Measurement of the performance of the inverted classroom methodology in the finance learning environment: A comparison with the traditional class

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Abstract. The inverted class or Flipped Classroom teaching methodology that proposes that the work of certain learning processes be transferred out of the classroom, that is to say that the students prepare the subjects outside the alma mater, through the use of information and communication technologies (TIC) and uses time in the classroom to carry out activities that require greater participation and student - teacher interaction, to debate ideas and development of constructs and mindfacts appropriate to generational change, management that is sustained with the support of new technologies; In conclusion, the method under study reverses the activities that are normally done in classes, with the activities that are done at home, that is, the technique proposes a change of paradigm more adjusted to the current realities of teaching. In order to demonstrate the potential of the Inverted Class proposal, the professors participating in this research reviewed in depth the results achieved with the application of this technique within the subject Capital Market pertaining to the degree of Business Administration and the financial area specifically to compare the results; To obtain the corresponding metrics, a perception measurement was displayed to students of two cohorts for the year 2017, distributed in 4 rooms per semester, and an average of 25 students per class, for a total of 212 students participating in the methodology belonging to the schools of economic and accounting administrative sciences of the private Universities of the region, where the technique object of study was applied and orienting others under the traditional system of education. This was elaborated in light of the case research approach, abstracting the results through the use of qualitative and quantitative methods, obtaining empirical evidence in the significant improvement of the students in terms of results and appropriation of competences, with an increase in the participation of students, and a strong orientation with discipline to the management of tasks and the research component, through interaction with technological tools placed at the service of pedagogy.

1. Introduction

With the technological advances achieved by society, it is a place that does not have an education can’t be excluded, which is why it must be adjusted to the changes that day by day in the world in life, elements such as information Communication and work styles have been changes in the transformative form for the 21st century [1]. By linking technology to learning processes, the symbiosis that can be used to take advantage of learning environments. The relationship between technology and the teaching-learning
processes is not to share the new one, and these have been evolving and strengthening the academic processes.

The inverted class has been used as a strategy in the experiences developed within subjects of the branch of economic sciences [2], through the use of technology as support in the learning processes in the classroom. Another thing that can be rescued in the genesis of methodologies supported by technology was developed by North American chemistry professors from Woodland Park School in Colorado, to whom the scientific community is endorsed by the consolidation of the term Inverted Classroom [3]. This is a pedagogical approach in which "direct instruction moves from the collective learning space to the individual learning space, and the resulting space is transformed into a dynamic and interactive learning environment in which the educator guides the students learn in the subject" [4], it is also indicated that the technique is about a didactic model in which students learn new content through online video tutorials, usually at home [5] what used to be "duties" (assigned tasks), are now carried out in the classroom with the teacher, the tracking of the evidences, the samples of the technology of the technological tools, the teaching process, the teachers, the help, the task of the students, the learning processes, the best assignment of competences to achieve the dynamics of this methodology, it is necessary, in addition, of a student, in an efficient way, a commitment, and in any other way, be the builder of their own learning, what can be introjected and then what is multiplied and/or integrated into their context or reality. Likewise, [6,7] agree that the inverted classroom technique considers the delivery of content including video conferences, to be reviewed outside the classroom, focusing class time in the development of exercises and applications in class, and that from his observations is an innovative method to create improvements in student learning.

In order to achieve the above, the commitment of all those involved in the educational process is necessary, demanding from them a competence not only in what is particularly socialized in the classroom, but also competence in the use of technological tools such as multimedia resources of learning, Virtual Learning Objects (OVAs), online discussion forums, and other instruments and tools available for this purpose that support said strategy; added to this is the development of strategies, construction and preparation of material aligned to what is necessary for the student, then this methodology reverses traditional models in the teaching-learning process, facilitating online work patterns from outside the classroom and moving certain tasks within the class [8].

There is little research done in the field of finance regarding the teaching methodology to be developed with the students and even more, when we have ICTs in mind to favor an approach of the contents in a more current way, so the Flipped Classroom or inverted class we consider it an adequate method to favor this learning and the results of research with this form of learning made in other areas of knowledge indicate that (see Table 1):

| Research                                      | Results                                                                 |
|-----------------------------------------------|-------------------------------------------------------------------------|
| Opazo, Acuña y Rojas (2016)                   | Increase of 5% of grades, greater autonomy in learning, more participation and solving doubts |
| Díaz, Martín y Sánchez (2017)                  | Higher learning outcomes, increased student motivation, acquisition of generic and specific skills |
| Hinojo, Mingorance, Trujillo, Aznar y Cáceres (2018) | Greater performance, more involvement in the subject and, consequently, less university dropout. |

In [9] the impact of the flipped classroom methodology on the learning outcomes of (28) students was evaluated, comparing them with the previous cohort of (56) students who had experienced a traditional methodology. Using the application with a pretest and posttest measure, the learning gain was calculated observing the results shown in Table 1. Another investigation in which the efficiency of the flipped classroom methodology was observed was developed in the discipline of Operations Management, where a control group (136 students) and an experimental group (65 students) were taken applying a pretest and posttest to compare both groups. The results obtained also reflected the importance of using this tool [10]. The research developed by Hinojo, Mingorance, Trujillo, Aznar and...
Cáceres, aimed to analyze if there are significant differences in academic performance and if attendance improves, depending on the methodology used in the overall teaching-learning process, with the paradigm of the intervention change, in which the main axis is centered on the student, that is, to know if the flipped classroom methodology improved academic performance [11]. For this study, an empirical-analytical research was implemented, with quasi-experimental groups of two groups of future physical education teachers, with a sample of 131 students. Finally, after the implementation of the different sessions, it is found in the results that the experimental group increased its ratings with respect to those that followed a traditional methodology.

For all the above, we can define a definition of Flipped Classroom or inverted class as an active learning method centered on the student, which allows the teacher to turn the classroom into a place to solve problems, advance concepts and participate in collaborative learning [10].

Exposed the spectrum and the implication of the formative process, and the use of technology, so that said process is more in accord with the times of today, the present investigation was oriented to investigate and to specify the perception of the university students of the city of Bucaramanga about the experience and / or experience they have had with the subject of the inverted classroom, an activity that was developed to greatly facilitate the appropriation of knowledge online, based on projects for the Capital Market subject, taught at Universidad Pontificia Bolivariana (UPB) and Universidad Santo Tomás de Aquino (USTA) of the city of Bucaramanga, Colombia.

The proposal made the main objective of improving the quality of teaching and the efficiency of learning, to deploy and observe the performance in each of the two semesters of the year 2017. For this research, there was a participation of 402 students and 212 of them were instructed under the inverted class methodology. To observe the results of this work, mixed research methods were used, instruments necessary to explain and understand the perception of students in reference to the teaching strategy under study. The results show a significant improvement in students'

2. Methodology
Each semester, the Capital Market class (which has 3 credits) hosts an average of 26 students, divided into 2 groups per semester in each university (4 groups per semester between the two institutions) which must be attended by the orientation teacher of the subject. The course presents requirements for the approval of other subjects in the area of finance necessary for the development of the programmatic content of Capital Markets. The time of interaction in the classroom is 16 weeks, in which two competency checks are made by means of a partial exam and follow-up notes such as quiz and / or short or punctual controls of a specific topic and the use of cases of study for the learner to present his / her opinions with reference to the topic addressed.

The inverted classroom is feedback with ICT considering it a methodology based on them, since mainly their previous work is supported in the observation of short videos, basic presentations of the thematic axis to be treated. Through the use of OVA's fourteen products were prepared, recorded and edited with the content of the main theories necessary for teacher mediation. The videos have a time between 10 and 35 minutes, with an average of around 14 minutes. These support tools, with the thematic axes described in the curricular syllabus, are shared and consulted by the students, in the EDOOME free educational platform five days before the face-to-face activity, with the aim of generating a reflection space that potentializes the interaction of the student based mainly on the use of MS-Excel spreadsheets.

Teacher mediation begins with a short feedback of the thematic axis that has been socialized in the videos and the supporting material, and then one or several questions are shared for the students to address during the development of the class, generating enough time to clarify the doubts that arise in the self-taught, which allows to explore in depth the issues and objectives raised in the development of the chair. After granting a period of no more than 15 minutes in the preparation of the assignment, the
results obtained are discussed and the objective of teaching the class proper is discussed. It is fundamental that the self-learning component of the students is evidenced by the student's interaction based on their prior learning related to the virtual learning object that has been socialized, the tracking of these videos on this platform can’t be controlled since only Record the download of the video only once.

3. Results
For this study, a quasi-experimental design was implemented in two groups of students of the capital markets subject. A control group of 190 students who followed the traditional methodology and the experimental group 212 students who followed the Flipped classroom. To obtain the results, the techniques of the eclectic method of research were used, which aims to show the progress made by the students addressed with this dynamic, comparing two teaching environments traditional and inverted class. The evidences obtained are shown under the quasi-experimental structure implemented for the study, since of the four groups addressed per semester, two of them were applied, during 16 weeks of academic work in each semester of 2017, the treatment condition while at the other two do not.

To minimize the biases given by the quasi-experimental technique, rooted in the issue of randomness of the units and treatments, the activity is carried out using all the thematic axes described in the syllabus curricula, and in the same way the evaluation instruments as it was quiz, case of studies and partial exams, given in two moments of each academic semester. With these instruments it was possible to assess the efficiency and effectiveness of the inverted class method by observing the cumulative results achieved; these quantitative metrics were potentiated with qualitative metrics obtained from the answers provided in the completion of the structured tool questionnaire for this purpose.

The evidences were observed through scales such as student cohesion, innovation and academic performance. These three domains were analyzed by means of an instrument applied electronically and anonymously, which yielded a p. valued (p<0.05). The consistency of the instrument is validated with the alpha coefficient of Crom Bach. The 212 participating students completed the survey where each respondent considered the three stages indicated above to provide their corresponding assessments and answers. The general reading of the exercise is considered to be well aligned with the quantitative results. The survey consists of a series of different questions about the course under study, the general learning environment, etc.

To validate the scope of the methodology, the application of a questionnaire was considered in order to obtain the insights and experiences of the participating students with the methodology proposed for this purpose. The questionnaire was answered by 212 participants (men: 57%, age: 20.6±4.13 years and 43% women, age 21.5±4.10 years). The overall score of the exercise and that of its variables were very outstanding with the inverted classroom strategy, with which the technique shows the positive impact of the same in this subject (see Table 2).

| Table 2. Observed and expected frequencies regarding the updated contents. |
|----------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Calcification                    | Frequencies Observed |                 |                 | Frequencies Expected |                 |                 |                 |
|                                 | Students | Professional | Total | Students | Professional | Total |                 |
| 1 - Totally disagree            | 0       | 4            | 4     | 0.57     | 3.43        | 4     |                 |
| 2 - In disagreement             | 2       | 7            | 9     | 1.27     | 7.73        | 14    |                 |
| 3 - Agree                       | 20      | 117          | 137   | 19.39    | 117.61      | 99    |                 |
| 4 - Totally agree               | 8       | 54           | 62    | 8.77     | 182         | 95    |                 |
| Total                           | 30      | 182          | 212   | 30       | 182         | 212   |                 |

With respect to statistical inference, a non-parametric statistical analysis procedure was applied, such as the Pearson Chi-square test, for independent samples. The purpose of using this statistic was of statistically significant differences between the students participating in the measurement of the technique and the traditional model in terms of the scale of self-perception of initial learning. To measure the statistically significant differences, a level of confidence (1-α) in 95% and alpha (α) of 5% were
considered (see Table 3). For the subject of innovation, the question evaluated was: do you consider that the contents to be studied may be more current if the ICT resources are used as support for the methodology followed in class?

Table 3. Statistics used.

| Calculated Chi | Tabulated Chi | Degrees of Lib. | P - value | Valid Cases |
|----------------|--------------|-----------------|----------|-------------|
| 0.000          | 7.815        | 3               | 0.000    | 212         |

On the other hand, to clarify the students' self-perception regarding the contents, the following question was asked: Do you consider that a change in the traditional methodology can influence your academic performance? Applying the same statistical process, with a level of significance of 5% (0.05), which resulted, as a result, a test statistic \( \chi^2 = 0.00 \), that is, that the hypothesis that there are significant differences between the students linked to the investigative process. It is concluded that there is no difference between the opinions of the groups studied, the former obtains its virtue in the result of the statistic \( p-value=0.000 \), evidence that the \( H_0 \), is rejected (see Table 4 and Table 5).

Table 4. Perception of methodology and the impact on academic performance.

| Calculation          | Frequencies Observed | Expected Frequencies |          |
|----------------------|----------------------|----------------------|----------|
|                      | Students | Professional | Total | Students | Professional | Total |
| 1 - Totally disagree | 0       | 4           | 4     | 0.57     | 3.43         | 4     |
| 2 - In disagreement  | 2       | 12          | 14    | 1.98     | 12.02        | 14    |
| 3 - Agree            | 9       | 90          | 95    | 14.01    | 84.99        | 99    |
| 4 - Totally agree    | 19      | 76          | 95    | 13.44    | 81.56        | 95    |
| Total                | 30      | 182         | 212   | 30       | 182          | 212   |

Table 5. Statistics used.

| Calculated Chi | Tabulated Chi | Degrees of Lib. | P - value | Valid Cases |
|----------------|--------------|-----------------|----------|-------------|
| 0.000          | 7.815        | 3               | 0.000    | 212         |

For the third stage under analysis, the following question is asked: Do you consider that a change in the traditional methodology can influence your content retention, being this better and more lasting? Like the previous two, a level of significance of 5% (0.05) was taken, resulting in a test statistic \( \chi^2 = 0.00 \), that is, the hypothesis that there are significant differences between the groups is rejected. Object of study. It is concluded that there is no difference between the opinions of both students with the inverted class treatment and students oriented with traditional methodology, the above is demonstrated by the revision of the \( p \)-value which yields a result of 0.000, evidence that the \( H_0 \), it is rejected (see Table 6 and Table 7).

Table 6. Change of methodology and content retention.

| Calculation          | Frequencies Observed | Expected Frequencies |          |
|----------------------|----------------------|----------------------|----------|
|                      | Students | Professional | Total | Students | Professional | Total |
| 1 - Totally disagree | 0       | 4           | 4     | 0.57     | 3.43         | 4     |
| 2 - In disagreement  | 2       | 16          | 18    | 2.55     | 15.45        | 18    |
| 3 - Agree            | 14      | 91          | 105   | 14.86    | 90.14        | 105   |
| 4 - Totally agree    | 14      | 71          | 85    | 12.03    | 72.97        | 85    |
| Total                | 30      | 182         | 212   | 30       | 182          | 212   |

Table 7. Statistics used.

| Calculated Chi | Tabulated Chi | Degrees of Lib. | P - value | Valid Cases |
|----------------|--------------|-----------------|----------|-------------|
| 0.000          | 7.815        | 3               | 0.000    | 212         |
Regarding the perception of the change of methodology and content retention, developed this stage with a level of significance of 5% (0.05), delivered as a result, a test statistic $\text{Chi}^2 = 0.00$ that is, rejects the hypothesis that there are significant differences between the study groups. It is concluded that there is no difference between the opinions of both graduates and employees; a p-value = 0.000, evidence that the $H_a$ is rejected.

In addition to the process of statistical inference, and to demonstrate the benefits that arose from the application of the methodology of the class invested in the development of the Capital Market subject, in Table 8 and Table 9 the notes reached in each of the participating groups, which is presented below.

### Table 8. Numerical results of the tests applied to the capital market matter first half 2017.

| Measuring Instrument          | Inverted class students | Students traditional method |
|------------------------------|-------------------------|-----------------------------|
|                              | State                   | Q student | %  | Average score | Q student | %  | Average score |
| Quiz total                   | Approved                | 48        | 47 | 4.2          | 32        | 30 | 3.9          |
|                             | Reprobate               | 55        | 53 | 2.8          | 73        | 70 | 2.5          |
|                             |                         | 103       |    |              | 105       |    |              |
| Study cases total           | Approved                | 49        | 48 | 4.4          | 45        | 43 | 4.1          |
|                             | Reprobate               | 54        | 52 | 2.7          | 60        | 57 | 2.6          |
|                             |                         | 103       |    |              | 105       |    |              |
| 1st cut evaluation total    | Approved                | 50        | 49 | 4.0          | 40        | 38 | 3.6          |
|                             | Reprobate               | 53        | 51 | 2.7          | 65        | 62 | 2.2          |
|                             |                         | 103       |    |              | 105       |    |              |
| 2nd court evaluation total  | Approved                | 51        | 50 | 4.1          | 41        | 39 | 3.7          |
|                             | Reprobate               | 52        | 50 | 2.8          | 64        | 61 | 2.3          |
|                             |                         | 103       |    |              | 105       |    |              |

### Table 9. Numerical results of the tests applied to the capital market matter second semester 2017.

| Measuring Instrument          | Inverted class students | Students traditional method |
|------------------------------|-------------------------|-----------------------------|
|                              | State                   | Q student | %  | Average score | Q student | %  | Average score |
| Quiz total                   | Approved                | 47        | 43 | 4.3          | 33        | 39 | 3.8          |
|                             | Reprobate               | 62        | 57 | 2.8          | 52        | 61 | 2.5          |
|                             |                         | 109       |    |              | 85        |    |              |
| Study cases Total           | Approved                | 47        | 43 | 4.4          | 46        | 54 | 4.2          |
|                             | Reprobate               | 62        | 57 | 2.8          | 39        | 46 | 2.8          |
|                             |                         | 109       |    |              | 85        |    |              |
| 1st cut evaluation total    | Approved                | 47        | 43 | 4.4          | 39        | 46 | 3.8          |
|                             | Reprobate               | 62        | 57 | 2.8          | 46        | 54 | 2.3          |
|                             |                         | 109       |    |              | 85        |    |              |
| 2nd court evaluation total  | Approved                | 49        | 45 | 4.5          | 38        | 45 | 3.8          |
|                             | Reprobate               | 60        | 55 | 2.8          | 47        | 55 | 2.4          |
|                             |                         | 109       |    |              | 85        |    |              |

The previous table shows a significant improvement with the class methodology invested in each and every one of the instruments used for the measurement of competencies, where the rating of 5.0 would be the highest rating and 0.0 the lowest, the data have relative consistency by those found in [12] and [10].
4. Conclusions
Among the most representative findings, it is evident that in the results obtained by the students of the inverted class, the grades obtained in the four measurement stages (quiz, jobs and exams) are higher in reference to the students assisted by the traditional class. Now, in terms of the perception that students apply in three scenarios, it is evident that there are no significant disagreement results among the perceptions of the groups studied, arriving to a large extent to say that the application of this technique brings significant learning for the potential professionals.

References
[1] Niess M 2005 *J. Edu. Technol. Soc.* 21(5) 89-100
[2] Lage M, Platt G and Treglia M 2000 *J. Eco. Edu.* 31(1) 30-43
[3] Bergmann J and Sams A 2012 *Flip your classroom: Reach every student in every class every day* (Washington: ISTE)
[4] Bergmann J and Sams A 2014 *Training & Development* 68(2) 28-31
[5] Tourón J and Santiago R 2015 *Rev. Edu.* 368 196-231
[6] Deslauriers L, Schelew E and Wieman C 2011 *Science* 332(6031) 862–864
[7] Mason G, Shuman T and Cook K 2013 *IEEE Trans. on Edu.* 56(4) 430-435
[8] Barreras M 2016 *Educatio Siglo XXI* 34(1) 173-196
[9] Opazo A, Acuña J and Rojas M 2016 *Innoeduca* 2(2) 90-99
[10] Díaz E, Martín M and Sánchez J 2017 *Working Papers on Operations Management* 8(S.1) 15-18
[11] Hinojo F, Mingorance A, Trujillo J, Aznar I and Cáceres M 2018 *Sustainability* 10(5) 1334
[12] Baepler P, Walker J, and Driessen M, 2014 *Computers & Education* 78 227-236