



Transitioning a Large Biology Class from an in-Person to an Online Exam During the COVID-19 Pandemic

Niki Sharan, Meaghan Cuerden, Denis Maxwell, Anne Simon

Abstract: As occurred in many Universities worldwide, the response to the COVID-19 pandemic required us, professors at Western University (London, Canada), to quickly convert a first-year biology course with over 1200 enrolled students from an in-classroom format to an on-line format. This transition included the course exams. While the first multiple-choice exam in February 2020 was in-person and proctored, we changed the second multiple-choice exam in March 2020 so that it was completed by students online at home without a proctor. We had concerns about this online conversion, including whether the grades would represent student understanding of the course material when access to peers and other resources during the exam was not monitored. In this report we show student scores on the online exam were highly correlated with their prior in-person exam. A similar correlation was observed with prior first-year students who took similar exams in February and March 2019 which were both in-person and proctored. These results provide some reassurance that it is possible to rapidly transition the delivery of an exam from an in-person format to an online format without compromising the exam process.

Keywords: biology education, examination, COVID-19

I. INTRODUCTION

As of Sept 20th, 2021, the 2019-21 coronavirus pandemic that began in China has spread to over 200 countries and has resulted in over 4.6 million deaths.¹ The need for physical distancing during the early days of the pandemic required many University campuses to close worldwide.² Many students who were receiving an in-person classroom course were rapidly transitioned to receiving course content exclusively online at home. Lectures were recorded and posted online within a short period. Individual instructors needed to make decisions on how to assess student understanding and application of the course material, with

some level of confidence that the grade assigned to a student was a reflection of their knowledge and performance.³

At Western University in London, Ontario, Canada, in the Winter semester of 2020, there were over 1200 students enrolled in the first-year biology course (Biology 1002B). University classes stopped being delivered in-person on March 18th, 2020. At that time, almost three quarters of the course was complete (9 weeks out of 12), including an in-person proctored multiple-choice exam done in February 2020. With high student stress at the time of a pandemic, we, the course professors, considered simply giving all students who had a grade of 50% or more at that point a 'pass' on the course (with no numeric grade on their transcript) without any further exams. However, several students indicated a numeric grade was important for their career goals. It may also be a disservice to pass students who did not understand the full course content, as they would go on to pay tuition for additional years of university despite little chance of success. Extending the semester to wait until the pandemic ended was not an option. Thus, we decided to quickly convert our March 2020 in-person exam to an online format, where students would complete multiple-choice questions on their own computers without a proctor. A concern with the online format, particularly with a large class, was the possibility of widespread cheating, as access to peers and other resources during the exam was not monitored by proctors.⁴

In this report we describe how the March 2020 online exam was undertaken (e.g., time of day and time to complete), and how a student's score compared to their prior February 2020 in-person exam. For reference, prior first-year students completed both the February 2019 and March 2019 exams in-person with proctors, and performance between the two exams was well correlated; as shown in the **Supplementary Figure**, students who performed well on the February 2019 exam were more likely to perform well on the March 2019 exam. We reasoned a similar level of correlation between the in-person February 2020 and online March 2020 exam would provide some reassurance that students completed the online exam as intended.

II. METHODS

A. Setting

Western University is a large Canadian public institution located in London, Ontario, Canada.⁵ The Biology Department offers the second half of a foundational first-year biology course in the winter semester, which runs from January to April.

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This course is taken by over 1200 students each year and is a pre-requisite for upper-year courses offered in the Department of Biology and in the Department of Medical Sciences. The content is delivered as two 1-hour lectures each week along with separate laboratory sessions. Western University has an online learning management system (called OWL), where we host the first-year biology course website. We also use OWL to deliver multiple-choice open-book short quizzes, but historically have never used it for an exam.

B. First-year Biology Exams

Students complete both a February and March multiple-choice exam for their course grade. These are in-person exams proctored in a classroom. Students routinely start the exam at the same time and are given the same amount of time to complete the exam. Some students have special needs and are given more time to complete the exam (referred to as accommodation).

Students completed the in-person exam in February 2020, and the online exam in March 2020. The February 2020 exam, which consisted of 35 multiple-choice questions, was a total of 80 minutes and was scored from 0 to 100%.

The content tested on the March 2020 exam was delivered through in-person lectures prior to the campus closure. The March 2020 exam covered all course content to that date including material tested in the February 2020 exam. We converted the March 2020 exam to an online format, which we delivered through OWL (online learning management system). Given substantial student stress at the time of the pandemic we decided to make the March 2020 exam easier than the February 2020 exam. We also decided to deliver the exam as two parts each administered on separate days, so that with the new online format we would have an opportunity to address any issues in part one during part two of the exam (reducing the risk of losing the entire exam). Each part of the exam consisted of 20 multiple-choice questions; part one took place on March 23, 2020, and part two on March 25, 2020. So as not to overwhelm the server with all students starting the exam at the same time, students could start the online exam anytime between 10 am and 10 pm on each date, and once started had 50 minutes to complete the exam (the exception was special needs students who were accommodated to have 120 minutes to complete the exam). Students decided for themselves when to start their exam. The online exam was not proctored and was completed by students on their home computers. Unlike a proctored exam, during the online exam students were unable to ask the professor to clarify any exam question. Students were instructed to answer the questions by themselves and that any evidence of academic misconduct would be subject to disciplinary action. Students were also asked not to refer to course materials during the exam. However, unlike our in-person proctored exam, student identity was not confirmed, and we did not observe how students conducted the exam, including whether they completed the exam with others.

C. Statistical Analysis

To understand how students undertook their online exam, we recorded the hour of the day when they started each of the two parts of their exam (rounded to the nearest hour) and the exam duration. All exam results are reported as percentages from 0 to 100% to enable comparisons. To assess whether students started part one and two of their online exam at the

same time of day we computed an R^2 value using linear regression (to estimate the proportion of the variance in the time of day of starting part two of the March exam explained by the time of day of starting part one of the March exam). The same was done to estimate the proportion of the variance in the score on the March exam (the average of both parts) explained by the score on the February exam. Results are presented as medians (25th, 75th percentiles), unless otherwise specified. We used SAS software version 9.4 for all analyses. The Director of our Research Ethics Review Board indicated we could perform and report de-identified analyses as the course professors for the purposes of understanding and improving the delivery of our education without the need for student consent or Board Review.

III. RESULTS

Of the 1280 course students, we excluded 23 who had no mark either for the February or March exam. A total of 1257 students were included in the analysis, of which 37 received accommodation for more time to take the online exam.

Students started their online exam across the entire range of available times (**Table 1**). The median start time was 5 pm for part one and 6 pm for part two. Most students used all the available 50 minutes to complete each part of the exam; non-accommodated students took a median of 48 minutes for part one and 47 minutes for part two; accommodated special needs students took 76 and 92 minutes, respectively. Students generally started part one and part two of the online exam at the same time of day [the difference in starting time between the two parts was 0 (-1, 1) hour, R^2 0.59].

Table 1: The timing of how students took the online exam. Times reported as median, (25th, 75th percentile), and minimum - maximum

	Part 1 Start time	Part One Length	Part 2 Start time	Part Two Length	Correlation Start time
Non-accommodated students n= 1220	5 pm (3 pm, 7 pm)	48 min (43 min, 50 min)	6 pm (3, 8 pm)	47 min (41, 50 min) - 50 min	R ² 0.59
Accommodated students n= 37	10 am – 10 pm	76 min (62, 101 min) - 31 min - 120 min	10 am – 10 pm	92 min (55 min, 103 min) - 26 min - 120 min	

The average score on the in-person exam was 68% and for the online exam was 77%. Students who did well on the in-person exam were more likely to do well on the online exam (**Figure 1a and 1b**, R^2 0.49).



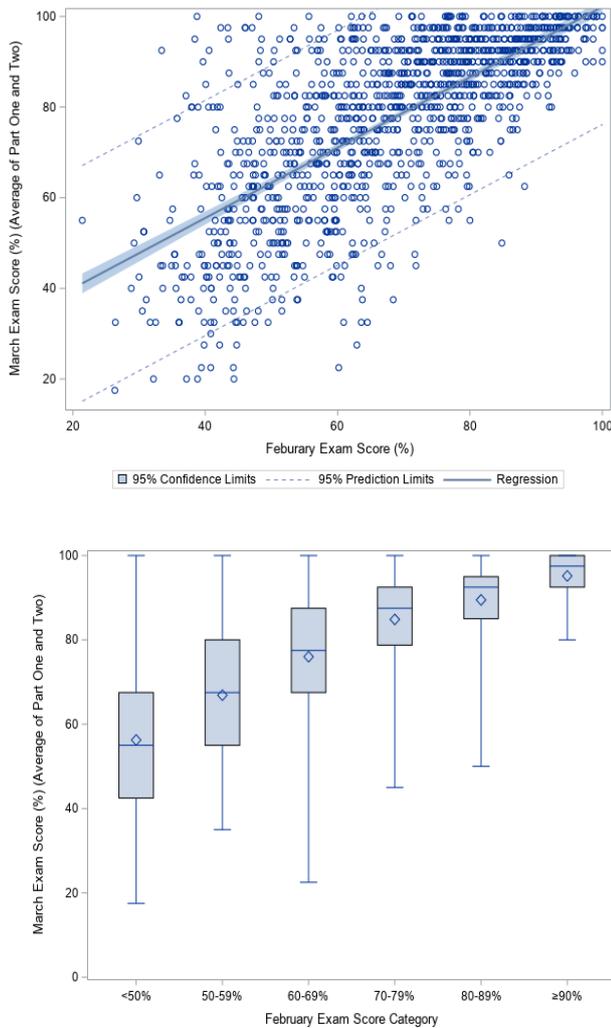


Figure 1a and 1b. Student exam results on the February 2020 in-person exam and the March 2020 online exam. Students who scored well on the in-person exam were more likely to score well on the online exam.
a) Correlation plot, R^2 0.49, b) boxplot.

In a supplementary analysis we used a Poisson regression model to determine whether students who started their online exam later in the day received higher marks (which might suggest they received information from early exam takers). Students who started their online exam later in the day did slightly worse than those who started it earlier in the day (for both part one and two, the score was 1% lower for each hour increase in the start time; $p < 0.01$ for each part).

IV. DISCUSSION

The start of the COVID-19 pandemic made it impossible for university instructors to complete their ongoing courses using an in-classroom in-person format. A commitment to inclusion means adapting to COVID in a way that is sensitive to the needs of all students. During the early months of the pandemic, we successfully delivered the online exam to students with special needs who required additional time to complete the exam. There are several caveats to our analysis. We only considered group trends and it remains possible some students completed the online exam in a way that did not test their understanding of the material. This said, open-book exams which allow students to collaborate may be a way of testing in the future. Alternatively, an honour pledge

can be used prior to taking an exam,^{6,7} or online proctoring can be used during an exam, to increase the chance students act with integrity. Allowing only 2.5 minutes per multiple-choice question (as done with our exams) also provided very little time to do much else other than answer each question.

Our exams were not designed with the rigor undertaken for licensing exams, which includes a careful analysis of the psychometric properties of each question prior to use and assurance that each exam has a similar level of difficulty.⁸ This, along with our interest of not setting a very difficult exam during the pandemic, may explain why the average score of the online exam was higher than the in-person exam. However, the online exam still differentiated between higher and lower performing students.

By necessity our exam for this large class only consisted of multiple-choice questions, and our findings may not generalize well to other exam formats. We did not measure student satisfaction with the online test, which can be considered in the future. There was no photocopying or proctors for the online exam, and we did not assess the difference in cost with this exam format. Finally, we did not assess whether students without a home office, or international students unable to go home during the pandemic, were disadvantaged by the online instruction and testing.

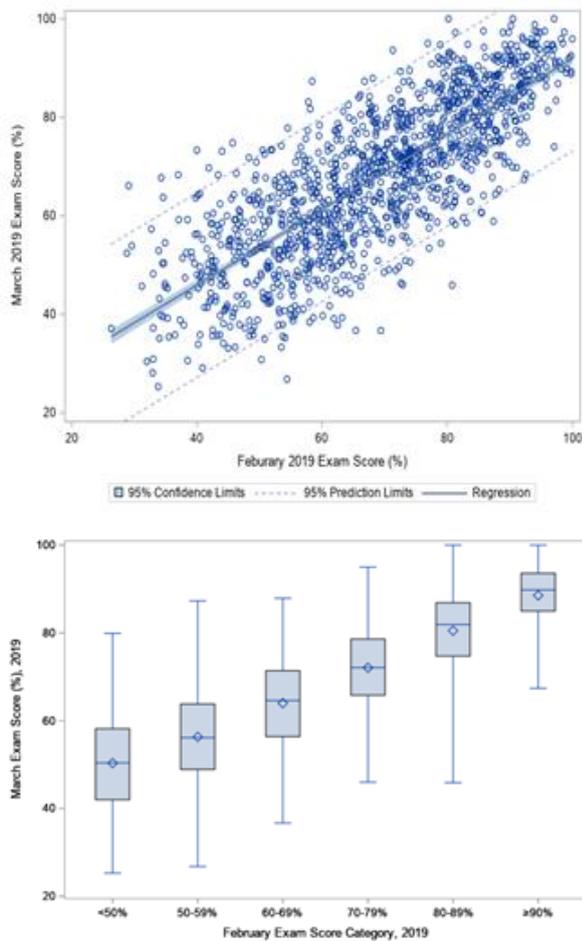
V. CONCLUSION

The findings of our report provide some reassurance that it is possible to rapidly convert a proctored in-person exam to a non-proctored online exam without compromising the exam process. We shared the results of this report with other course professors at our university, to guide their decisions for course evaluation during the pandemic.

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APPENDIX SUPPLEMENTARY FIGURE



Dr. Anne Simon is an Associate Professor in the Department of Biology at Western University in London, Ontario, Canada. She earned her PhD in molecular and cellular genetics from the University of Paris XI. She currently serves as the Associate Chair for undergraduate studies in the Department of Biology.

Supplementary Figure a and b. First year biology student exam results on the February 2019 in-person exam and the March 2019 in-person exam. Students who scored well on the February 2019 exam were more likely to score well on March 2019 exam. a) Correlation plot, R^2 0.62, b) boxplot

AUTHORS PROFILE



Dr. Niki Sharan is an Assistant Professor in the Department of Biology at Western University in London, Ontario, Canada. She earned her PhD in molecular biology and genetics from McMaster University. She currently has a leadership role teaching first-year biology to over 2300 students.



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