An Application of Decision Analysis on the Strategy of Professors with the Absorption of Knowledge Between Face-to-Face and Online Learning

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Abstract
The COVID-19 pandemic has changed our educational life as online classes emerged as a way to adapt for educational institutions in the new normal. This has helped in continuing to cater to the educational needs of the students to prevent the spread of the virus. Several intuitions have implemented ways on how online learning can be accessible and convenient for students. Though this has been beneficial, the concern of professors in determining what is the best factor in the experience of students with their learning capacities given the situation. With more than a year in online classes, students have voiced concerns about today's learning platforms as it affects several factors and challenges in the magnitude of their learning.

This research aims to compare the absorption of knowledge of students between face-to-face learning and online learning, in order to identify what factor results with the highest absorption of knowledge. From that, the best strategy to be used by professors can be obtained. By conducting a survey, the researchers used the obtained data from the students of Mapua University, to be able to perform various calculations, statistical and decision analyses. As a result, the factor of Interaction/Communication yielded the highest among other factors, which indicates that it should be considered by professors when conducting face-to-face learning and online learning, in order for the students to meet the maximum level of absorption of knowledge. As a conclusion, this also implies that the students were able to perform academically well whenever an interaction with their peers and classmates took place. Given this, it can also be concluded that it is best for professors to provide interactive activities to their students to be able to obtain a high learning absorption.

Keywords
Education, Students, Absorption, Program, Performance

1. Introduction
In the first quarter of 2020, the outbreak of the new coronavirus pandemic has shaken educational life throughout the world. It provided the most daunting challenge for the global education system in the previous century. Over 1.6 billion people in over 190 countries across all continents have been affected by school closures, with repercussions in how instructors and students have acclimatized to the limitations given by e-learning.

Educators are finding it progressively impracticable to overlook the parallels and contrasts between face-to-face and online courses as they encounter rising challenges to include online conversations. The pressure to include innovative ideas into school curricula stems from a variety of sources. Certainly, several academic institutions are in the process of connecting with disadvantaged youth, and workers are being forced to offer more online education. Even as synchronous sessions are held concurrently in a nation with internet problems and scantiness, multiple technological issues occur for students and teachers, particularly those who live in rural locations.

1.1 Objectives

Online classes aid institutions and universities in the learning experience and the educational attainment of students especially during this pandemic. The objective of this paper is to determine what type of strategy professors will use in whichever educational platform, whether online classes or face-to-face, is best in helping the students in their learning absorption and activity participation.

1.2 Gap of the Research

Since this study would be focusing on calculating the absorption levels of the students through the participation of the students, the gap for this research is the number of quantitative researches available to be considered from. Based on the review of related literature, there may be countless studies that involve the comparison of learning during face-to-face classes and online classes. However, this study still lacks a number of studies that involve quantitative calculations that measure both the students' participation, taking into account the students' experiences in practicing their skills and the aspects of their learning environment.

2. Literature Review

Student Barriers to Online Learning: A factor analytic study

As the use of computer technology evolves, the potential for the use of online learning increases as well. This study was focused on how effective the use of online classes are given that there is the presence of face-to-face classes as well. Moreover, there has been clearly a number of barriers that differ both methodologies of teaching from each other. The definition of barrier in this perspective refers to the effectiveness of online learning, online learning enjoyment, and likelihood of taking a fully online course in the future. In conclusion, social interaction of both the teachers and the students are still in discussion on whether this affects the number of online courses to take in the future. According to Muilenburg & Berge (2005), it can be a recommendation to the online educators to at least reduce the student barriers present in online learning to improve its way of teaching as well.

Comparing Student Achievement in Online and Face-to-Face Class Formats

For this research, sections such as groups of undergraduate and graduate students studying via face to face classes vs. groups of undergraduate and graduate students studying via online classes have been provided with a set of assignments for the comparison of results. Each assignment has been graded according to a given rubric. As a result, the undergraduate students have shown no differences in terms of learning via face-to-face or online class. As for the group of graduate students, results are different. Students who are studying through online classes have shown a better quality of work compared to students studying via face-to-face. This study concludes that online classes should be an important method of instructional activities. Results have indicated that whatever the platform, students are able to attain education and learn. Either way, students have actively participated and engaged in their activities and provide quality of work.

Online learning amid the COVID-19 pandemic: Students' perspectives

As the Covid-19 emerges, the higher education institution temporarily shuts down schools and universities to prevent the spread of the virus and prepares for distant learning. Because of the uncertainty of when schools will reopen and operate full time, universities have made online learning a priority to provide quality education to help students and professors to create the best learning experience despite the situation. Due to this, researchers are looking for the challenges and opportunities that are in line with e-learning during this pandemic.

In the face of the coronavirus, this study investigates the attitudes of Pakistani higher education students regarding mandatory digital and distant learning university courses (covid-19). Undergraduate and postgraduate students were polled to learn about their thoughts on online education in Pakistan. The study's findings revealed that in poor nations like Pakistan, Where the great majority of students are unable to use the internet owing to technical and financial difficulties, online learning cannot achieve desired outcomes. Other problems raised by higher education students were a lack of face-to-face connection with the instructor, reaction time, and the absence of conventional classroom socializing.

3. Methods

In gathering the data for this research, a survey questionnaire was conducted among the college students from Mapua University prior Batch 2019. The survey questionnaire was created with the use of Google Forms. The survey consists of four (4) parts. As for the first part, the survey collected the respondents' profile such as their name (optional) and

their program (engineering or non-engineering). As for the second part, it consists of questions that ask for the respondent's rating on their experience during face-to-face classes. This section of the survey asked for their ranking on their priorities during face-to-face classes which are class participation, timely feedback from instructors, clear understanding of lessons offered, motivation, interaction/communication, and application of practical skills. With ranking all 6 categories, the survey used a 1-6 ranking scale, with 1 being their top priority and 6 as the least priority. After ranking all six (6) categories, their rating experience for each category was also collected. The survey used a 1-5 rating scale, with 5 being the highest, and 1 being the lowest. This section ended with a multiple-choice type of question where it asked for the challenges they have encountered during their face-to-face classes. As for the third part, it consists of the same type of questions as the second part. However, this part focuses on their experience during online classes. This section ended with a question of asking what challenges they have encountered during their online classes during this pandemic. Fourth and lastly, the last part of the survey consists of the respondent's overall ranking on whether they prefer face-to-face classes or online classes. Other than that, their overall ranking was asked as well on what type of learning method they prefer before, during, and after the pandemic has occurred.

4. Data Collection

Table 1. Summary of Average Scores and their Probability under Engineering Programs

	Overall	**Before**	**During**	**After**
Face-to-Face Classes	64	64	37	46
Online Classes	10	10	37	28
Total	74	74	74	74
Probability of Face-to-Face Classes	0.86	0.86	0.5	0.62
Probability of Online Classes	0.14	0.16	0.5	0.38

Table 1 shows the data summary of the obtained data from all 74 respondents from engineering programs, where it shows what their overall preferred learning method was, which resulted in 86% of the respondents prefer face-to-face classes. Before the quarantine occurred, 86% of the respondents preferred face-to-face classes as their learning method. During the quarantine, 50% of the respondents preferred both face-to-face classes and online classes. After quarantine, 62% of the respondents prefer face-to-face classes as well.

Table 2. Summary of Average Scores and their Probability under Engineering Programs

	Overall	**Before**	**During**	**After**
Face-to-Face Classes	57	52	25	37
Online Classes	8	13	40	28
Total	65	65	65	65
Probability of Face-to-Face Classes	0.88	0.8	0.38	0.57
Probability of Online Classes	0.12	0.2	0.62	0.43

Table 2 shows the data summary of the obtained data from all 65 respondents from Non-Engineering programs, where it shows what their overall preferred learning method was, which resulted in 88% of the respondents prefer face-to-face classes. Before the quarantine occurred, 80% of the respondents preferred face-to-face classes as their learning method. During the quarantine, 62% of the respondents preferred online classes. After quarantine, 57% of the respondents prefer face-to-face classes.

5. Results and Discussion

5.1.1. Engineering Programs

Table 3. Payoff Table for Engineering Programs

Alternatives (Strategies to Consider)	**STATES OF NATURE**	
	Face-to-Face Classes	**Online Classes**
Class Participation	3.00	2.55
Timely Feedback from Instructors regarding concerns	3.61	2.88
Clear Understanding of Lessons Offered	3.58	2.88
Motivation	3.64	2.49
Interaction / Communication	4.18	3.42
Application of Practical Skills	3.82	2.50

Table 3 displays the payoff table that will be used for Engineering Programs. The following payoff values were obtained based on the average rating for each alternative and state of nature from the survey conducted.

Table 4. Probabilities for Face-to-Face Classes After Quarantine

	Prior Probability	Conditional Probability	Joint Probability	Posterior Probability
Face-to-Face Classes After Quarantine	0.86	0.62	0.54	0.89
	0.14	0.50	0.07	0.11
Sum			0.61	1.00

Table 4 displays all the computed conditional, joint, and prior probabilities from all respondents from Engineering programs, if face-to-face classes would continue after the quarantine.

Table 5. Probabilities for Online Classes After Quarantine

	Prior Probability	Conditional Probability	Joint Probability	Posterior Probability
Online Classes After Quarantine	0.86	0.38	0.33	0.83
	0.14	0.50	0.07	0.17
Sum			0.39	1.00

Table 5 displays all the computed conditional, joint, and prior probabilities from all respondents from Engineering programs, if online classes would continue to still occur after the quarantine.

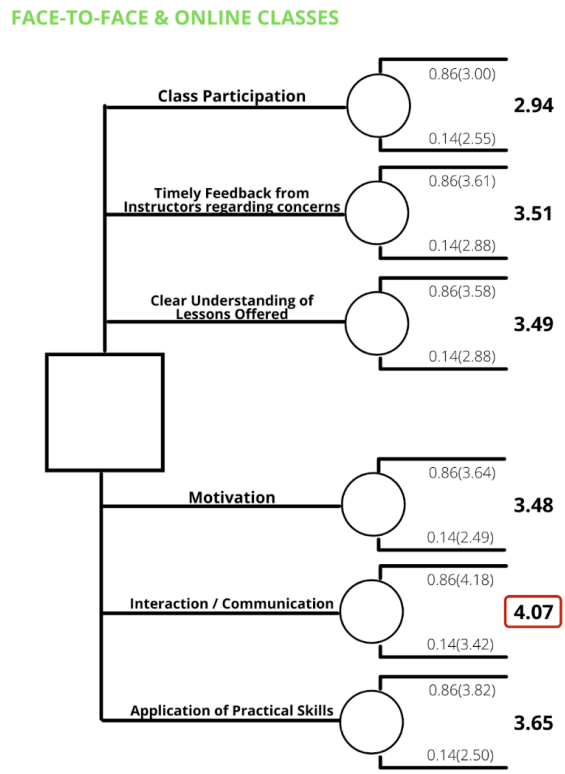

Figure 1. Decision Tree for Engineering Programs with Prior Probabilities.

With Figure 1, it has resulted in an expected value of 4.07 from the state of nature of Interaction / Communication which states that the respondents from engineering programs often interact with their classmates/peers. This result indicates that the best strategy that one needs to consider in order to obtain the maximum amount of absorption of knowledge, is to consider how students interact and communicate with each other.

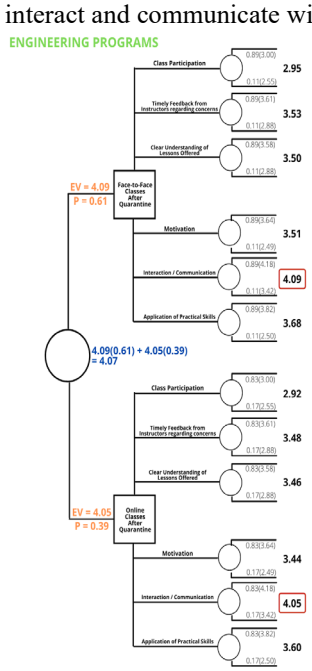

Figure 2. Decision Tree for Engineering Programs with Conditional and Joint Probabilities.

In Figure 2, it can be seen that the decision shows the posterior and joint probabilities in an event when the quarantine ends. The probabilities are added to the decision tree and the results showed that the decision that will yield the highest value will be interaction/communication for both online class and face to face classes.

Table 6. Payoff Table for Non-Engineering Programs

Alternatives (Strategies to Consider)	**STATES OF NATURE**	
	Face-to-Face Classes	**Online Classes**
Class Participation	3.18	2.86
Timely Feedback from Instructors regarding concerns	3.34	2.71
Clear Understanding of Lessons Offered	3.71	2.83
Motivation	3.49	2.37
Interaction / Communication	3.72	3.15
Application of Practical Skills	3.62	2.75

With Table 6, it displays the payoff table that will be used for Non-Engineering Programs. The following payoff values were obtained based on the average rating for each alternative and state of nature from the survey conducted.

Table 7. Probabilities for Face-to-Face Classes After Quarantine

	Prior Probability	Conditional Probability	Joint Probability	Posterior Probability
Face-to-Face Classes After Quarantine	0.88	0.57	0.50	0.91
	0.12	0.38	0.05	0.09
			0.55	1.00

In Table 7, it displays all the computed conditional, joint, and prior probabilities from all respondents from non-Engineering programs if face-to-face classes would continue after the quarantine.

Table 8. Probabilities for Online Classes After Quarantine

	Prior Probability	Conditional Probability	Joint Probability	Posterior Probability
Online Classes After Quarantine	0.88	0.43	0.38	0.83
	0.12	0.62	0.08	0.17
			0.45	1.00

In Table 8, it displays all the computed conditional, joint, and prior probabilities from all respondents from Non-Engineering programs, if online classes would continue to still occur after the quarantine

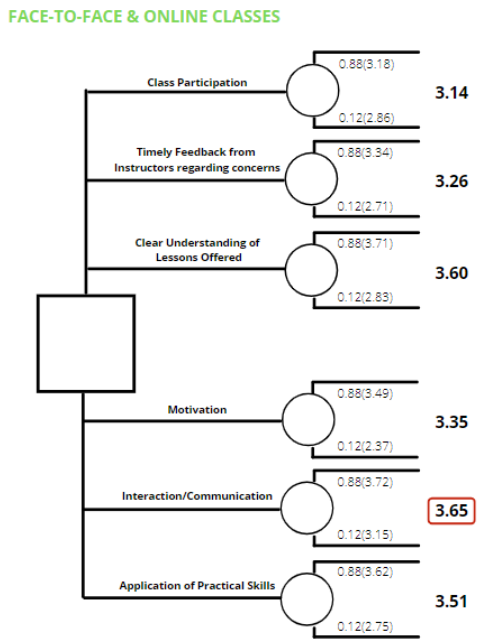

Figure 3. Decision Tree for Non-Engineering Programs with Prior Probabilities

With Figure 3, it has resulted in an expected value of 3.65 from the state of nature of Interaction / Communication which states that the respondents from non-engineering programs often interact with their classmates/peers. This result indicates that the best strategy that one needs 32 to consider in order to obtain the maximum amount of absorption of knowledge, is to consider how students interact and communicate with each other.

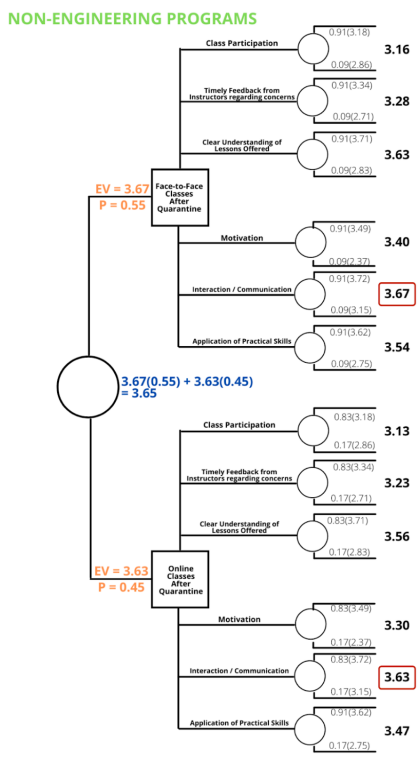

Figure 4. Decision Tree for Non-Engineering Programs with Conditional and Joint Probabilities.

In Figure 4, it can be seen that the decision shows the posterior and joint probabilities in an event when the quarantine ends. The probabilities are added to the decision tree and the results showed that the decision that will yield the highest value will be interaction/communication for both online class and face to face classes. The decision tree shows that if face-to-face classes would occur after quarantine, then the factor that needs to be considered in order for the students to reach the maximum level of absorption is the factor of Interaction/Communication, with an expected value of 3.67 which indicates that the students would often interact and communicate with their peers and classmates. On the other hand, if online classes would occur after quarantine, then the factor that needs to be considered in order for the students to reach the maximum level of absorption is the factor of Interaction/Communication, with an expected value of 3.63, which indicates that the students would often interact and communicate with their peers and classmates.

5.3 Proposed Improvements

The researchers would recommend professors in an educational institution to plan for a strategy beforehand every start of academic season to communicate with their students. And learn how to hook their student's attention since in this paper the researchers learned that communication with the teacher and within the class are essential for a student's learning absorption. This statement is true either if a class is in an online class or a face to face class. Conducting ice breakers and collaborative activities in the first week to get to know each other in order to be acquainted with another.

The researchers would also recommend to other researchers aiming to improve this study to widen the respondents to other college programs and students that experienced senior high in a face to face setting in order to get a more accurate answer and to be able to cover courses that is dependent on hands on applications and to cover courses that are more knowledge dependent.so that professors are able to provide the best quality of education that they could give to their students the researchers would also recommend to gather more respondents to gain a more accurate answer.

5.4 Validation

Engineering (Face-to-Face Classes)

Factor	N	Median	Ave Rank	Z
Application of Practical Skills	6	13.000	18.9	0.11
Class Participation	6	13.500	19.6	0.28
Clear Understanding of Lessons Offered	6	8.500	15.7	-0.72
Interaction / Communication	6	13.000	19.9	0.36
Motivation	6	11.500	18.1	-0.11
Timely Feedback from Instructors regarding concerns	6	12.500	18.8	0.08
Overall	36		18.5	

H = 0.63 DF = 5 P = 0.987
H = 0.64 DF = 5 P = 0.986 (adjusted for ties)

Figure 5. Kruskal Wallis Test of Face-to-Face Classes under Engineering Programs

Figure 5 shows the ranking of each factor within Face-to-Face classes under the Engineering Program. Through this, the criteria of Clear Understanding of Lessons Offered have the highest ranking with a rank value of 15.7 in which students prioritize their experience in Face-to-Face classes under the Engineering Programs. Based on the survey, 1 is the highest ranking while 6 is lowest ranking in determining the importance of each factor.

Engineering (Online Classes)

Factor on Online Eng	N	Median	Ave Rank	Z
Application of Practical Skills	6	12.000	18.8	0.08
Class Participation	6	9.500	16.3	-0.57
Clear Understanding of Lessons Offered	6	9.500	15.9	-0.66
Interaction / Communication	6	14.500	20.8	0.57
Motivation	6	12.500	19.3	0.19
Timely Feedback from Instructors regarding concerns	6	13.500	20.0	0.38
Overall	36		18.5	

H = 1.07 DF = 5 P = 0.957
H = 1.07 DF = 5 P = 0.956 (adjusted for ties)

Figure 6. Kruskal Wallis Test of Face-to-Face Classes under Non-Engineering Programs

Figure 6 shows the ranking of each factor within Online Classes under the Engineering program. Through this, the criteria of Clear Understanding of Lessons Offered still has the highest ranking with a rank value of 15.9 in which students prioritize their experience in Online Classes under the Engineering Programs. The highest ranking with a rank value of 1 determined the important factor engineering students prioritize through Online Classes.

Non-Engineering (Face-to-Face Classes)

Factor on F2F Non-Eng	N	Median	Ave Rank	Z
Application of Practical Skills	6	8.500	17.4	-0.28
Class Participation	6	8.500	16.9	-0.40
Clear Understanding of Lessons Offered	6	10.500	19.2	0.17
Interaction / Communication	6	12.500	20.7	0.55
Motivation	6	12.500	19.3	0.19
Timely Feedback from Instructors regarding concerns	6	10.000	17.6	-0.23
Overall	36		18.5	

H = 0.55 DF = 5 P = 0.990
H = 0.56 DF = 5 P = 0.990 (adjusted for ties)

Figure 7. Kruskal Wallis Test of Face-to-Face Classes under Non-Engineering Programs

Figure 7 shown above shows the ranking of each factor within Face-to-Face classes under the Non-Engineering Program. Through this, the criteria of Class Participation have the highest ranking with a rank value of 16.9 in which non-engineering students prioritize their experience in Face-to-Face classes under the Non-Engineering Programs. Through the survey, 1 is the highest ranking while 6 is lowest ranking in determining the importance of each factor.

Non-Engineering (Online Classes)

Factor on Online Non-Eng	N	Median	Ave Rank	Z
Application of Practical Skills	6	10.000	19.9	0.36
Class Participation	6	9.500	16.5	-0.51
Clear Understanding of Lessons Offered	6	10.000	17.7	-0.21
Interaction / Communication	6	11.000	19.6	0.28
Motivation	6	12.000	20.0	0.38
Timely Feedback from Instructors regarding concerns	6	9.500	17.3	-0.30
Overall	36		18.5	

H = 0.62 DF = 5 P = 0.987
H = 0.63 DF = 5 P = 0.987 (adjusted for ties)

Figure 8. Kruskal Wallis Test of Online Classes under Engineering Programs

Figure 8 shows the ranking of each factor within Online Classes under the Engineering program. Through this, the criteria of Clear Understanding of Lessons Offered still has the highest ranking with a rank value of 15.9 in which students prioritize their experience in Online Classes under the Engineering Programs. The highest ranking with a rank value of 1 determined the important factor engineering students prioritize through Online Classes.

6. Conclusion

The pandemic has made learning institutions be lenient in online classes to prevent the spread of the virus through direct contact with teachers, staff, and students. Although this has been beneficial to continue and to adapt to the learning system suited in this new normal, the concern on which is the better learning method in the absorption of learnings and activity performance of the students is determined. To further expound what learning method is what the student's think is best for their learning absorption and activity performance, the results have shown that students in both engineering and non engineering prefer the Face-to-Face classes as their preferred learning platform. As for the students' experience in both Face-to-Face Classes and Online Classes, the factor of Interaction/Communication with professors and classmates are given as an important factor that maximizes how they absorb learning knowledge and activity of performance.

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Biographies

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Gaea Marithe Victor is a striving 2nd Year BS Industrial Engineering student in Mapua University, aspiring to become a successful industrial engineer that meets both of her personal interests and professional goals. Aside from being an academic student, she is currently the Membership Head of the PROMAP organization from her department in which she looks forward to, to gain more experiences that could help her in the future.

Julianne Mikhaella Delos Reyes is a 2nd year BS-MS Industrial Engineering student in Mapua University. She is currently the President of Philippine Institute of Industrial Engineers (PIIE). Julianne is an industrious and diligent student who is passionate about her goals and attributes in life. After graduation, her objectives are to be a successful person and to pursue a career that is in line with her profession.

Louis Miguel C Dural is currently a student in Mapua University and is taking an undergraduate degree in B.S. Industrial Engineering. He is also a member of the Philippine Institute for Industrial Engineers, as well as the business manager for the industrial engineering organization Production and Operation Management Association of the Philippines (PROMAP) Mapua Chapter.

Rene D. Estember is a Professor in the School of Industrial Engineering and Engineering Management at the Mapua University in Manila City, Philippines. He earned his B.S. in Management and Industrial Engineering from Mapua Institute of Technology, Master's in Business Administration from Ateneo de Manila University, Master of Science in Industrial Engineering from the University of the Philippines, and finishing his Doctorate in Business Administration from the Pamantasan ng Lungsod ng Maynila (PLM), all located in the Philippines. He is presently undertaking consultancy work on quality management systems documentation and also involved as a regular resource speaker of a training company conducting technical trainings. His research interests include human factor and ergonomics, manufacturing, risk management and optimization