

Effectiveness of Flipped Classroom Approach in the Delivery of Basic Computer Applications Lecture and Assessments at DLSU Manila

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Highlights

- Delivery of the same lecture contents in four teaching modes, purely online, hybridized traditional, hybridized flipped-classroom approach, and predominantly face-to-face.
- The effectiveness of delivering lectures in a flipped classroom applies to pure online and hybridized classes.
- Performance factors affect the output of the students.
- Tools necessary for effective delivery of flipped classroom approach.

Abstract

Education during the time of the pandemic is challenging, especially during the times when face-to-face modality is hardly allowed. The previous crisis led to some improvising methods that compromised the quality of lecture delivery. As the Philippines opens its economic doors, holding face-to-face classes becomes more accessible again to many institutions, especially for those who are not fully online-ready. This paper aims to provide an eye-opener to other teaching strategies applicable to engineering education and its related fields backed by statistical methods to prove scientifically that a flipped classroom approach is effective in delivering lectures, especially if the tools are available. Data will be analyzed and interpreted statistically. And the subject students are first-year students of DLSU currently taking the Basic Computer Applications Subject. The basis of the assessment would be the departmental midterm exams so that questions are evenly distributed to the exam's contributors to avoid further bias. At the end of the study, students under the flipped classroom setup performed better in the exams compared to the other learning setup.

Keywords: Engineering Education, Flipped Classroom Approach, Learning Setup, Educational Technology, Learning and Teaching Methodology, Statistics.

1. Introduction

Horace Mann once said, "Education is the great equalizer of men's conditions and the balance-wheel of the social machinery, greater than all other inventions of human creation." (Duncan, 2021). The pandemic challenged educators during the onset of the pandemic (un.org, 2020). Some schools closed because of a lack of facilities (un.org, 2020). Some educators had difficulty devising methods to proceed with their teaching because of the non-availability of tools necessary for online teaching, such as Panopto, canvas, blackboard applications, and the like (un.org, 2020). The current COVID-19 pandemic has created complicated issues and impacted the educational sectors; its conclusion is unknown (Tria, 2020). Every nation is currently putting plans and procedures in place to contain the virus, but the number of illnesses is growing (Tria, 2020). In the context of education, to continue and offer, Despite lockdown and community quarantine, provide quality education by considering the new average and standard educational plans and execution (Tria, 2020). According to (Schleicher, 2020), Pupils from wealthy backgrounds, with parental support and who are willing and capable of learning might navigate past the school doors to alternate learning opportunities for education (Schleicher, 2020). Those with less bright backgrounds frequently remained in

the dark when their schools closed. This crisis has highlighted numerous shortcomings and injustices (Schleicher, 2020). In our educational systems, including broadband access and computers required for online education, as well as the enabling settings toward education, were misalignments of requirements and resources (Schleicher, 2020).

Those facts taken from some sources address an eye-opener on what problems the educational landscape is facing. The challenges the faculty may encounter depend on the availability of materials, tools, and the like, but this is quickly addressed by having access to the tools through funding. The author made this study to deliver the class in four different setups with permission from the other teachers to conduct the same lecture in different delivery setups, with the author utilizing the flipped classroom approach to deliver the lectures in comparison with the other three lecture delivery approaches. According to Michigan State University and Flipped Learning Network, A flipped classroom approach is a pedagogical approach where direct instruction shifts from the group learning space to the individual learning space (Michigan State University, 2022; Flipped Learning Network, 2014). and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively with the subject matter (Michigan State University, 2022) (Flipped Learning Network, 2014). Through the statistical and comparative methods, the study generally aims to prove the effectiveness of the flipped classroom approach and raise the awareness of educators to adopt the technique in the delivery of lectures, especially since the flipped classroom approach is practical in the delivery of online, hybridized and face to face lectures.

2. Methodology

The author studied DLSU ID 122 students taking the introductory computer applications course. For the data gathering and interpretation of data, the author of the paper observed the following procedures:

- 1.) Determine the data sizes suitable for each section and determine the base learning setup in coordination with the faculty assigned.
- 2.) Perform and execute the learning instruction in the base section.
- 3.) Coordinate with the other faculty on the structure of the departmental exam as the basis of the assessment.
- 4.) Administer the departmental exam uniformly on all sections without question bias.
- 5.) Gather the data from the faculties assigned without the names of the student.
- 6.) Analyze the data using appropriate statistical tools of analysis of variance and box and whisker plots.

For the statistical design of the research, the author used a quantitative method to interpret the data.

3. Results and Discussion

3.1 The Data Size and Groups

The balanced number per group is 43 students, with a maximum of 45 students per group. The author balanced the number of samples to 43 to perform a balanced analysis of variance. According to (Minitab, 2016), ANOVA cannot exist in an unbalanced design; more so, this is fortified (Navarro, 2022). The number of samples is also balanced depending on the four class setups.

3.2 The Learning Instruction per Section

Lectures are delivered as follows: For the predominantly face-to-face section, the lectures are delivered synchronously through traditional classroom methods practiced during the pre-pandemic era. It includes discussion through a chalkboard or a whiteboard and the projector to present slides and lectures. For the class on full online delivery, lectures are delivered through online zoom meetings synchronously with slides presented during lectures. Lectures are recorded for replay in complete online/distance learning. For the hybrid traditional, lectures are somewhat delivered in a mix of fully online and predominantly face-to-face. During online sessions, lectures are delivered synchronously through the meeting platform.

In contrast, the lectures are delivered through the chalkboard and whiteboard during face-to-face sessions in this learning modality. The last modality is somewhat unique but requires a lot of effort from the teacher since it is delivered in a hybrid but in flipped classroom approach. In this modality, the teacher fully utilizes learning management tools in contrast with the other learning modalities, where the teacher only utilizes the tool for exercises. In the hybrid flipped classroom approach, the teacher also uses other educational tools to deliver the lecture, such as gamifying the lecture through programming and making it interactive so that the lecture will not move if questions in the platform are not answered. The only drawback of the flipped classroom approach is that the teacher/instructor bears the strain and effort to deliver the lecture but makes it more accessible to students for later review. More so, in flipped-classroom, consultations are done synchronously rather than entertaining questions in the middle of the class. While synchronously discussing, making it more efficient to make other students move on to the next part of the lecture, especially if they already have the necessary information about the topic.

3.3 Coordination of the Structure of the Departmental Exam

The course's departmental exam is the basis for assessing the approach's effectiveness compared with the base method assigned to the sections. The questions are unanimously agreed upon among the four teachers/instructors teaching the course to avoid further bias concerning the exam outcome after administration.

3.4 Administration of the Departmental Exam without Bias

The departmental exam was administered last October 12, 2022, through the canvas platform with real-time monitoring enabled to make further the results valid. All student's activities are monitored during the exam. Electronic devices other than the end device for taking the exam are not allowed during the exam. The exam is administered uniformly to all students in all settings. The exam has a time limit of two and a half hours. The exam has fifty-four items with five sets of randomized questions per item, one point each; the questions are all solving. The preliminary observation of the time the scores are arranged from least to most excellent is that more students got a perfect score in the hybridized flipped classroom approach as opposed to the other three groups.

3.5 Gathering of the Data from the Faculties Assigned per Section/Settings

With the consent of the teachers/instructors teaching the course, the author gathered all the data from the other sections handling the same subject. One hundred seventy-two students took the exam; the data are grouped into four groups, purely online, hybridized traditional, hybridized flipped classroom, and hybridized but predominantly face-to-face. The following data were gathered, and the author preliminarily observed the following details. The raw data is presented in figure 2, with the sketchy details as follows, shown in figure 1.

	Pure Online	Hybridized Traditional	Hybridized Flipped Classroom	Hybrid Predominantly Face to Face
Average	35.39534884	41.1627907	44.27906977	28.51162791
Number Failing	24	10	7	32
Number Passing	19	32	36	11
Median	35	43.5	46	27

Figure 1: Preliminary Detail of Data without Thorough Analysis

Pure Online	Hybridized Traditional	Hybridized Flipped Classroom	Hybrid Predominantly Face to Face
20	17	24	4
20	17	28	10
20	21	29	12
21	21	31	13
22	30	34	14
23	30	36	14
24	31	37	16
25	33	38	19
26	33	39	19
27	35	39	21
27	37	39	21
29	38	39	22
30	38	40	22
31	38	40	23
32	38	41	23
32	40	42	23
32	42	42	24
32	42	42	24
34	43	45	24
34	43	45	26
35	43	45	26
35	43	46	27
35	44	47	27
37	45	47	29
38	45	48	29
38	46	48	31
39	46	48	32
39	46	48	32
40	47	49	32
41	48	50	33
42	48	50	33
43	48	50	36
43	48	50	40
44	49	51	40
44	50	52	41
45	50	52	42
46	50	52	43
46	51	53	45
47	51	53	45
48	51	53	47
49	51	54	47
53	51	54	47
54	52	54	48

Figure 2: Raw Data of Scores Arranged from Least to Greatest per Settings

3.6 Analysis of the Data Using Appropriate Statistical Tools

Using a balanced analysis of variance (ANOVA), the following data were observed based on the raw data gathered from the four groups. Figure 3: Shows the Method, the method, and the hypotheses for the data.

Method

Null hypothesis	All means are equal
Alternative hypothesis	Not all means are equal
Significance level	$\alpha = 0.05$

Equal variances were assumed for the analysis.

Figure 3: Null and Alternate Hypothesis with a Significance level of Alpha Equal to 0.05

Basically, through hypothesis testing, it is always assumed that in the null hypothesis, all means are equal, and not all means are equal for the alternate hypothesis; the basis of this interpretation will be based on the p-value, which will be shown in the later parts of this section.

The factor information of the data is as shown in Figures 1 and 2; the data is grouped for the pure online section, hybridized traditional, hybridized flipped classroom, and the hybrid predominantly face-to-face.

The analysis of variance is performed using Minitab and Microsoft Excel, and the following has been found, as shown in figure 4.

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	6213	2070.97	22.46	0.000
Error	168	15490	92.20		
Total	171	21702			

Figure 4: Analysis of Variance(ANOVA) of the Data Gathered

After performing the analysis of the data through the analysis of variance (ANOVA), it has been found that the means of all the factors (pure online, hybridized traditional, hybridized flipped classroom, and hybridized face-to-face predominantly) are not the same. It can be inferred by looking at the P-value of the data since the P-value is lower than 0.05 ($p < 0.05$). By the rule of statistics, that would mean that the null hypothesis is not valid, which equates to the conclusion that the means of all factors/groups are not equal (Stats Direct, 2002). Since the p-value is a total zero, the author can infer a factual finding that not all means are accurate (Stats Direct, 2002). The succeeding figures (Figures 5,6, and 7) show other parameters involved in performing the analysis of variance that further fortifies the integrity of the data.

S	R-sq	R-sq(adj)	R-sq(pred)
9.60206	28.63%	27.35%	25.19%

Figure 5: Standard Deviation and Coefficient of Determination

Means

Factor	N	Mean	StDev	95% CI
Pure Online	43	35.40	9.40	(32.50, 38.29)
Hybridized Traditional	43	41.16	9.52	(38.27, 44.05)
Hybridized Flipped Classroom	43	44.28	7.70	(41.39, 47.17)
Hybrid Predominantly Face to Fa	43	28.51	11.43	(25.62, 31.40)

Pooled StDev = 9.60206

Figure 6: Comparison of Means

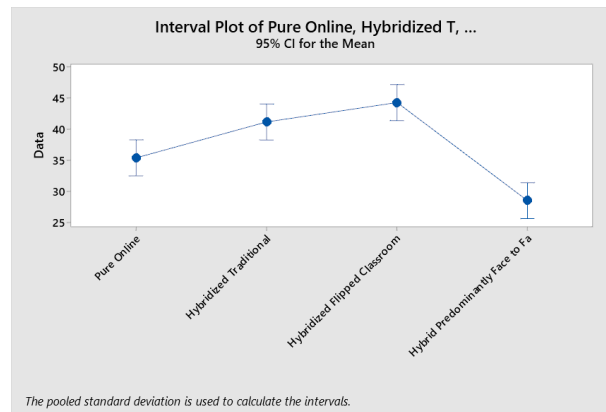


Figure 7: Box and Whisker Plot Representation of Data

Figure 5 provides the standard deviation and the coefficient of determination. According to (Penn State University, 2018), the coefficient of determination gives the data landscape if the statistical model is predictable or not (Penn State University, 2018). The standard deviation, on the other hand, shows the spreading of the data (Penn State University, 2022). With enough data in figure 5, the author can infer that the data variation is high since a variation of data higher than two is considered high (Penn State University, 2022). The author also considered the variance analysis coefficient of determination to fortify the data. The obtained value is lower than usual, meaning the model or the data value is not predictable, requiring in-depth analysis using the method.

In figure 6, the author considered the means and the spreading per factor. Since all data are randomized, the standard deviation of each data group is different and higher than usual. The values of the means are also different for each group. For each factor, there are 43 samples to make it uniform and suitable for analysis of variance.

Figure 7 shows the box and whisker plot representation of the data. Generally, it can infer that the students in the predominantly face-to-face group performed the worst among the four groups. The group in the flipped-classroom approach performed the best, followed by the hybridized traditional approach and the pure online class delivery. The means of all the data are also different; the worst performing student can be found in the hybrid predominantly face-to-face group with a score of 4/54, while the best performing student can be found in the hybridized flipped classroom who scored 54/54. The median of the scores also differ, and the interquartile range of each group differs from one another. Through the box and whisker plot represented. The author shows that the students in the hybridized flipped classroom perform more efficiently or better than the other groups. Hybridized flipped classroom performs about 20% better than hybridized traditional, 40% versus pure online traditional,

and way better than the predominantly face-to-face and traditional learning group. Based on the comparison of the approaches, the factors that affected the performance are how the professor kept the student engaged—constant communication and a more hospitable environment for the student. Compared with the traditional approach as applied in the other three sections (fully online, hybrid more face-to-face, and hybrid traditional), the flipped classroom approach addresses this concern more effectively, as discussed in the early part of this manuscript. The approach opens more possibilities in teaching and keeps students more engaged through various educational technology tools. Since less effort is needed in the classroom, this opens the opportunity for the teacher to be connected more to the students and address their concerns, thus promoting better student-teacher communication. Furthermore, good teacher-student communication builds trust making the student more comfortable with the teacher and further promoting determination to study. Remember that according to (Salandanan, 2012), an adequate learning space should characterize a warm and inviting atmosphere, be it physical or intangible, and the activities the educator gives will also affect how productive the classroom output will be (Salandanan, 2012).

3.7 Pros and Cons of Hybridized Flipped Classroom

Table 1 provides the author's experience in implementing the flipped classroom approach.

Table 1: Pros and Cons of Hybridized Flipped Classroom

Pros	Cons
Keeps students engaged	Preparations are way more difficult compared with preparation in a traditional classroom approach
More student-teacher communication	This may involve more investment in other LMS tools other than those provided by the institution that is capable of making the activity engaging.
More opportunities for student self-discovery	Health issues for some practitioners since some instructors might need to stay up late at night to finish the activity for the next day if the preparations hadn't been created for the term or may need to be updated.
A more relaxed classroom atmosphere, making learning fun.	Some students might procrastinate if no deadlines are immediately given.
It makes the teacher do other preparations effectively if the preparation is already developed.	Aside from investment in LMS tools, it also requires investment in other tools necessary for delivering the lectures, such as licensed software, better multimedia tools, and the like.

4. Tools Used by the Author

The author used the following tools to effectively deliver the flipped classroom approach: Kahoot Premium Plus, Quizzily, Quizlet, Instructure Canvas LMS, Panopto, Vimeo, Youtube, and Zoom Online Meeting.

5. Future Directives of the Research

The author sees the research directive that, in the future, through advocacy and research backed by statistics, will encourage engineering and technology educators to try the same. Though the approach is a double edge sword, it can be a game changer, especially if more engineering and technology educators are aware of the other classroom teaching approach, such as the flipped classroom approach. As more web application LMS tools are developed, this further opens the possibility to more effectively and efficiently implement the approach that makes the engineering or technology educator create preparations effectively and further reduces the cons, as shown in Table 1. Though it might still be challenging since preparations in flipped classroom approach should be more detailed and must promote self-discovery to the student.

6. Conclusion

Through the study and the data, the author concludes that with the use of the necessary LMS tools, flipped classroom approach is more effective compared with other learning methods. It can be made possible if the preparations are carefully created and the practitioner invests in the necessary tools for the approach, such as Kahoot premium plus. Though more effective in the delivery of the lectures, flipped classroom approach might cause health issues for the practitioner, especially if there is a need to rush the work and there is a time constraint. Furthermore, in flipped classroom approach, the practitioner must detail the instructions to the students more efficiently so that students can immediately grasp the instructions as desired by the instructor/educator. Educators must also set deadlines to prevent students from procrastinating. And even though it can be concluded that flipped classroom approach can be expensive and might cost the educator's effort. Flipped classroom approach makes the student more engaged, promotes better student-teacher communication, enables student self-discovery, and provides a more relaxed classroom atmosphere, making learning fun. Also, through the data gathered statistically and by implementing the approach in 4 sections, the teaching approach is statistically proven that applying the flipped classroom approach is effective in classroom delivery, having analyzed by the author through the use of ANOVA and box and whisker plot representation.

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