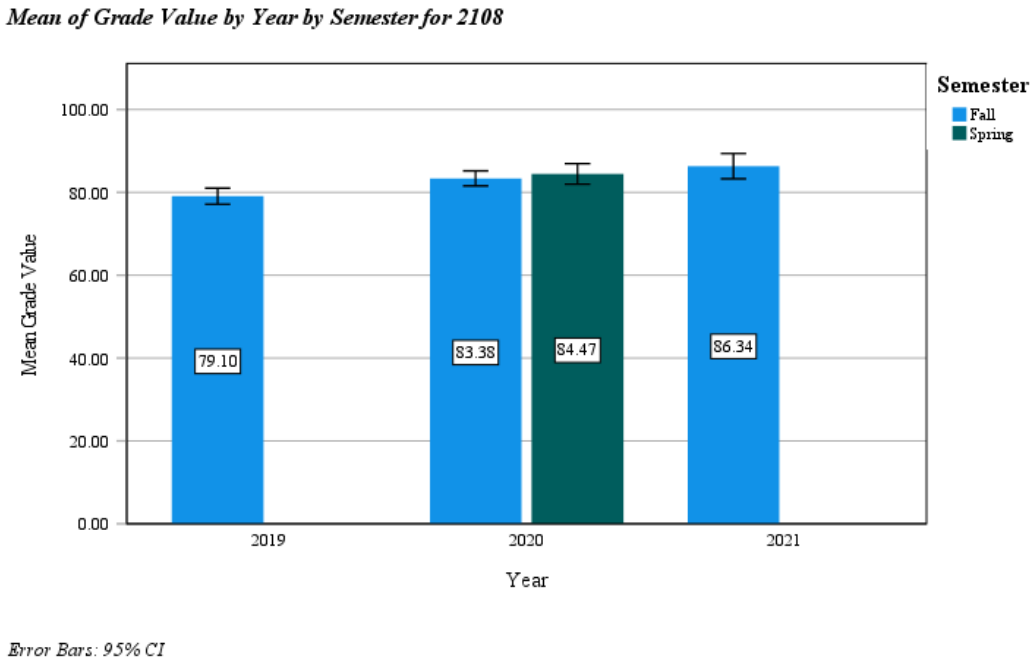

Figure 2 Mean of Grade Value by Year by Semester for Principles of Biology II

The clustered bar chart depicted above was created with the final grades for Principles of Biology II (2108). These grades are separated by year (2019, 2020, and 2021) and clustered by semester (Spring and Fall). The white boxes depict the average final grade for each semester in each bar. Total grades across all bars for Principles of Biology II n = 994.

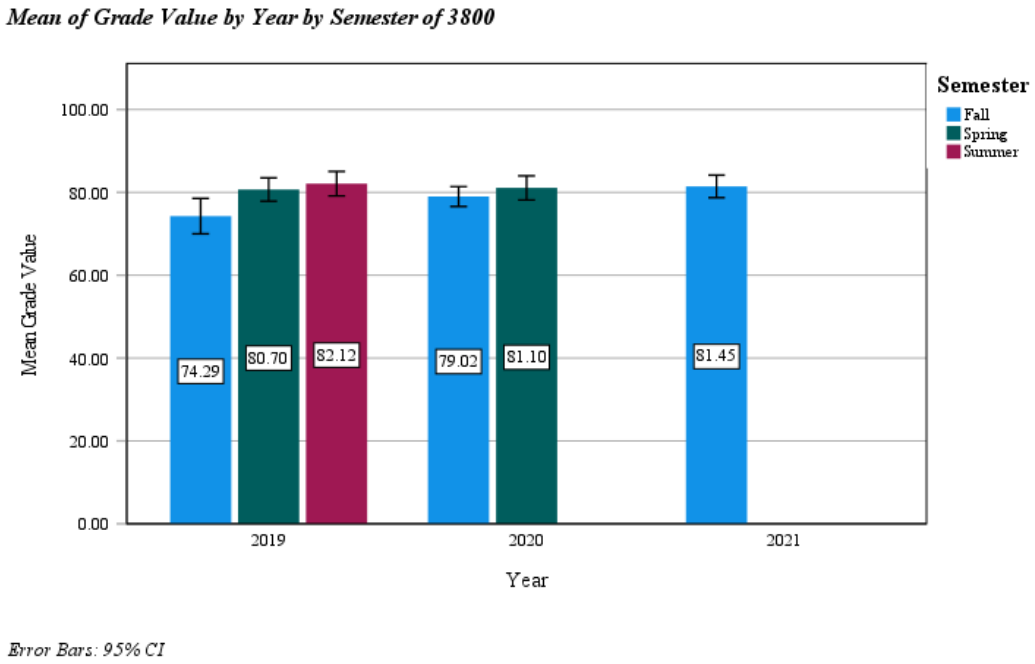

Figure 3 Mean of Grade Value by Year by Semester for Molecular Cell Biology

The clustered bar chart depicted above was created with the final grades for Molecular Cell Biology (3800). These grades are separated by year (2019, 2020, and 2021) and clustered by semester (Spring, Summer, and Fall). The white boxes depict the average final grade for each semester in each bar. Total grades across all bars for Molecular Cell Biology n = 823.

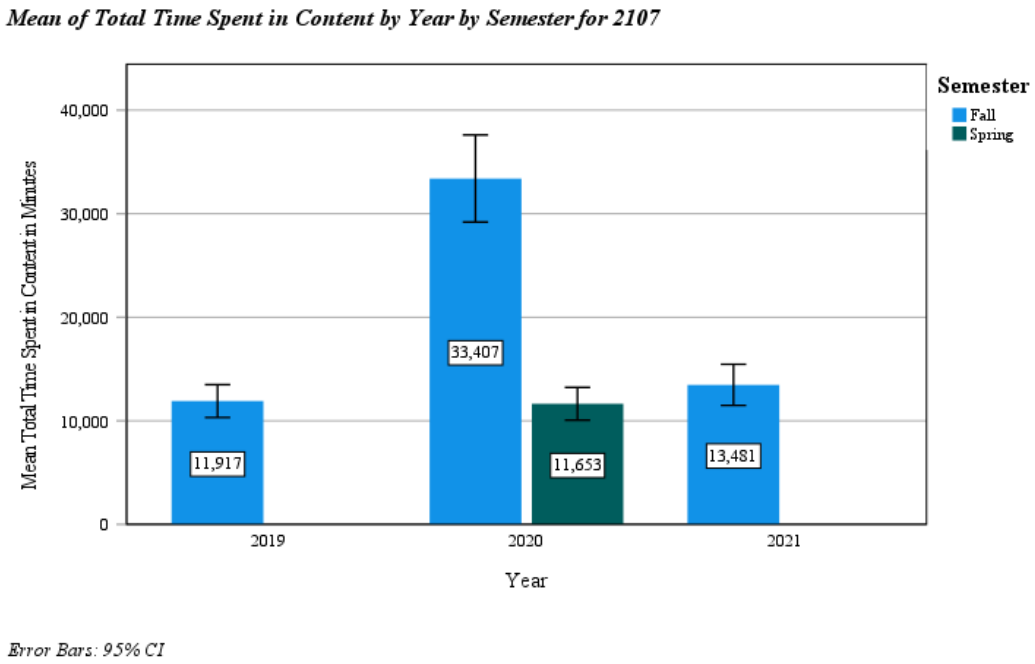

Figure 4 Mean of Total Time Spent in Content in Minutes by Year by Semester for Principles of Biology I

The clustered bar chart depicted above was created with the total time spent (mins.) in content for Principles of Biology I (2107). Engagement data are separated by year (2019, 2020, and 2021) and clustered by semester (Spring and Fall). The white boxes depict the average total time (mins.) for each semester in each bar. Total engagement data across all bars for Principles of Biology I n = 1,494.

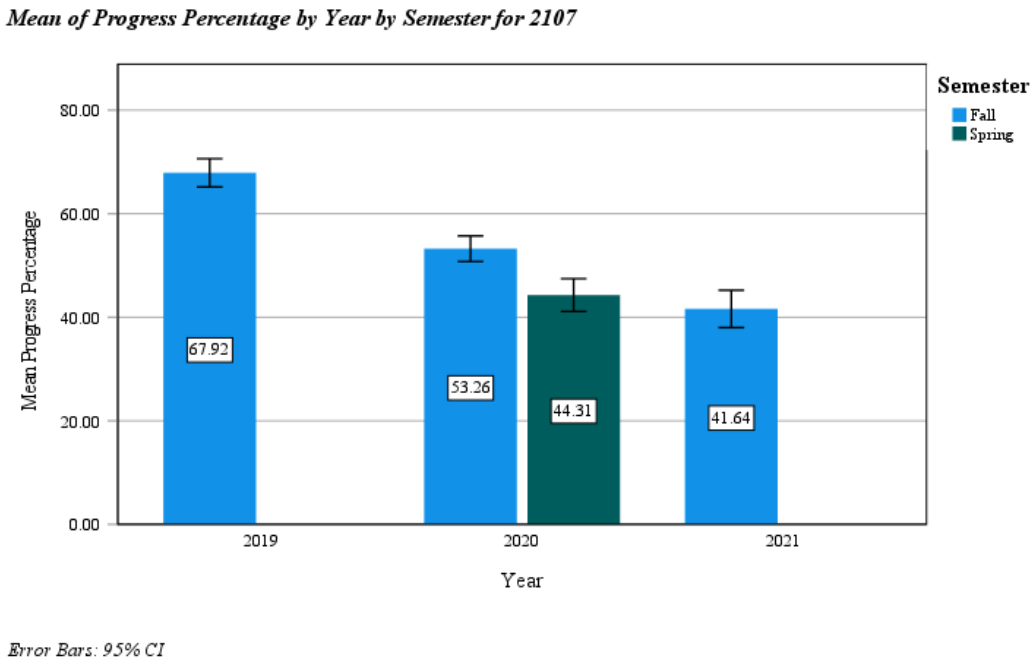

Figure 5 Mean of Progress Percentage by Year by Semester for Principles of Biology I

The clustered bar chart depicted above was created with the progress percentage (content completed/content required) for Principles of Biology I (2107). Engagement data are separated by year (2019, 2020, and 2021) and clustered by semester (Spring and Fall). The white boxes depict the average progress percentage for each semester in each bar. Total engagement data across all bars for Principles of Biology I n = 1,494.

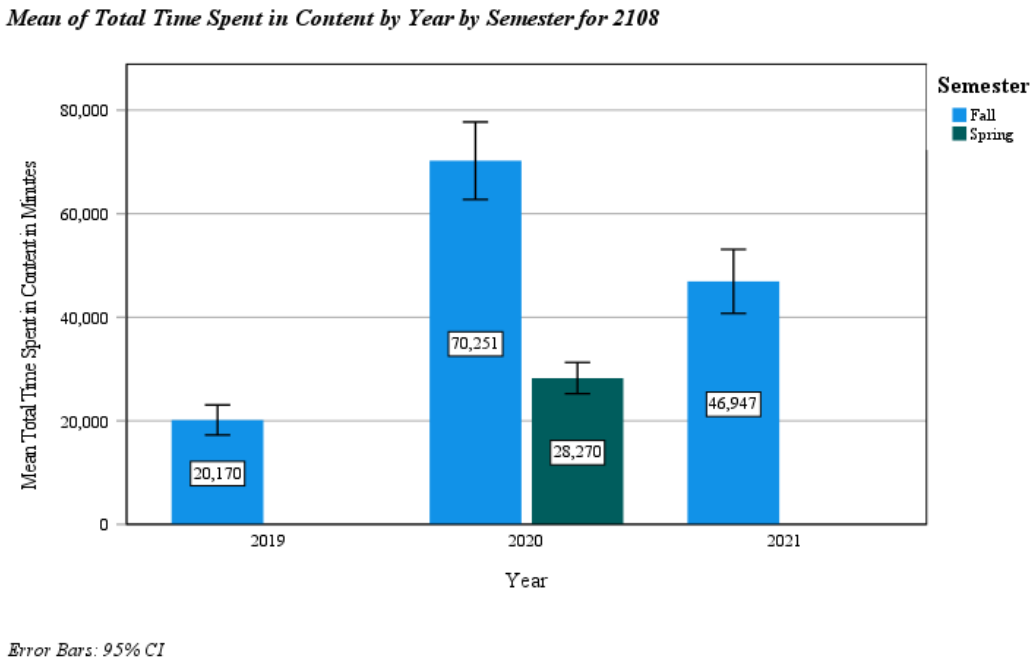

Figure 6 Mean of Total Time Spent in Content in Minutes by Year by Semester for Principles of Biology II

The clustered bar chart depicted above was created with the total time spent (mins.) in content for Principles of Biology II (2108). Engagement data are separated by year (2019, 2020, and 2021) and clustered by semester (Spring and Fall). The white boxes depict the average total time (mins.) for each semester in each bar. Total engagement data across all bars for Principles of Biology II n = 1,424.

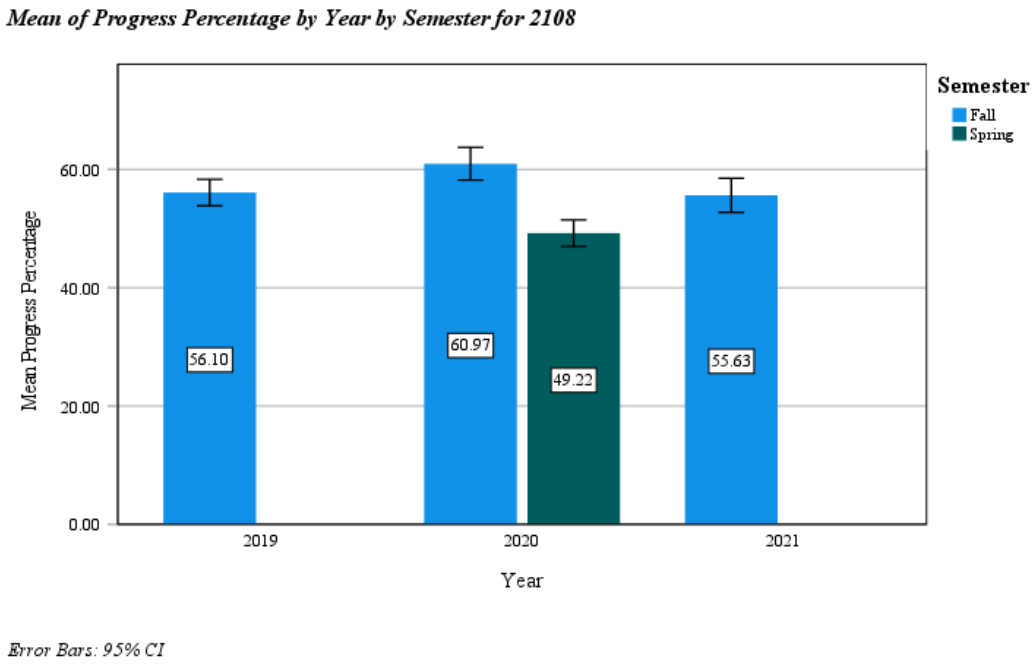

Figure 7 Mean of Progress Percentage by Year by Semester for Principles of Biology II

The clustered bar chart depicted above was created with the progress percentage (content completed/content required) for Principles of Biology II (2108). Engagement data are separated by year (2019, 2020, and 2021) and clustered by semester (Spring, Summer, and Fall). The white boxes depict the average progress percentage for each semester in each bar. Total engagement data across all bars for Principles of Biology II n = 1,424.

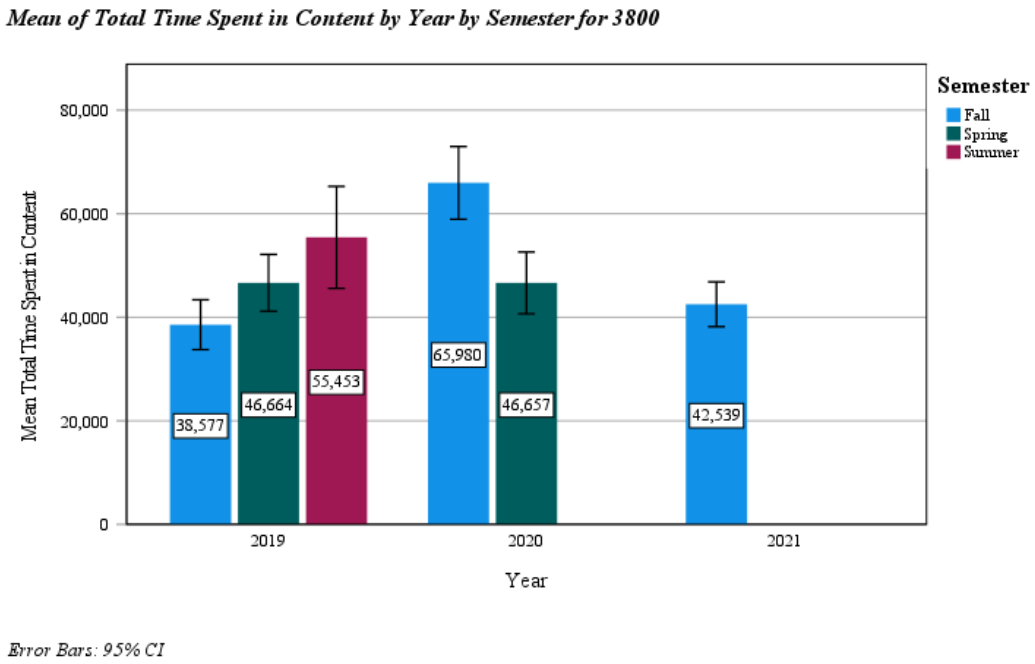

Figure 8 Mean of Total Time Spent in Content in Minutes by Year by Semester for Molecular Cell Biology

The clustered bar chart depicted above was created with the total time spent (mins.) in content for Molecular Cell Biology (3800). Engagement data are separated by year (2019, 2020, and 2021) and clustered by semester (Spring, Summer, and Fall). The white boxes depict the average total time (mins.) for each semester in each bar. Total engagement data across all bars for Molecular Cell Biology n = 1,478.

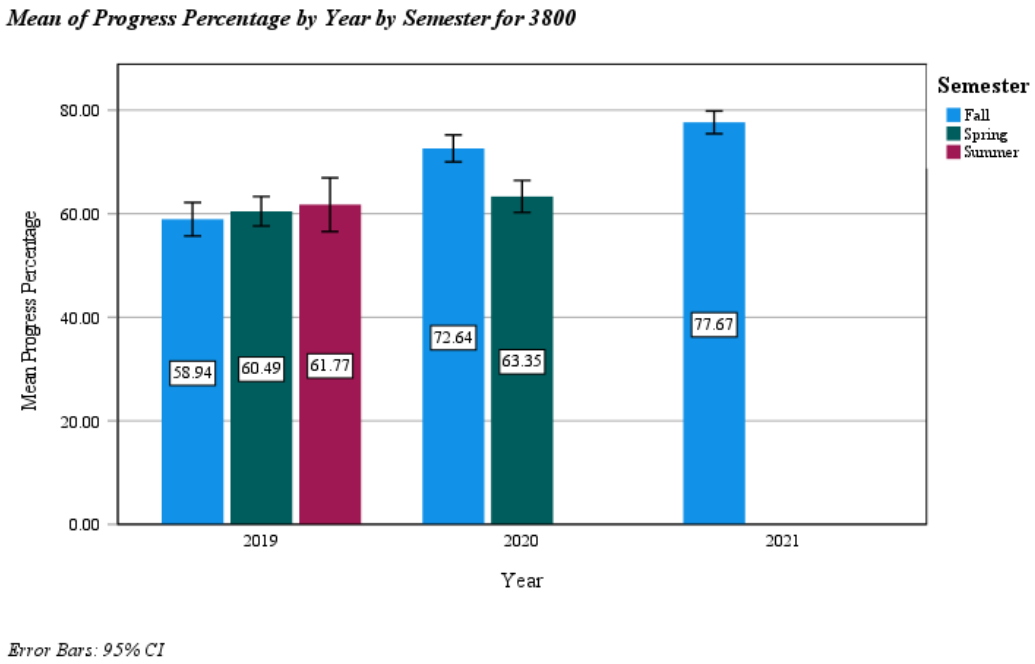

Figure 9 Mean of Progress Percentage by Year by Semester for Molecular Cell Biology

The clustered bar chart depicted above was created with the progress percentage (content completed/content required) for Molecular Cell Biology (3800). Engagement data are separated by year (2019, 2020, and 2021) and clustered by semester (Spring, Summer, and Fall). The white boxes depict the average progress percentage for each semester in each bar. Total engagement data across all bars for Molecular Cell Biology n = 1,478.

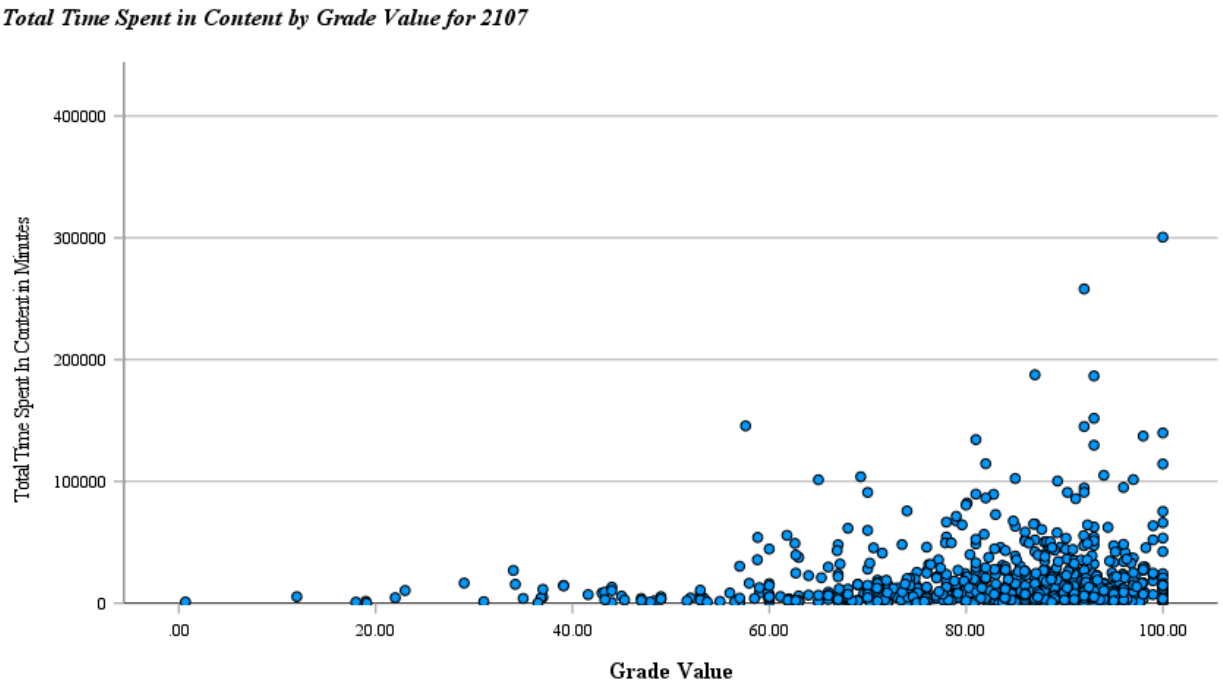

Figure 10 Total Time Spent in Content by Grade Value for Principles of Biology I

The scatter plot depicted above was created with the total time spent (mins.) in content and final grade values for Principles of Biology I (2107) for 2019 and 2020 $r(671) = .23$, $p < .001$, $n = 673$).

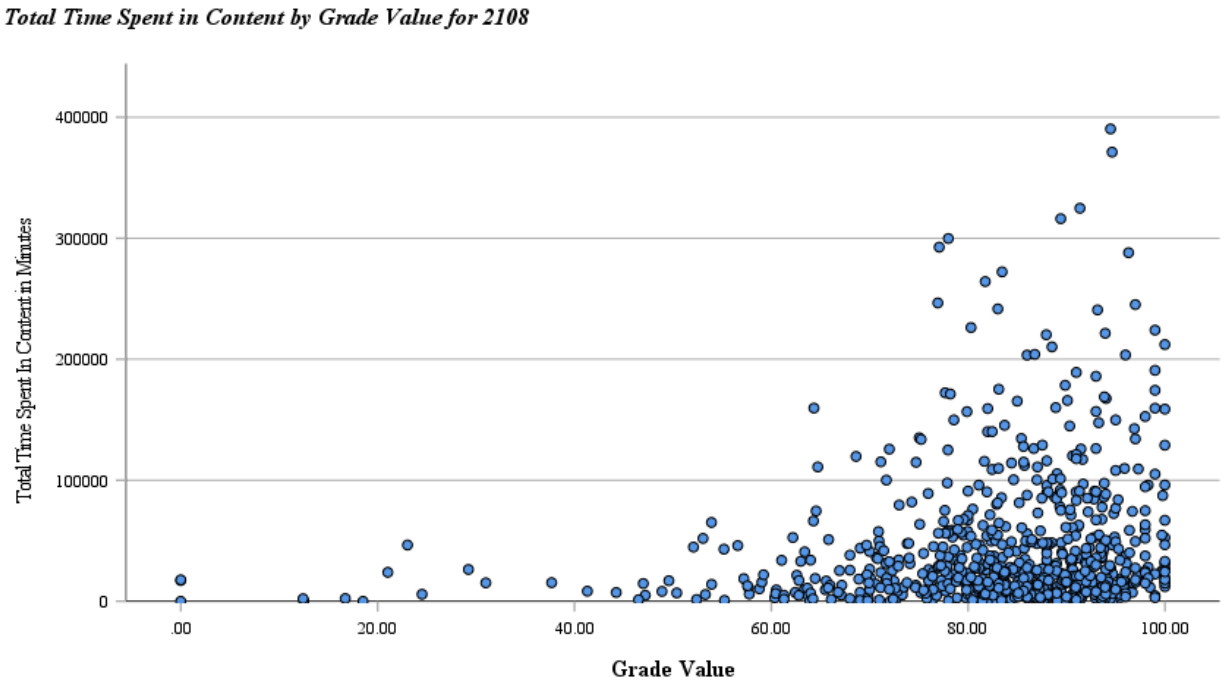

Figure 11 Total Time Spent in Content by Grade Value for Principles of Biology II

The scatter plot depicted above was created with the total time spent (mins.) in content and final grade values for Principles of Biology II (2108) for 2019 and 2020 $r(734) = .16$, $p < .001$, $n = 736$).

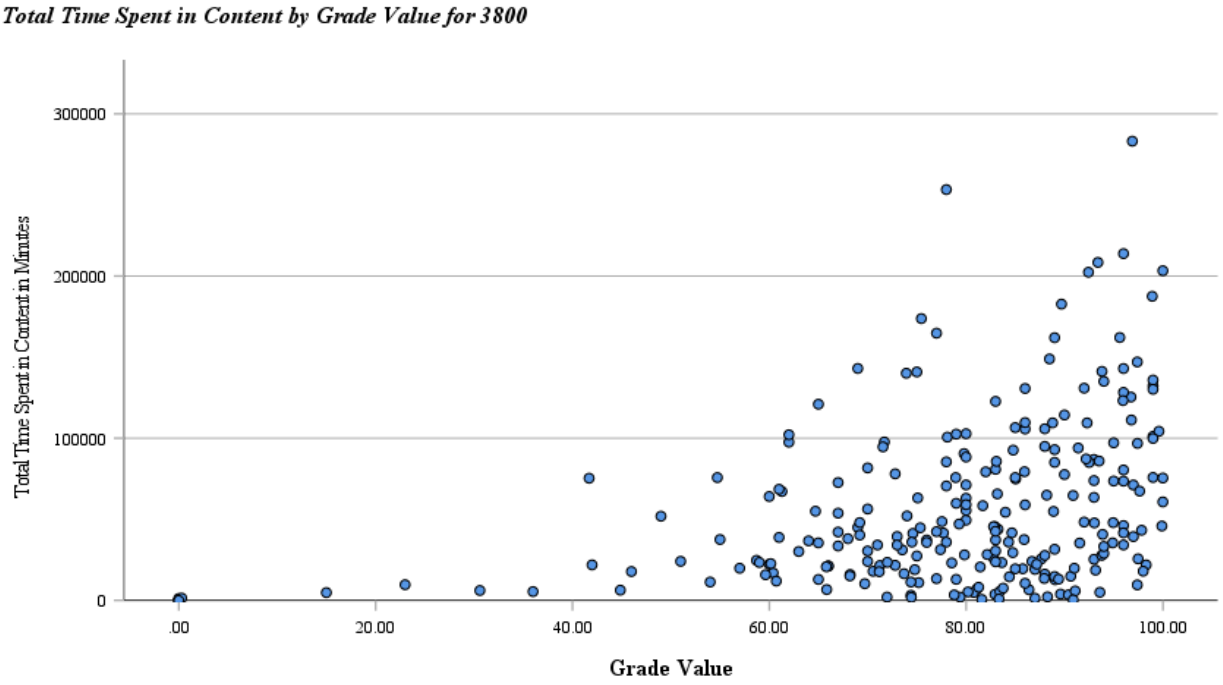

Figure 12 Total Time Spent in Content by Grade Value for Molecular Cell Biology

The scatter plot depicted above was created with the total time spent (mins.) in content and final grade values for Molecular Cell Biology (3800) for 2019 and 2020 $r(253) = .36$, $p < .001$, $n = 255$).

Table 1 Student Survey Demographics Table

This table was created with demographic questions from the student survey n = 24.

Student Survey Demographics Table

		Count	Column N %
Age	18 - 24	19	79.2%
	25 - 34	5	20.8%
Household Size	1	2	8.3%
	2	4	16.7%
	3	5	20.8%
	4 or more	13	54.2%
No. Virtual Learning	1	8	33.3%
	2	7	29.2%
	3	7	29.2%
	4 or more	2	8.3%
Previous Online Courses	No	8	33.3%
	Yes	16	66.7%
Computer	Yes	24	100.0%
WIFI	No	2	8.3%
	Yes	22	91.7%
Smartphone	Yes	24	100.0%
2020 Major	Biological Sciences	2	8.3%
	Biology	19	79.2%
	Biology and English	1	4.2%
	Microbiology	2	8.3%
Current Major	Chemistry	1	4.2%
	Microbiology	1	4.2%
	Psychology	1	4.2%
	Public Health	1	4.2%
	Same as above	20	83.3%

4 DISCUSSION

From 2019 to 2020, final grades increased significantly ($p < .001$ for both) for Principles of Biology I and II, as revealed by the Independent Samples t-Tests. These differences were visualized in Figure 1 for Principles of Biology I and Figure 2 for Principles of Biology II.

Figure 1 shows the differences in final grade means for the Spring and Fall semesters of 2020. When we look at the year 2020, grades decreased from Spring (the start of the pandemic) to Fall by 8.48 points. In Figure 2, we can see the final grades for Principles of Biology II also decreased, although slightly, from Spring 2020 to Fall 2020 by 1.09 points, and we see the same again in Figure 3 for Molecular Cell Biology with a decrease from Spring 2020 to Fall 2020 of 2.08 points.

Grades were also provided for 2021, although they were only available for the Fall semester. For Principles of Biology I, the final grades were not a reliable measure (there were a significant amount of zeroes in the data set, *as seen in Figure 1*) to determine how grades changed after the pandemic for that course. However, the Fall 2021 grades for Principles of Biology II and Molecular Cell Biology can be compared to the grades from 2020. For Principles of Biology I, there was an increase from Fall 2020 to Fall 2021 of 2.96 points; for Molecular Cell Biology, there was an increase from Fall 2020 to Fall 2021 of 2.43 points.

Figures 4 and 5 depict the changes in the total time spent in content and the progress percentage for Principles of Biology I. The total time spent in content in the year 2020 increased from Spring to Fall by 21,754 minutes. For progress percentage, there was an increase from Spring 2020 to Fall 2020 of 8.95%. Figures 6 and 7 depict the changes in the total time spent in content and the progress percentage for Principles of Biology II. For 2020, we see an increase in total time spent in content from Spring to Fall of 41,981 minutes and an increase in progress

percentage by 11.75%. For figures 8 and 9 for Molecular Cell Biology, there was an increase in total time spent in content from Spring 2020 to Fall 2020 of 19,323 minutes and an increase in progress percentage by 9.29%.

The Spearman Correlations (Figures 10, 11, and 12) revealed that engagement data and grades were weak but positively correlated for Principles of Biology I ($r = .23$), Principles of Biology II ($r = .16$), and Molecular Cell Biology ($r = .36$). This significance ($p < .001$ for all three courses) can be attributed to the large sample size of 1,664.

While the survey responses did not reveal any significant associations, the open-ended responses provided insight into how students were challenged during the pandemic. Several students expressed concern about their mental and physical health and how it was difficult to cope with a global pandemic and deadlines "*There were so many assignments that all I could keep up with were deadlines and studying for tests became less of a priority. I felt like these classes were quite literally occupying all of my time and this made my mental and physical health suffer tremendously. I also had a hard time prioritizing all of my classes and eventually just put more work into whatever class I had the lowest grade in at the time." (a response to What learning challenges did you face while taking this course?).* In addition to the added stressors of health concerns, some students also had to worry about work and home responsibilities and struggled to find a balance between the two "*Having to take exams with a child that was also doing virtual learning. Not very easy to find distraction free space for studying or test taking. Keeping up with new course schedule and policies."* (a response to What learning challenges did you face while taking this course?). Students struggled, but they adapted. Students expressed implementing new learning strategies to stay successful in the course "*Finding someone that is having a hard time just like you are, and motivating each other to keep*

pushing forward. Also it helps to review material together." "*I started going over material early and revisiting concepts to ensure the procedures building off of it or connected to it were still understood*." (a response to What learning strategies did you implement that were useful for you?)

5 CONCLUSION

Principles of Biology I & II are typically the first experience students have with classes that are in their degree program. These courses are prerequisites for Molecular Cell Biology, so it would make sense that students would experience more flexibility and, therefore, higher grades in the prerequisite courses as they would be relatively new to learning the concepts. This course pathway could also explain why no significant differences were seen for Molecular Cell Biology because students were expected to be prepared for the course's concepts and rigor. When comparing student performance semester by semester, grades still increased in the Spring of 2020, when the pandemic first started; however, they decreased in the Fall of 2020 for all three courses. The decrease seen from semester to semester could indicate students didn't perform well at the start of the pandemic (Spring 2020) simply because they were better prepared or had a better understanding of the material, but due to more flexibility and allowance from their instructors.

Quite the opposite was seen in the engagement data. Total time spent in content and progress percentage increased from semester to semester for 2020. This increase makes sense as students would spend more time accessing and interacting with content on iCollege when classes were primarily online in the Fall of 2020. During the Spring before the pandemic sent students home in March, they didn't rely as heavily on iCollege to receive all their announcements, assignments, assessments, and grades. This online transition explains the significant increase seen in both engagement measures.

When we look at the engagement data, all Spearman correlations revealed a weak positive relationship between total time spent in content and final grades. If students spent more time in the course content, there was a small chance they performed better, but as mentioned above, the

significance of these relationships is due to the large sample size. How total time spent in content is measured needs to be explored more. Does total time spent mean students spent more time logged into the course page or more time interacting with supplementary materials to study? Is time taking quizzes and exams included in that measurement? Determining how time spent in content is calculated can give more accurate information about the relationship between grades.

To expand the project, factors such as socioeconomic status, living situation, and working status can be studied to determine how that might have affected student performance. The data could also be looked at more closely. We received data for three courses, Fall, Spring, and Summer semesters, for 2019, 2020, and 2021 and each course had different instructors, technologies, assignments, quizzes, exams, projects, and extra credit opportunities. If we could look more closely at the data and see how instruction and performance varied for each course, we would learn more about student performance and why that increase in grades was so significant. Future questions could include: How did students perform in Spring 2020 for one instructor versus another? How did students perform in Spring 2020 in synchronous versus asynchronous courses? Or how did students perform in flipped courses versus non-flipped courses?

Grades increasing in Spring 2020 doesn't mean that students grasped the concepts enough to perform well in their upper-level courses. Principles of Biology I & II and Molecular Cell Biology are foundational courses that provide students with necessary concepts about plants and animals, like cell structure and function, reproduction, body systems, ecosystems, and so much more. These concepts are then built upon in upper-level classes like Plant Biology, Animal Biology, Microbiology, and Genetics. Students who might have performed well in Spring 2020

might be unable to keep up with the rigor or handle the complexities of these subjects if they did not or could not take the time to learn in the foundational courses.

Overall, students performed significantly better in Spring 2020 compared to Fall 2019. Even through the challenges students faced, they continued to do the work. Learning during a pandemic was difficult for all students, especially those unfamiliar with online learning beforehand. Students faced new challenges and responsibilities like staying motivated and focused on their own, finding a workspace in the home where they could be productive and escape distractions, and learning how to use new technologies and resources. While preparations may have been made for and by students, nothing could have prepared them for this experience. There is still much to be learned about student experiences and performance during the pandemic. With more information, we can implement technologies and learning strategies that work for students to better their learning experiences in future instruction.

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APPENDICES

Appendix A

Appendix A.1 Contributing Factors of Covid-19 Biology Performance Survey Flow

Start of Block: Block 1

Q42 The purpose of the study is to determine how students performed in Principles of Biology I (BIOL 2107), Principles of Biology II (BIOL 2108), and Molecular Cell Biology (BIOL 3800) courses during the pandemic. You are invited to participate in this research study because you are a Georgia State University student enrolled in the undergraduate biology program.

In this study, you will not have any more risks than you would in a normal day of life. No injury is expected from this study, but if you believe you have been harmed, contact the research team as soon as possible. Georgia State University and the research team have not set aside funds to compensate for any injury.

This study is not designed to benefit you personally. Overall, we hope to gain information about how the challenges presented by the pandemic affected student performance in biology courses. This information will allow us to plan for more effective biology instruction moving forward.

We will keep your records private to the extent allowed by law. The following people and entities will have access to the information you provide: • Principal Investigator: Laura Carruth, Ph.D. • Co-Investigators: Aakanksha Angra, Ph.D. and Jonathan Sylvester, Ph.D. • Student Principal Investigator: Aliyah Martin • GSU Institutional Review Board • Office for Human Research Protection (OHRP)

To complete this 28-question survey, you don't have to provide any personal information like your name or email address. The information you provide will be stored on password- and firewall-protected computers. When we present or publish the results of this study, we will not use your name or other information that may identify you. The participant should be aware that data sent over the Internet may not be secure, special procedures to protect the data such as encryption will not be used, and we will not collect IP addresses.

If you would like to participate in this survey click "I consent" and continue to the survey. If you do not want to participate click "I do not consent".

- ○ I consent (1)
- ○ I do not consent (2)

End of Block: Block 1

Start of Block: Default Question Block

Q1 What is your age?

- Under 18 (1)
- 18 - 24 (2)
- 25 - 34 (3)
- 35 - 44 (4)
- 45 - 54 (5)
- 55 - 64 (6)
- 65 or older (7)

Page Break

Q2 What is your household size (including yourself)?

- 1 (1)
- 2 (2)
- 3 (3)
- 4 or more (4)

Page Break

Q3 Before the pandemic, have you previously taken online courses?

- ○ Yes (1)
- ○ No (2)

Q4 Do you have access to a computer, laptop, tablet, or chromebook?

- ○ Yes (1)
- ○ No (2)

Q5 Do you have access to consistent WIFI?

- ○ Yes (1)
- ○ No (2)

Q6 Do you have access to a smartphone or cellular device?

- ○ Yes (1)
- ○ No (2)

Q7 How many people in your household were doing virtual learning during the 2020 school year? At any level, not just college? Include yourself.

- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 or more (4)

Page Break

Q8 What was your major during 2020?

_____

Q9 What is your current major? If it has not changed type "same as above".

_____

Page Break

Q10 Which courses did you take in Spring 2020?

- [ ] BIOL 2107 - Principles of Biology I (1)
- [ ] BIOL 2108 - Principles of Biology II (2)
- [ ] BIOL 3800 - Molecular Cell Biology (3)
- [ ] N/A (4)

Q16 What was your classification while taking this course?

- ○ Freshman (0-29 credits) (1)
- ○ Sophomore (30-59 credits) (2)
- ○ Junior (60-89 credits) (3)
- ○ Senior (90+ credits) (4)

Q13 Did you use any of the resources the Center for Excellence in Teaching, Learning, and Online Education (CETLOE) made available during this time?

- ○ Yes (1)
- ○ No (2)

Q14 Did you get in contact with your professor or classmates outside of class time?

- ○ Never (1)
- ○ Sometimes (2)
- ○ About half the time (3)
- ○ Most of the time (4)
- ○ Always (5)

Q19 Did you use any tutoring services offered by GSU?

- Never (1)
- Sometimes (2)
- About half the time (3)
- Most of the time (4)
- Always (5)

Q20 How would you rate your performance in this course?

- Far below average (1)
- Somewhat below average (2)
- Average (3)
- Somewhat above average (4)
- Far above average (5)

Q18 What grade did you receive in this course?

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_____

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_____

_____

Q22 Did you retake this course, or do you plan to retake this course?

- No (1)
- Yes (2)

Page Break

Q11 Which courses did you take in Summer 2020?

- ☐ BIOL 2107 - Principles of Biology I (1)
- ☐ BIOL 2108 - Principles of Biology II (2)
- ☐ BIOL 3800 - Molecular Cell Biology (3)
- ☐ N/A (4)

Q32 What was your classification while taking this course?

- ☐ Freshman (0-29 credits) (1)
- ☐ Sophomore (30-59 credits) (2)
- ☐ Junior (60-89 credits) (3)
- ☐ Senior (90+ credits) (4)

Q15 Did you use any of the resources the Center for Excellence in Teaching, Learning, and Online Education (CETLOE) made available during this time?

- ○ Yes (1)
- ○ No (2)

Q34 Did you get in contact with your professor or classmates outside of class time?

- ○ Never (1)
- ○ Sometimes (2)
- ○ About half the time (3)
- ○ Most of the time (4)
- ○ Always (5)

Q35 Did you use any tutoring services offered by GSU?

- Never (1)
- Sometimes (2)
- About half the time (3)
- Most of the time (4)
- Always (5)

Q36 How would you rate your performance in this course?

- Far below average (1)
- Somewhat below average (2)
- Average (3)
- Somewhat above average (4)
- Far above average (5)

Q37 What grade did you receive in this course?

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Q39 Did you retake this course, or do you plan to retake this course?

- No (1)
- Yes (2)

Page Break

Q40 Which courses did you take in Fall 2020?

- ☐ BIOL 2107 - Principles of Biology I (1)
- ☐ BIOL 2108 - Principles of Biology II (2)
- ☐ BIOL 3800 - Molecular Cell Biology (3)
- ☐ N/A (4)

Q41 What was your classification while taking this course?

- ☐ Freshman (0-29 credits) (1)
- ☐ Sophomore (30-59 credits) (2)
- ☐ Junior (60-89 credits) (3)
- ☐ Senior (90+ credits) (4)

Q42 Did you use any of the resources the Center for Excellence in Teaching, Learning, and Online Education (CETLOE) made available during this time?

- ○ Yes (1)
- ○ No (2)

Q43 Did you get in contact with your professor or classmates outside of class time?

- ○ Never (1)
- ○ Sometimes (2)
- ○ About half the time (3)
- ○ Most of the time (4)
- ○ Always (5)

Q44 Did you use any tutoring services offered by GSU?

- Never (1)
- Sometimes (2)
- About half the time (3)
- Most of the time (4)
- Always (5)

Q45 How would you rate your performance in this course?

- Far below average (1)
- Somewhat below average (2)
- Average (3)
- Somewhat above average (4)
- Far above average (5)

Q46 What grade did you receive in this course?

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Q47 Did you retake this course, or do you plan to retake this course?

- Yes (1)
- No (2)

Page Break

Q24 How would you rate your learning experience while taking these courses?

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Q25

How would you describe the changes you experienced in classroom structure?

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Q26 Did you have difficulty focusing while taking these courses? Why?

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Q27 How would you rate your academic performance during the pandemic?

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Q28 What learning challenges did you face while taking this course?

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Q29 What learning strategies did your instructor implement that were useful for you?

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Q30 What learning strategies did you implement that were useful for you?

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Q31 Are there any changes you made to your studying habits because of your learning experience during the pandemic?

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End of Block: Default Question Block