Evolution of the Perceived Impact of the Pandemic on University Students

Danielle Morin* and Sara Hossaini

***Abstract*—The Coronavirus pandemic has taken the world hostage. All aspects of society have been affected, including the education system with the closure of universities and the adoption of abrupt measures to continue offering university programs virtually. Unexpectedly, the difficult situation has continued until at least December 2021. This paper studies the evolution of the perceived impact of the pandemic on students over four semesters, from Winter 2020 to Fall 2021. A survey conducted at the end of each semester captured the evolution of the impact felt by students. Using Text Mining and Sentiment Analysis, per semester, per gender and per age category, the progression of certain sentiments was identified. The study reveals that the professor's attitude and support was a key element at the beginning of the pandemic and for many, it has been a good learning experience overall. The loss of direct/in person communication has been strongly felt and it got worse as time progresses. The level of negative comments seems to decrease over time for Female students, while for Male students, it tends to increase. Students from different age groups also reacted differently. Students in the most prevalent age group from age 25 to 30 show at first a decline in the proportion of negative comments followed by an increase, while older students from the 30 to 35 age group have a steady decrease of negativity.**

***Index Terms*—Pandemic, online teaching, face-to-face teaching, text mining, sentiment analysis**

I. Introduction

The pandemic that has taken the world hostage for the last two years, had many impacts on the different aspect of our lives. People have reacted differently, the health care system has seen the load of patients, sick with the Coronavirus reached new limits, many residents of the senior homes did not survive the decease, and families could not see each other for long periods of time to prevent the spread of the virus.

Curfews were introduced, cinemas, restaurants and places of worship were closed, which resulted in strong feelings of isolation, loneliness, lack of motivation, financial stress to name just a few. Everybody has a sad story to recall. Many research papers have been written on the impact of the pandemic on the global economy, the socio-economic of the labor market, the food supply chains to mentioned just a few [1–3].

In the field of education, in universities in particular, campuses were closed and all the teaching that was done in class, reverted to online teaching during the month of March 2020. Overnight, instructors had to learn to use the online technology, which was for most of them, a first experience. Within a few days, teaching and learning took a new dimension and from their homes, professors started to teach students who were also in their homes. Assignments, exams, tutorials, and all other learning activities became virtual. Long hours in front of a computer screen, became the new normal for both professors and students. Several research studies have investigated the impact of the sudden change in university education, mainly through the use of questionnaires [4–17].

The research [13] concluded that in general, the average levels of anxiety tend to decrease when the in-class pedagogy was completely changed to online. This might not be the case in all academic fields, but in some quantitative areas, there was a new feeling of being in control that could be attributed to the additional support and the additional resources and learning activities that were introduced to offset the sudden closure of campuses. While professors are concerned with students' motivation and memory development, online delivery seems to have failed in that area, and other research found that that there is neither improvement, not deterioration in performance [7, 8].

The focus of this research is to study the prolonged impact of the pandemic on students. From the beginning of the pandemic when campuses closed abruptly during the Winter 2020 semester to only offer online delivery of courses to completely virtual teaching for three semesters in a row: Fall 2020, Winter 2021 and Fall 2021, this unusual situation has certainly affected many aspects of students' life. Using an open-ended question analyzed with text-mining and sentiment methodology, this paper will assess the gradual impact of the pandemic.

II. Methodology

A. The Semesters

Four academic semesters are considered for this research: Winter 2020 (January to April 2020), Fall 2020 (September to December 2020), Winter 2021 (January to April 2021), and Fall 2021 (September to December 2021). The Winter 2020 semester started as a normal in-class semester with face-to-face classroom teaching, in person office hours with the professor and tutor, complemented with several YouTube videos and other learning tools on the Moodle platform. However, after the 9th week, the course abruptly was switched to online with little or no experience from the professor. Zoom was used to teach synchronously and/or asynchronously and the course continued to be supported on the Moodle platform with office hours, exams and tutorials online.

Manuscript received on June 15, 2022; revised July 1, 2022; accepted July 22, 2022.

D. Morin is with John Molson School of Business at Concordia University, Montreal, Canada.

S. Hossaini is with Domtar in Montreal, Canada. She is also with Concordia University, Canada.

*Correspondence: Danielle.Morin@Concordia.ca (D.M.)

doi: 10.18178/ijiet.2023.13.5.1866

B. The Course

A first course in a master of business administration (MBA) program at a Canadian university was selected. This course is a mandatory managerial analytics course offered in the fall and winter semesters of each year. Most sections of the course were thought by the same instructor. The quantitative nature of the course is sometimes a source of concern for students from non-quantitative academic background.

C. The Questionnaire

Portions of a survey instrument [17] is utilized to collect data at the end of each semester. The questionnaire contains several parts, but only two were used for this research. The first part is about demographics such as gender and age categories and the second part is an open-ended question concerning the impact of the pandemic: *How did the pandemic affect you?* Since the coronavirus situation has continued much longer than expected, for two years, surveys conducted at the end of each semester can give a picture of the evolution of students' perceptions of its impact. Data collected is analyzed using Text mining techniques and Sentiment analysis of the comments to study the evolution of the perceived impact of the pandemic.

D. Text Mining and Sentiment Analysis

The highest growing data available in the world is text being produced every second of every day in different forms such as a twit, comment, message, or feedback over different platforms available to consumers and users. Mining this wealth of unstructured data and preparing it for analysis is the next step in data mining.

Text Mining is the process of transforming unstructured text data into structured format to identify and extract hidden trends, patterns and relationships contained within the text data. Text mining solutions and natural language processing (NLP) techniques help us with this transformation. Natural language processing (NLP) refers to different computational techniques and solutions that analyze and comprehend or represent naturally occurring texts and human language. The raw data input could be text, spoken (by adding a system for speech recognition) or written language. NLP can be used to produce a database or summaries of data, or to sustain a live interchange with a user as part of an interface [18].

NLP was introduced around 1950s as the juncture of artificial intelligence and linguistics sciences. Computer translation was the first use of computer to understand natural language [19]. With time, NLP has changed. At present, NLP derives from several, various fields such as computer science, artificial intelligence, linguistics, and data science. NLP follows certain steps to analyze sentence structure and grammar such as Tokenization, Text Categorization, Sentiment Analysis and Performing Sentiment Analysis using Text Categorization.

In this paper, responses to an open-ended question provide the researcher with a wealth of information that cannot be analysed with conventional statistical methods. Since there are no suggested features of the learning process for the students to comment on, answers can reveal new aspects and feelings of the pandemic on their academic life that were not anticipated. The use of text mining to analyze respondents' comments allows this opportunity. The open source programming language Python is utilized for the analysis. The Sentiment Analysis is then used to analyze each piece of text to determine the sentiment behind it, as positive, negative or neutral. It makes it possible to study the evolution of positive, negative or neutral sentiments across gender, age groups and semesters.

E. Python and NLTK

One of Python packages that contains several NLP algorithms is NLTK (Natural Language Toolkit), which includes tokenization, part-of-speech tagging, stemming, topic classification and sentiment analysis.

For this analysis, NLTK is used for tokenization which is the process of breaking down the students' comment into smaller portions and multiple units of opinion to help the algorithm to understand the human language better. The text categorization modeling which a is supervised machine learning method to analyze text data and categorize them is utilized. This step follows a predefined set of categories that will help with categorization modeling of our text data. It provides a structure for the unstructured textual data.

Sentiment analysis is run on tokenized data to have a complete representation of multiple sentiments that can exist within one single comment. The process is based on machine learning approach which utilizes a predefined set of text data that are labeled as positive, negative, or neutral to train the model. The trained model is then run on our existing dataset to get the sentiment categories on the students' comments.

III. Results

A. Demographics

Table I shows the number of students who completed the survey taken at the end of each of the four semesters of interest resulting in 49 respondents in the Winter 2020 semester, 46 in the Fall 2020 semester, 63 respondents in the Winter 2021 semester and 62 in the Fall 2021 semester of which 37%, 37%, 32% and 26% are female respondents.

TABLE I: Enrollment per Semester and Gender

Semesters	Students	Female	Male
Winter 2020	49	18(37%)	31(63%)
Fall 2020	46	17(37%)	29(63%)
Winter 2021	63	20(32%)	43(68%)
Fall 2021	62	16(26%)	46(74%)

After the Winter 2020 semester, several students started their MBA program from their home country entirely virtually. In the Winter 2021 and Fall 2021, in spite of the pandemic not being over, enrollment went up, perhaps as a sign that the world is adapting to the new reality. Even though the total number of students increases for the last two semesters, the percentage of female students does not show that increase.

Table II shows the age distribution of students per semester. We note that the most frequent age category is 25–30 which corresponds to "25 to less than 30". In the fall semesters, we also observe higher proportions of students in the 35–40 that is "35 to less than 40" than in the winter semesters. Overall, students are slightly older on average by one or two years in the fall semesters.

TABLE II: STUDENT'S AGE CATEGORIES PER SEMESTER

Semesters	20–25	25–30	30–35	35–40	40+
Winter 2020	0%	55%	32%	7%	6%
Fall 2020	0%	48%	30%	15%	7%
Winter 2021	5%	51%	33%	8%	3%
Fall 2021	5%	52%	23%	18%	3%

B. Text Mining Analysis

Text analysis was performed on the comments written by students to answer the following question: *How did the pandemic affect you?* Text analysis is conducted in following four steps:

1) The first step is to break down students' comments into multiple opinion units since one comment can contain various opinions on different subjects. There is no list proposed to respondents. This step allows a better understanding of the opinion and form a basis for analysis. The comments of a respondent can refer to different aspects of the perceived impact of the pandemic.
2) The second step is to group similar opinion units into categories, about 27 categories have been identified to build the categorization model.
3) The third step is to finalize a list of categories presented in alphabetical order in Table III.

TABLE III: CATEGORIES OF OPINION

Additional Stress	Lack/loss of motivation
Additional time to study	Loss of direct/in person communication
Additional workload	Loss of in class learning
Decreased performance	Loss of interest/enthusiasm
Different Time Zones	Lost track of time
Difficult to perform in personal space	No Impact
Difficult to focus	Personal/family issues
Difficult to handle assignments/project	Professor's support
Feeling uneasy	TA availability & support
Good Learning Experience	Technical/Software Issues
Increased Anxiety	Time/Work Issue
Lack of Structure	Uncategorized
	Weak Quantitative Background

4) The fourth step consists in a Sentiment Analysis on units of opinion. The Sentiment analysis is also used to sort the opinion units as Negative, Positive or Neutral avoiding the situation where different positive and negative sentiments could cancel out each other.

C. Sentiments Analysis per Semester

Table IV presents the results of the Sentiment Analysis after categorizing each unit of opinion as Negative, Positive or Neutral. For each semester, the frequency of the sentiments is presented.

TABLE IV: SENTIMENT ANALYSIS PER SEMESTER

Sentiment	Negative	Neutral	Positive	Total
Winter 2020	90(56%)	33(20%)	39(24%)	162
Fall 2020	54(46%)	32(27%)	31(26%)	117
Winter 2021	56(51%)	23(21%)	30(28%)	109
Fall 2021	63(50%)	33(26%)	31(24%)	127

We note than the total number of comments for each semester exceed the number of students who answered the questionnaire. The reason is that most respondents have written multiple comments touching on different aspects of their feelings.

Table IV also shows that at the beginning of pandemic (Winter 2020), the negative sentiment is dominant with 56% which decreases to 46% in the next term (Fall 2020). During the next two semesters (Winter 2021 and Fall 2021), it increases but remains stable (51% and 50%). The negative sentiments form the most frequent group and are maintained throughout the four semesters under study. This can be due to the new variants of virus and reimplementation of sanitary restrictions causing a feeling of discouragement.

D. Sentiments Analysis per Gender

The results of the sentiment analysis is also performed by gender for each semester and combining all four semesters, is presented in Table V. Even though there are fewer Female students compared to Male students, reviews by Female students show more negative sentiments. For Female students, 55% of their comments overall could be considered Negative, while it is lower for Male students at 49%. The proportion of positive comments for Males, 27% is higher than that for Females at 22%. Overall, it seems that Male students were more optimistic during the pandemic.

TABLE V: SENTIMENT ANALYSIS PER GENDER

Semester	Gender	Negative	Neutral	Positive
Winter 2020	Female	35 (65%)	11 (20%)	8 (15%)
	Male	55 (51%)	22 (20%)	31 (29%)
Fall 2020	Female	19 (54%)	7 (20%)	9 (26%)
	Male	35 (43%)	25 (30%)	22 (27%)
Winter 2021	Female	17 (55%)	6 (19%)	8 (26%)
	Male	39 (50%)	17 (22%)	22 (28%)
Fall 2021	Female	10 (37%)	9 (33%)	8 (30%)
	Male	53 (53%)	24 (24%)	23 (23%)
Overall	Female	81(55%)	33(22%	33(22%)
	Male	182(49%)	88(24%)	98(27%)
	Total	263(51%)	121(24%)	131(25%)

We can also observe in Table V that the proportion of positive comments for Female respondents gradually increases over time from 15%, 26%, 26% and 30%. This is not the case for male respondents with the proportion of positive comments tends to decrease over time as follows: 29%, 27%, 28% and 23%. This could be interpreted as the higher adaptability of Female respondents.

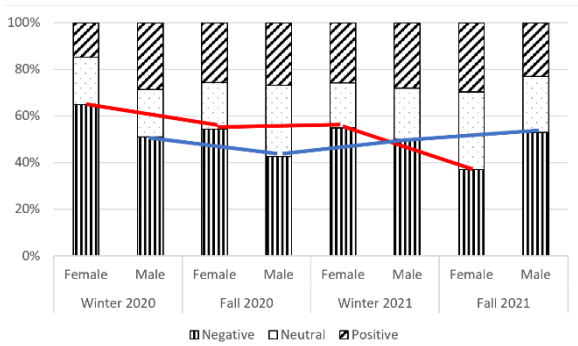

Fig. 1. Sentiment analysis over time.

Fig. 1 illustrates graphically the evolution of the sentiments by gender over time. The sentiments seem to evolve over time, as if students learned to live with this new reality. There are still negative feelings, but they are not as strong. Male and Female students do not have the same level of positive/negative sentiments. Fig. 1 shows this difference. There is a downward trend in the proportion of negative

comments for Female respondents (upper line), with an upward trend for proportion of positive comments while a different pattern is observed for Male respondents, with a decrease and then an increase (lower line) in negative comments and a decrease in positive comments. Male and Female respondents seem to assess the impact of the pandemic differently

E. Sentiments Analysis per Age Category

A sentiment analysis is performed considering the age categories. The five age categories are labeled as A1, A2, A3, A4 and A5 in Table VI. The most frequent age group of students is 25 to 30-year-old (A2). This age group has 52% negative sentiment in total, across four semesters as indicated in Table VI and has a 50% or higher rate of negative sentiments in each of the four semesters. The proportion of negative comments for that age category, had a slight decrease in Fall 2020 semester to increase afterward. The corresponding proportion of positive sentiments had its lowest level in the fourth semester of the pandemic. This could be an indication of Zoom fatigue and loss of hope.

TABLE VI: SENTIMENT ANALYSIS PER AGE CATEGORY OVER FOUR SEMESTERS AND OVERALL

Semester	Age	Negative	Neutral	Positive
Winter 2020	A1	0 (0%)	2 (100%)	0 (0%)
	A2	41 (50%)	18 (22%)	23 (28%)
	A3	38 (58%)	12 (18%)	15 (23%)
	A4	8 (100%)	0 (0%)	0 (0%)
	A5	3 (60%)	1 (20%)	1 (20%)
Fall 2020	A1	0 (0%)	0 (0%)	0 (0%)
	A2	24 (56%)	9 (21%)	10 (23%)
	A3	18 (40%)	12 (27%)	15 (33%)
	A4	11 (46%)	9 (38%)	4 (17%)
	A5	1 (20%)	2 (40%)	2 (40%)
Winter 2021	A1	3 (75%)	1 (25%)	0 (0%)
	A2	27 (50%)	10 (19%)	17 (31%)
	A3	17 (55%)	8 (26%)	6 (19%)
	A4	3 (43%)	2 (29%)	2 (29%)
	A5	6 (46%)	2 (15%)	5 (38%)
Fall 2021	A1	6 (86%)	1 (14%)	0 (0%)
	A2	35 (53%)	20 (30%)	11 (17%)
	A3	9 (36%)	4 (16%)	12 (48%)
	A4	10 (38%)	8 (31%)	8 (31%)
	A5	3 (100%)	0 (0%)	0 (0%)
Overall	A1	9(69%)	4(31%)	0(0%)
	A2	127(52%)	57(23%)	61(25%)
	A3	82(49%)	36(22%)	48(29%)
	A4	32(49%)	19(29%)	14(22%)
	A5	13(50%)	5(19%)	8(31%)
	Total	**263(51%)**	**121(24%)**	**131(25%)**

The second most frequent age group 30-to-35 (A3) shows a high level of proportions of negative comments (58% and 55%) for the Winter semesters (Winter 2020 and Winter 2021) and a decrease of proportions of negative comments (40% and 36%) for the Fall semesters (Fall 2020 and Fall 2021). The proportion of positive comments reached a maximum (48%) in Fall 2021 semester

The 35 to 40 age group (A4) shows an increase in proportion of positive comments from 0% in Winter 2020 to 31% in Fall 2021 semester. The age group with highest proportion of positive sentiments in total, is the older age group of 40 or more (A5). But since there are fewer students in this age group, we will not extrapolate from this result.

Fig. 2 visually summarizes the proportions of positive and negative comments per age categories and semesters.

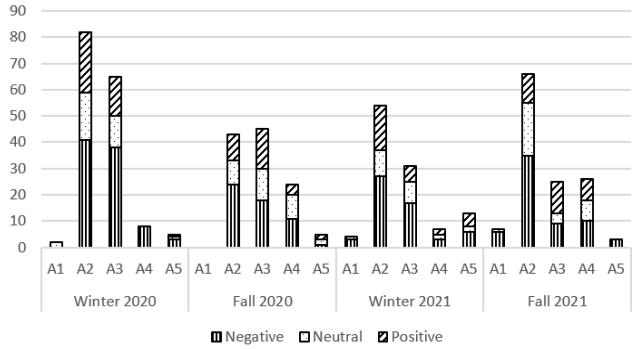

Fig. 2. Sentiment analysis by age and semester.

F. Categorization Models with Sentiments

After having broken down each respondent's comment into units of opinion on different aspects of their experience during the pandemic, categories of opinions were identified in Table III. A Sentiment Analysis on the opinion units is performed to sort them as Negative, Positive or Neutral. Tables IV, V and VI present the sentiments by semester, by gender and by age category. Table VII presents the most frequent negative and positive categories of opinion per semester called the categorization models per semester. It allows the researcher to identify their evolution over time.

The common POSITIVE categories that show up more frequently are:

- Professor's support (3 semesters)
- Good Learning Experience (4 semesters)
- Additional Time to study (3 semesters)

In Winter 2020, when decisions were made to close campuses, and in consequence, teaching and learning went from in-class to completely online, results in Table VII shows that the most important element in the successful transition was the Professor's support. It seems to be a key element to help students deal with the abrupt transition. Overtime, results show that it turned out to be a "Good Learning Experience" for many students, as indicated by the presence of this category in all four semesters. The third category "Additional Time to study" is also very popular among positive comments. It is understandable that not having to commute to campus, has freed some time in a day and gave more time to study. It seems that respondents only appreciated this benefit starting in the second semester of the pandemic.

The common negative categories that show up more frequently are:

- Loss of direct/in person communication (4 semesters)
- Difficult to focus (3 semesters)
- Difficult to perform in personal space / to handle assignments and assignments (3 semesters)
- Different time zones (2 semesters)

TABLE VII: CATEGORIZATION MODELS PER SEMESTERS

Winter 2020	Fall 2020	Winter 2021	Fall 2021
Positive Sentiments			
Professor's support (15) Good Learning Experience (11)	Good Learning Experience (14) Additional time to study (6)	Good Learning Experience (14) Additional time to study (6) Professor's support (3)	Good Learning Experience (15) Additional time to study (9) Professor's support (2)
Negative Sentiments			
Difficult to focus (10) Technical/Software Issues (9) Difficult to perform in personal space (9) Personal/family issues (8) Loss of direct/in person communication (7)	Loss of direct/in person communication (8) Difficult to focus (8) Additional workload (5) Difficult to perform in personal space (5)	Different Time Zones (9) Feeling uneasy (9) Loss of direct/in person communication (7)	Loss of direct/in person communication (21) Difficult to focus (10) Difficult to handle assignments/project (10) Different Time Zones (5)

The "Loss of direct/in person communication" is a common negative category and got worst overtime, especially in the Fall 2021 when many people experienced Zoom fatigue and felling of isolation. With travel restrictions impacting semesters from Fall 2020, coming to Canada became impossible and students had to take classes from their home country in different time zones resulting in attending classes and writing quizzes late at night or during the night. The difficulty to focus and the challenge of different time zones were also major challenges for students.

Categories "Difficult to perform in personal space" and "Difficult to handle assignments/project" which refer to academic performance in online and virtual environment show up in 3 semesters with negative sentiment associated with them. This reflects the worries and perception of students that learning and academic performance occur more easily in non-virtual environment and with face-to-face meetings. Many students did not have a quiet space to study and work which aggravated the situation.

The common neutral category that shows up every semester is that several respondents indicated that the pandemic has had no significant impact on their learning experience.

IV. CONCLUSIONS

With the use of text mining and sentiment analysis, we could uncover the evolution of the perceived impact of the pandemic on students. These perceptions evolve over time and differ according to gender and age categories. One of the most important factor that contributed positively to this experience is the professor's attitude and support. It seems that professors had a major role to play in this difficult period especially in the first semester of the pandemic. Although not easy to turn around and change the pedagogy from in-class to online teaching, respondents appreciated the leadership and hard work of the instructors to support them. This seems to have contributed to students' feeling that they were provided

with a good learning experience. It would have been interesting to replicate this study among different groups of students and different professors. From the second semester of the pandemic (Fall 2020), students started to appreciate having more time to study by not having to commute and working from home. Although this came up as a positive aspect, there were also challenges such as the difficulty to focus and lack of a quiet space to study, which were identified in the negative category.

The loss of direct/in person communication has been strongly felt in all four semesters of the pandemic and it got worse in the Fall 2021 semester, which could be due to the Zoom fatigue and feeling of isolation and loneliness. The difficulty to focus and studying under different time zones, are common negative factors experienced by students. However, it is to be noted that several respondents did not feel significant impact on their academic experience.

The levels of negativity as indicated by the frequency of negative comments seem to decrease over time for Female respondents as if they have learned to live with the situation, while for Male students, this level increased over time. Female respondents show an increase in the level of positive comments while Male respondents exhibit a decline. However overall Male students have higher positivity level.

Respondents from different age categories react differently over time. Students in the most prevalent age group from 25 to 30, show at first a decline in the proportion of negative comments followed by an increase, which could be an indication of tiredness of the situation. The corresponding proportion of positive sentiments has its lowest level in the fourth semester of the pandemic.

Older students in the 30 to 35 age category, exhibit higher levels of negativity in the Winter semesters as compared to the Fall semesters. It seems that longer and colder nights of the Winter semesters added to the challenges of the pandemic. The highest level of positivity for this age category can be observed in the Fall 2021 semester. .

In conclusion, the collection of comments over the four semesters of the pandemic helps understand the impact of the instructors, the difference between Male and Female perceptions and the age categories. Instructors should keep in mind that Winter semesters tend to be more challenging for students especially in times of pandemic. It would be very interesting to have collected similar data in different courses taught by different instructors.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Danielle Morin: director of the project, created the questionnaire and did the literature review and parts of the statistical analysis and wrote the final paper. Contribution: 60%. Sara Hossaini: did all the Text Mining analysis and helped with the other sections 40%. Both authors approved the final version of the paper.

REFERENCES

[1] U. Gaba. (2021). Impact of the coronavirus pandemic on the global economy. *World*. [Online]. Available: https://countercurrents.org/2021/02/impact-of-the-coronavirus-pandemic-on-the-global-economy/

[2] M. Nicola, Z. Alsafi, C. Sohrabi, A. Kerwan, A. Al-Jabir, C. Iosifidis, M. Agha, and R. Agha, "The socio-economic implications of the coronavirus pandemic (COVID-19): A review," *International Journal of Surgery*, vol. 78, pp. 185-193, June 2020.

[3] G. Ambrogio, F. Luigino, F. Longo, and A. Padovano, "Workforce and supply chain disruption as a digital and technological innovation opportunity for resilient manufacturing systems in the COVID-19 pandemic," *Computers and Industrial Engineering*, vol. 169, 108158, 2022.

[4] A. Packham, "I was just sat in my room all day: Lonely students seek mental health support," *The Guardian*, October, 28, 2020.

[5] A. Bozkurt and R. C. Sharma, "Emergency remote teaching in a time of global crisis due to coronavirus pandemic," *Asian Journal of Distance Education*, vol. 15, no. 1, pp. i-vi, 2020.

[6] K. Lee, M. Fanguy, X. S. Lu, and B. Bligh, "Student learning during COVID-19: It was not as bad as we feared," *Distance Education*, vol. 42, no. 1, pp. 164-172, 2021.

[7] SETHUGHES. (2020). *Why Traditional Classroom Learning Is Better Than Online Courses*. [Online]. Available: https://owlcation.com/academia/Why-Traditional-Classroom-Learning-is-Better-than-Online-Courses

[8] J. Paul and F Jefferson, "A comparative analysis of student performance in an online vs. face-to-face environmental science course from 2009 to 2016," *Frontiers in. Computer Sciencei.*, vol. 1, no. 7, 1019, doi: 10.3389/fcomp.2019.00007.

[9] D. Blizak, S. Blizak, O. Bouchenak, and K. Yahiaoui, "Students' perceptions regarding the abrupt transition to online learning during the COVID-19 pandemic: Case of Faculty of Chemistry and Hydrocarbons at the University of Boumerdes—Algeria," *Journal of Chemical Education*, vol. 97, no. 9, pp. 2466–2471, 2020.

[10] K. Nachimuthu, "Student teacher's attitude towards online learning during Covid-19," *International Journal of Advanced Science and Technology*, vol. 29, no. 6, 8745–8749, 2020.

[11] T. Tang, A. Abuhmaid, M. Olaimat, D. M. Oudat, M. Aldhaeebi, and E. Bamanger, "Efficiency of flipped classroom with online-based teaching under COVID-19," *Interactive Learning Environments*, 2020, DOI: 10.1080/10494820.2020.1817761

[12] S. Rashid and S. S. Yadav, "Impact of Covid-19 pandemic on higher education and research," *Indian Journal of Human Development* , vol. 14, no. 2, pp. 340-343, 2020.

[13] R. M. Cutri, J. Mena, and E. F. Whiting "Faculty readiness for online crisis teaching: transitioning to online teaching during the COVID-19 pandemic," *European Journal of Teacher Education*, vol. 43, no. 4, pp. 523-541, 2020, DOI: 10.1080/02619768.2020.1815702

[14] E. M. Aucejo, J. F. French, M. P. U. Araya, and B. Zafar, "The impact of COVID-19 on student experiences and expectations: Evidence from a survey," *NBER Working Paper No. 27392*, June 2020.

[15] D. Morin, "Transition from Face-to-Face Teaching to Online Teaching in Times of Pandemic," *International Journal of Information and Education Technology (IJIET)*, vol. 12, no. 3, pp. 246-251, 2022.

[16] D. Morin, "Teaching and learning during the coronavirus pandemic," in *Proc. 13th annual International Conference on Education and New Learning Technologies*, EDULEARN21, Palma, Spain, July 2021.

[17] D. Morin, "The impact of the pandemic on attitudes and perceptions of students in an MBA analytics course," in *Proc. the 15th International Technology, Education and Development Conference INTED21*,Valence, Spain, pp. 9132-9141, March 2021

[18] F. A. Allen, *Natural Language Processing. Encyclopedia of Computer Science*, John Wiley and Sons Ltd., GBR, pp. 1218–1222, 2003.

[19] E. D. Liddy, *Natural Language Processing. In Encyclopedia of Library and Information Science*, 2nd Ed. NY. Marcel Decker, Inc. 2001

Copyright © 2023 by the authors. This is an open access article distributed under the Creative Commons Attribution License which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited (CC BY 4.0).