# Impact of COVID-19 on Higher Education

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# Abstract

COVID-19 outbreak in 2020 affected many lives and interrupted the higher education system in Canada. The outbreak caused its first lockdown in Ontario forcing Universities to shift to an online environment. This was a sudden disruption from our everyday lives and while the higher education system migrated to online learning, there was insufficient data about the online learning experience. The impact of COVID-19 on higher education is discussed while examining the impact it had on students.

A survey was created for students to share their experiences during the pandemic whether positive or negative and distributed online to various communities. The data was broken down into Ontario Tech students and a combination of all the students. Machine learning algorithms were applied to find patterns or correlations between the data. The student's experience with online learning will be explored while finding the key concerns among students and trying to find the primary factor leading to the concern.

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# Introduction

COVID-19, also known as Coronavirus, has impacted everyone worldwide for the past two years and disrupted everyday life. The virus originated in Wuhan, Hebei, China and the first case in Canada was found on January 25th, 2020, in British Columbia. As the pandemic worsened, actions were deemed necessary for the greater good while impacting the higher education systems. The first lockdown in Ontario was initiated on March 17, 2020, and Premier Doug Ford declared a state of emergency. As of August 8th, 2022, there are 585 million cases worldwide, with 6.42 million deaths. As the outbreak was accelerating rapidly, Canada's higher education system had to take action to provide students with a safe and effective learning environment, which initiated a migration from in-person to online learning. The purpose of this research is to provide definite facts about the student's experience during the pandemic while analyzing the data to predict what may have caused the student to be affected by the specific situation while migrating to an online environment.

# Background

The research is aimed to examine the impact of COVID-19 on higher education and get feedback from the students to analyze what the students found challenging during the pandemic. The best and most efficient way to get a response from students is from a survey, as everyone’s perspective varies. The survey was divided into multiple sections that best fit student concerns. The area of concern was student accessibility to course material, student concern with coursework, student relationship with the professors, the effect on students due to the proof of vaccination directive, student academic evaluations, and student personal/mental health. The survey was distributed on various online communities such as Reddit groups, Facebook groups, and Discord groups. The survey was distributed to all the communities online, but most of the communities were Engineering based. Our survey's top 5 university participants were from Ontario Tech University, Brock University, Carleton University, University of Toronto, and Toronto Metropolitan University (Previously known as Ryerson University). The participants from the top 5 universities are shown below in table 1.

*Table 1 – Top 5 University responses*

|  |  |  |
| --- | --- | --- |
| University | Total Students | Percentage |
| Ontario Tech University | 190 | 49.4% |
| Brock University | 28 | 7.3% |
| Carleton University | 26 | 6.8% |
| University of Toronto | 18 | 4.7% |
| Toronto Metropolitan University | 14 | 3.6% |

# Methodology

The research conducted about the impact of COVID-19 on higher education is extremely limited and as pandemics can occur at any point in time, the best response is to learn from experience while allowing the universities to provide students with the best possible learning experience. To examine the impact of COVID-19 on higher education, a survey will be required to be filled out by students which will allow us to assess the current situation of the students.

Initially, a draft template of the survey was constructed with questions relating to the impact of COVID-19 on the students. Once the survey was finalized, the Google forms platform was used to create and record the responses from the students. All the responses were saved to an excel sheet which was imported to Python and stored in a data frame using Panda’s library to analyze each data point individually. As we were expecting a big dataset, a machine algorithm must be applied to find the correlation or pattern between the data points.

## Machine Learning Algorithm

There is two unsupervised machine learning method called K-Means and K-Mode clustering. K-Means clustering uses Euclidean distance to measure the similarities between the data points and requires numerical values while mapping categorical values to a numerical value such as yes to zero and 1 to no was proved to generate inconclusive data.

K-Mode clustering allows categorical data points where it uses dissimilarities between the data points, and the less there are dissimilarities between the data points, then they are more similar. It uses the mode rather than the mean which is used for the K-mean algorithm. K-Mode allows us to handle large datasets and create predefined clusters based on the number of matching categories between the data points. The only downside of K-Mode clustering is the predefined K value which must be predicted beforehand.

## How the data was analyzed

After applying the K-Mode algorithm to the data, the results were verified by analyzing each cluster. If the results are inconclusive, the algorithm is executed again with a different value for K until the results are usable. Once the correct results were extracted, models and tables were created for a better understanding of the data. All the code and results from the survey are stored online on GitHub and can be accessed at any time.

# Key Findings

## Survey Profiling

A total of 385 students completed the survey while 58 percent were male, and 39 percent were female. Of the 385 students, about 88 percent were studying undergraduate studies and only 12 percent were graduate students. Furthermore, 88 percent of the students were domestic and only 12 percent were international. 90 percent of the students attended the university as full-time students while only 10 percent were part-time students. Many of the participants that completed the survey were from the Faculty of Engineering and Applied Science (49%), followed by the Faculty of Social Science and Humanities (19%), and the third Faculty of Science (14%). 49 percent of total students that completed the survey were from year 4. A full breakdown of the survey profiling is provided down below.

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*Table 2 – Responses by Gender*

|  |  |  |
| --- | --- | --- |
| Gender | Count | Percentage |
| Male | 223 | 57.9% |
| Female | 149 | 38.7% |
| Non-Binary | 8 | 2.1% |
| Transgender | 1 | 0.3% |
| Other | 0 | 0% |
| I prefer not to say | 4 | 2% |

## Domestic vs International Students

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|  |  |  |
| --- | --- | --- |
| Status | Student | Percent |
| Domestic | 338 | 87.8% |
| International | 45 | 11.7% |
| No Answer | 2 | 0.8% |

*Table 3 – Responses by Domestic/International*

## Full-Time vs Part-Time Students

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*Table 4 – Responses by Student Status*

|  |  |  |
| --- | --- | --- |
| Status | Student | Percent |
| Full-Time | 346 | 89.9% |
| Part-Time | 39 | 10.1% |

## Undergraduate vs Graduate Students

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*Table 5 – Responses by Study Level*

|  |  |  |
| --- | --- | --- |
| Status | Student | Percent |
| Undergraduate | 338 | 87.8% |
| Graduate | 47 | 12.2% |

## Year Standing

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*Table 6 – Responses by Year Standing*

|  |  |  |
| --- | --- | --- |
| Standing | Student | Percent |
| Year 1 | 2 | 1.1% |
| Year 2 | 31 | 16.3% |
| Year 3 | 53 | 27.9% |
| Year 4 | 93 | 48.9% |
| Year 5 | 8 | 4.2% |
| Year 6 | 3 | 1.6% |

## Faculty Breakdown

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*Table 7 – Student Responses by Faculties*

|  |  |  |
| --- | --- | --- |
| Faculty | Total Count | Percent/total students |
| Faculty of Social Science and Humanities | 72 | **18.7%** |
| Faculty of Business | 52 | **13.5%** |
| Faculty of Engineering and Applied Science | 188 | **48.8%** |
| Faculty of Science | 53 | **13.8%** |
| Other | 20 | **5.2%** |

# Academic Experience

The primary web-based learning management used during the online learning environment was Canvas (58%), and 67 percent of students used google meet as their direct communication service during lectures. In the survey, the students were inquired about their preference for the learning environment. Forty-three percent of the students preferred an in-person environment, 39 percent favoured an online environment, and only 17 percent preferred a hybrid environment.

One hundred forty-five students, or 38 percent, felt the pandemic impacted their grades. Of the 145 students, 46 percent of the students (87) were from the Faculty of Engineering and Applied Science. A breakdown between each faculty is shown in table 11 and analyzed to see if there is any correlation between the data points while discovering that about 30 percent of the students in the faculty of engineering felt their course load was heavy and the quality of education was not similar to in-person. The highest percentage in other faculties was around 11 percent. A full breakdown of the academic experience for students is shown below.

## Accessing Course Material

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*Table 8 – Course Material Responses*

|  |  |  |
| --- | --- | --- |
| Platform | Students | Percentage |
| Blackboard | 60 | 15.6% |
| Canvas | 222 | 57.7% |
| D2L | 56 | 14.5% |
| Moodle | 31 | 8.1% |
| Other | 16 | 4.2% |

## Chart, pie chart Description automatically generatedCommunication service

*Table 9 – Communication Service Responses*

|  |  |  |
| --- | --- | --- |
| Communication Service | Students | Percentage |
| Google Meet | 257 | 66.6% |
| Microsoft Team | 50 | 13% |
| Zoom | 65 | 17.1% |
| Other | 10 | 2.6% |
| No Answer | 3 | 0.7% |

## Student Preference

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*Table 10 – Student Preference Responses*

|  |  |  |
| --- | --- | --- |
| Learning Process | Students | Percentage |
| In-Person | 166 | 43.1% |
| Hybrid | 67 | 17.4% |
| Online | 151 | 39.2% |
| No Answer | 1 | 0.3% |

## Which faculty had the most impact on grades?

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|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Faculty | Total Students | Grades Impacted | Percent Affected in Faculty | Percentage of Total Students |
| Faculty of Social Science and Humanities | 72 | 21 | 29.2% | **5.5%** |
| Faculty of Business | 52 | 15 | 28.8% | **3.9%** |
| Faculty of Engineering and Applied Science | 188 | 87 | 46.3% | **22.6%** |
| Faculty of Science | 53 | 17 | 32.1% | **4.4%** |
| Other | 20 | 5 | 25% | **1.3%** |

*Table 11 – Faculty and Grades Breakdown*

## Faculty Comparison

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*Table 12 – Faculty Comparison Responses*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Faculty | Total Students | Adapting to new communication easy | Learning from online lecture easy | Course load heavy and quality of education differ from in-person |
| Faculty of Social Science and Humanities | 72 | 36 | 36 | 3 |
| Faculty of Business | 52 | 27 | 30 | 0 |
| Faculty of Engineering and Applied Science | 188 | 123 | 77 | 55 |
| Faculty of Science | 53 | 32 | 20 | 6 |
| Other | 20 | 7 | 5 | 2 |

# Student Life

During the pandemic, students not only faced difficulty in their academia but also personal life. In this section, the student's life outside of academia is examined while discussing the effect of the pandemic on extracurricular activities and students entering the job market. Almost 60 percent of students had access to extracurricular/sports centres during the pandemic while 33 percent did not have access to such activities. During the early stages of the pandemic and lockdown, all access to extracurricular/sports centres were closed. As the lockdown got lenient, students were able to access extracurricular activities at the university.

As the world gradually shifts back to a post pandemic world, about 32 percent of the students were not concerned entering the job market and about 66 percent of the students had some concerns entering the job market following an online learning environment. A breakdown of student’s extracurricular involvement and entering the job market is shown below**.**

## Extracurricular Involvement

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*Table 13 – Breakdown of Extracurriculars*

|  |  |  |
| --- | --- | --- |
| Extracurriculars | Count | Percentage |
| Yes | 128 | 33.2% |
| No | 228 | 59.2% |
| N/A | 29 | 7.5% |

## Career

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*Table 14 – Student Job Concerns Breakdown*

|  |  |  |
| --- | --- | --- |
| Students concern level | Total Students | Percent |
| Not at all concerned | 121 | 31% |
| Moderately concerned | 167 | 43% |
| Extremely concerned | 87 | 23% |
| No Answer | 10 | 3% |

## Mental Health

Whether it's in-person learning or an online environment, most students suffer from mental health issues throughout the school year. This section discusses the impact of COVID-19 on students' mental health in an online environment. About 78 percent of the students found online learning somewhat stressful, about 12 percent found the stress similar to in-person learning, and about 10 percent did not find it stressful. About 45 percent of students have faced anxiety/depression throughout the school year. Students' anxiety or depression level throughout the pandemic is shown below in 15.

As stress levels may differ in various faculties, the examination of each faculty's stress level is required. The highest percentage of students that faced stress was in the engineering faculty, where about 161 out of the 188 students (86%) met stress at some point. The second highest percentage of students that faced stress was from the faculty of science, where 76 percent of students faced stress at some point during the pandemic. The breakdown of each faculty is shown below in table 17.

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*Table 15 – Student Stress Level Breakdown*

|  |  |  |
| --- | --- | --- |
| Stress Level | Count | Percentage |
| Not at all stressful | 38 | 9.9% |
| Similar to in-person learning | 46 | 11.9% |
| Moderately stressful | 217 | 56.4% |
| Extremely stressful | 83 | 21.6% |
| No answer | 1 | 0.2% |

*Table 16 – Student Anxiety/Depression Level Breakdown*

|  |  |  |
| --- | --- | --- |
| Anxiety/Depression Level | Count | Percentage |
| Never | 61 | 15.8% |
| Rarely | 149 | 38.7% |
| Sometimes | 106 | 27.5% |
| Often | 51 | 13.2% |
| Always | 16 | 4.2% |
| No Answer | 2 | 0.6% |

## Stress Level withIN Faculties

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*Table 17 – Faculty Stress Comparison*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Faculty | Total Count | Faced Stress | Percent Affected in Faculty | Percent/Total Students |
| Faculty of Social Science and Humanities | 72 | 50 | 69.4% | **13%** |
| Faculty of Business | 52 | 36 | 69.2% | **9.4%** |
| Faculty of Engineering and Applied Science | 188 | 161 | 85.6% | **41.8%** |
| Faculty of Science | 53 | 40 | 75.5% | **10.4%** |
| Other | 20 | 13 | 65% | **3.4%** |

# What went well?

Students faced many difficulties and challenges due to the COVID-19 pandemic, but the response from the universities and professors helped students transition to an online environment. In this section, we explore what went well for students during the pandemic. About 95 percent of students had a device for online learning, while only 5 percent had to share/borrow a device. Although only about 64 percent said they always had a safe and quiet place to study, another 32 percent of students sometimes had a quiet or safe place to learn. After examining the data, one of the primary reasons why several students had a quiet place to study is that about 83 percent were at home or living with their parents. As students are home, finding a quiet place to learn for hours is more challenging as there are other family members within the same house. One of the major positives among most students was the help from their professors accessing office hours and help with coursework. About 74 percent of students felt the office hours were easy to access and about 65 percent of the students found it comfortable communicating with their professors. Regarding coursework, 71 percent of students found they occasionally received feedback on time, while 25 percent felt they always received feedback on the coursework compared to in-person learning. A summary of what went well is shown below.

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# Areas of Concern

During the COVID-19 pandemic, students faced many challenges and concerns. This section investigates the primary concerns of the students. About 78 percent of the students found the online environment more stressful than in-person learning while 55 percent found it difficult to focus during online learning. 66 percent of the students are concerned with entering the job market after graduation plus 58 percent of the students have lost or found their research/internship opportunities delayed during the pandemic. The loss or delay of opportunities may have occurred from the proof of vaccination directive which forced students to drop their courses since some students did not want to get the COVID-19 vaccination. About 41 percent of the students were forced to withdraw from courses throughout the school year once the proof of vaccination directive was forced throughout Canada. 57 percent of the students faced financial difficulty through the pandemic. A summary of the major concerns is shown below.

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# Ontario Tech University Experience

This section provides detailed research on students' experience at Ontario Tech University and the impact of COVID-19 on the students. One hundred ninety students from Ontario Tech University participated in the survey, where about 64 percent were male and 33 percent were female. Most of the age group were between 18-22 and 23-26. Ninety-five percent of the students were domestic, while about 5 percent were international. Ninety-six percent of the students were enrolled in full-time studies, and only 4 percent were enrolled in part-time studies. Ninety-eight percent of the students were in undergraduate studies, while only 2 percent were from graduate studies. A detailed breakdown is provided below. A full breakdown is shown below.

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*Table 18 – Ontario Tech Gender Responses*

|  |  |  |
| --- | --- | --- |
| Gender | Count | Percentage |
| Male | 121 | 63.7% |
| Female | 63 | 33.2% |
| Non-Binary | 3 | 1.6% |
| Transgender | 1 | 0.5% |
| Other | 0 | 0% |
| I prefer not to say | 2 | 1% |

## Student Status

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*Table 19 – Responses by Domestic/International*

|  |  |  |
| --- | --- | --- |
| Status | Student | Percent |
| Domestic | 180 | 94.7% |
| International | 9 | 4.7% |
| No Answer | 1 | 0.6% |

## Full-Time

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*Table 20 – Responses by Student Status*

|  |  |  |
| --- | --- | --- |
| Status | Student | Percent |
| Full-Time | 182 | 95.8% |
| Part-Time | 8 | 4.2% |

## **Chart Description automatically generated**Graduate

*Table 21 – Responses by Study Level*

|  |  |  |
| --- | --- | --- |
| Status | Student | Percent |
| Undergraduate | 186 | 97.9% |
| Graduate | 4 | 2.1% |

## Year StandinG

**Chart, pie chart

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|  |  |  |
| --- | --- | --- |
| Standing | Student | Percent |
| Year 1 | 2 | 1.1% |
| Year 2 | 31 | 16.3% |
| Year 3 | 53 | 27.9% |
| Year 4 | 93 | 48.9% |
| Year 5 | 8 | 4.2% |
| Year 6 | 3 | 1.6% |

## Faculty Breakdown

To analyze the data further, a breakdown of the faculties is required to compare whether there is any correlation between students' grades and faculties. Approximately 81.1 percent of the students were from the Faculty of Engineering and Applied Science, 7.9 percent from the Faculty of Science, 5.8 percent from the Faculty of Business, 3.7 percent from the Faculty of Social Science and humanities, and 1.6 percent from other faculties.

About 50 percent of the students in the faculty of Engineering felt their grades were impacted and lower compared to in-person learning. In comparison, no more than 2 percent in other faculties felt their grades were affected. A full breakdown of students' grades is shown below in Table 23.

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*Table 23 – Faculty Breakdown for Ontario Tech Students*

|  |  |  |
| --- | --- | --- |
| Faculty | Total Count | Percent/Total students |
| Faculty of Social Science and Humanities | 7 | **3.7%** |
| Faculty of Business | 11 | **5.8%** |
| Faculty of Engineering and Applied Science | 154 | **81.1%** |
| Faculty of Science | 15 | **7.9%** |
| Other | 3 | **1.6%** |

## Impact on Grades

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*Table 24 – Grades Impacted in Each Faculty*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Faculty | Total Students | Grades Impacted | Percent Affected in Faculty | Percent/Total Students |
| Faculty of Social Science and Humanities | 7 | 3 | 42.9% | **1.6%** |
| Faculty of Business | 11 | 3 | 27.3% | **1.6%** |
| Faculty of Engineering and Applied Science | 154 | 77 | 50% | **40.5%** |
| Faculty of Science | 15 | 4 | 26.7% | **2.1%** |
| Other | 3 | 0 | 0% | **0%** |

## What went well?

In this section, we will discuss what went well for the students during the pandemic at Ontario Tech University. The students appreciated the universities approach to communicating with the students about the pandemic and the move to online learning, where about 72 percent of the students found the communication clear and helpful, 21 percent of the students found the communication somewhat transparent, and only 7 percent did not find the communication helpful at all.

Ninety-seven percent of the students had a device to access an online learning management system, 63 percent found adapting to new communication services easy, 35 percent found it moderate, and only 2 percent found it challenging. Eighty-two percent of the students found office hours easily accessible, and 18 percent had some difficulty accessing the office hours.

Sixty-four percent of students always had a safe and quiet place to study, and another 36 percent sometimes had a safe and quiet place to learn. Only 3.6 percent of students never had a safe or quiet place to study. Many of the students were not forced to delay their graduation as 82 percent of students are on track to graduate from their respective programs. A summary of what went well at Ontario Tech University is provided below.

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## What were the challenges?

In this section, we will discuss the challenges the students faced at Ontario Tech University. One of the major concerns most students had was academic related. 92 percent of the students felt they required extra time on assessments while about 49 percent of the students found the course load to be heavy, and 46 percent found their grades were lower compared to in-person learning, where 72 percent of students were concerned about their personal data during the online proctoring.

Two other concerns students faced during the pandemic were entering the job market and financial difficulty. 51 percent of the students faced financial difficulty at some point during the pandemic and 49 percent of the students were concerned about entering the job market after graduation.

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# A deeper look

In this section, we will take a deeper look at the data and analyze multiple data points together to find a correlation between them. The topics we will investigate are,

1. Did stress lead to anxiety or depression?
2. How was the student's relationship while facing difficulty managing their daily lives?
3. What was the leading factor that affected students' grades during the pandemic?

## Did stress lead to anxiety or depression?

One of the major concerns for students was the stress level during online learning. About 78 percent of the students felt online learning was more stressful than in-person learning. The breakdown of the student stress level is shown below.

*Table 25 – Stress Level Breakdown*

|  |  |  |
| --- | --- | --- |
| Student Stress Level | Count | Percentage |
| Not at all stressful | 38 | 9.9% |
| Similar to in-person learning | 46 | 11.9% |
| Moderately stressful | 217 | 56.4% |
| Extremely stressful | 83 | 21.6% |
| No answer | 1 | 0.2% |

As we analyze the data, we want to know whether the stress helped develop anxiety or depression in the students. About 9 percent of the students faced anxiety or depression but did not find online learning more stressful than in-person learning and about 11 percent found it as stressful as in-person learning. Although about 80 percent of the students that found online learning more stressful than in-person learning, developed anxiety or depression. The full breakdown is shown below in table x.

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*Table 26 – Students Stress Level vs Anxiety/Depression Breakdown*

|  |  |  |  |
| --- | --- | --- | --- |
| Stress | Students | Percent/Students that Faced Anxiety/Depression | Total Percent |
| Not Stressed | 16 | 9.2% | 4.2% |
| Same as in-person Learning | 19 | 11% | 4.9% |
| Stressed | 138 | 79.8% | 35.8% |

## Student's Relationships with peers while facing difficulty managing daily life

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*Table 27 – Student Relationships vs Managing Daily Life Breakdown*

|  |  |  |  |
| --- | --- | --- | --- |
| Relationship | Total Students | Faced Difficulty | Percent |
| Poor | 57 | 15 | **26.3%** |
| Fair | 137 | 41 | **29.9%** |
| Good | 155 | 36 | **23.2%** |
| Excellent | 35 | 1 | **2.9%** |
| No Answer | 1 | 0 | **0%** |

## What was the leading factor that affected STUDENT’S grades?

This section will explore the most significant factor for students who felt their grades were lower than in-person learning. It was concluded that the students who felt their grades were lower correlated with students who experienced the grading scale was too strict. About 21 percent of the students felt their grades were lower while 74 percent felt the grading scale was too strict.

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*Table 28 – Student Grades vs Grading Scale Breakdown*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Grades | Total Count | Grading Scale Too strict | Percent Affected that Found Grading Scale Too strict | Percent/Total students |
| Impacted | 145 | 80 | **74.1%** | 20.8% |
| Similar to in-person | 189 | 22 | **20.4%** | 5.7% |
| Not impacted | 48 | 5 | **4.6%** | 1.3% |
| No answer | 2 | 1 | **0.9%** | 0.26% |