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COMPARATIVE STUDY BETWEEN THE FLIPPED CLASSROOM METHODOLOGY AND THE TRADITIONAL METHODOLOGY IN SPANISH, ENGLISH AND MATHEMATICS CLASSES

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Abstract. The presence of new developments of technologies in the educational field requires an intensive intervention and adaptation toward the use of methodologies related to information technologies and communications (TICs) that contribute to the improvement of the students' academic performance. The objective of this article is to verify if there was a favorable impact on school performance with the use of the Inverted Classroom methodology in comparison with the use of the traditional methodology for the students of the ninth and tenth grade levels in the Spanish, English and Mathematics courses. On the other hand, in addition to goal was to offer a brief description of the concept of the Flipped Classroom with the review of some contributions derived from researchers as input for the students as well as the teachers. This study was of quantitative origin and with a quasi-experimental design. The sample was of 116 students divided into control group (65 students) and experimental group (51 students) of each subject. As an independent variable, the instruments applied were a pre-post test of academic achievement of each unit and the measurement of the results were analized using thet-Test statistical analysis system to verify its reliability. For the stadistical analysis, the IBM version 22 aplication was used. With respect to the results obtained, no statistically significant difference was observed between the pre-post tests before the experimental groups and control groups reasons that will be made known in the discussion and conclusion of the text. I have never seen this in a summary, it is normal to put them here.

Keywords: Technology, flipped classroom methodology, academic performance.

ESTUDIO COMPARATIVO ENTRE METODOLOGÍA DE AULA INVERTIDA Y METODOLOGÍA TRADICIONAL EN CLASES DE ESPAÑOL, INGLÉS Y MATEMÁTICAS

Resumen. La presencia de nuevos avances tecnológicos en el ámbito educativo, exigen una intensa intervención y adaptación hacia el uso de metodologías relacionadas con las tecnologías de la información y las comunicaciones (TICs) que contribuyan al mejoramiento del rendimiento académico de los estudiantes. El objetivo de este artículo fue comprobar si existió un impacto favorable en el rendimiento escolar con el uso de la metodología de Aula Invertida en comparación con el uso de la metodología tradicional en los estudiantes de los niveles noveno y décimo grado en los cursos de español, inglés y matemáticas. Por otro lado, también se intentó dar una breve descripción del concepto de Aula invertida con la revisión de algunas aportaciones de investigadores como aporte hacia el estudiante y al profesorado. Este estudio es de corte cuantitativo y con un diseño cuasi-experimental. La muestra fue de 116 estudiantes y se dividió en grupo control (grupos de 65 estudiantes) y grupo experimental (grupos de 51 estudiantes) de cada asignatura con un total de 116 estudiantes. Como variable independiente, los instrumentos aplicados fueron sobre el rendimiento académico de cada unidad (pruebas pre-post), cuyos resultados fueron analizados utilizando la prueba estadística t de Student para comprobar su fiabilidad. Para el análisis estadístico se utilizó la aplicación IBM SPSS Versión 22. Con respecto a los resultados obtenidos, no se observó una diferencia estadísticamente significativa entre las pruebas pre-post entre los grupos experimental y grupos control, motivos que se darán a conocer dentro de la discusión y conclusión del texto. Nunca he visto esto en un resumen, lo normal es que las pongan aquí.

Palabras claves: Tecnología, metodología de aula inversa, rendimiento escolar.

Introduction

Within this new society of technological developments, educational institutions face a continuous challenge and find themselves in an ongoing transformation. The new didactic rooms have been reflected in virtual learning centers. However, in these new environments, a higher reflection towards the use and incorporation of new technologies is necessary, where a critical integration of the what, why and for the what of its incorporation and use is formulated in order to obtain such skills as knowing how to read, write and create texts in multimedia formats, and knowing how to select, classify, process and transmit information integrated in multimedia formats in an oral, written, iconic and audiovisual manner (Cabero, 2007; Perez and Rodriguez, 2008; Bernete, 2009).

Today, with so many technological developments, routine and rote learning classes do not take advantage of the student's potential. Instead, teaching styles where students address problems both individually or in groups, where projects are used, and teachers start critical discussions by posing demanding questions to think analytically, are the tools in the teachers' hands to develop the student's intellectual capacity (García, 2005).

For students to successfully carry out their studies within the teaching-learning process, they must develop those specific skills that create learning strategies and techniques, among other type of complex cognitive mechanisms. In other words, to carry

out the different study tasks, the student must effectively acquire, process, retrieve and transfer information. In this way, the application of new learning strategies is of great help (Maquilón and Hernández, 2011).

Nowadays, classrooms have the tendency of becoming intermediate classrooms, also known as intelligent classrooms, because of the software they use to acquire, process and distribute information and knowledge in multimedia formats (written, graphic and video text, among others). Here, learning works as authentic learning laboratories (Andión, 2011).

In today's society, students do not need to be merely limited to a pre-stipulated curricular content that follows the traditional methodology (explain, listen, examine and point out), but must face a series of situations that used to happen less often. Some of these situations are the multiculturalism to which they are confronted, the interpretation of information, the capacity to work in groups or adapting to constant changes. All of them are linked to the need to develop creativity and follow the goal of educating reflective, critical and participative students, capable of solving the different situations that they must face in their daily life in a rational and reflective way (Achútegui, 2014).

The Concept of Flipped Classroom

The term Flipped Classroom is an approach attributed to professors Jonathan Bergmann and Aaron Sams.

Both Bergmann and Sams graduated from Biola University of Colorado in 2006 and both began teaching in *Woodland Park High School in Woodland Park*, Colorado, a high school of 950 students.

When they started working together, they recorded narrated PowerPoint content and distributed their lectures to help those students who missed their classes for whatever reason. They eventually realized that this system did not only help said students, but also those student's general study, thus managing to meet each one of their learning needs (Fortanet, González, Mira & López, 2013; García-Barrera, 2013; Tourón & Santiago, 2015; Bergmann & Sams, 2012).

Flipped Classroom, as its name suggests, enables the reversal of the traditional, face-to-face way of understanding, assimilating and comprehending theoretical content, switching to an education and support found outside of the classroom by means of diverse digital tools - materials created by the teacher and published online, written blogs, audio or video recordings (podcasts, videocasts, videoblogs, social media, etc.) or, simply, the Internet. Through this process, the student sets a level of reinforcement and understanding from within their own home, as a provider of knowledge that helps and guides the student during their competence acquisition. In this way, in-classroom time remains devoted to carrying out activities such as practical exercises, assignments, problem solving and/or questions, debates, small or large group work, which enables the student's peer assessment and self-assessment through cooperative learning (Fortanet et al., 2013; García-Barrera, 2013).

Flipped classroom switches the student's and teacher's roles. Educational acquisition is now conducted autonomously by the student and at the student's own pace based on the proposed teaching materials. The teaching staff consists, on one side, of the

design of activities, both for previous study and for classroom execution by using different techniques that fosters the student's active and cooperative learning; on the other hand, it consists of providing and conducting the teaching-learning process. In this way, the teaching staff's in-classroom activity with the students is enhanced, since general and specific competences, which are worked in tandem in this case, are difficult to achieve in a virtual context (Jordán, Pérez & Sanabria, 2014).

Being able to design activities, materials and lessons with ease for their contextual out-of-school use opens new opportunities for the students to adapt to the specific educational abilities, features, interests and needs that can appear for each student during their learning process. In this respect, flipping the classroom is a straightforward methodology that allows us to devote more time to assist the diversity existing in our classrooms, thus understanding the individual and interdividual differences of our students. Every student is different and have their own characteristics, abilities, competences, interests, motivations, previous knowledge, ideas and ideals, goals, dreams and learning styles (García-Barrera, 2013).

Another advantage, derived from the flipped method, is that the flipped classroom enables us to harness the time that the teaching staff usually devotes to creating classroom materials. The teacher can provide more customized attention to each student's needs to establish different learning itineraries according to the student's knowledge and abilities, provide different materials to each one, assign reasonable difficulty content or design different activities depending on their interests. Likewise, a flipped classroom could contribute in making the teaching staff's an individual or isolated one, as it can encourage collaborative work between teachers when implementing sessions, designing materials or exchanging activities, lessons and educational experiences (Tourón and Santiago, 2015).

Concerning the family, the flipped classroom pedagogical method enables collaborative transformation at home and makes participants of families by creating a bond and family engagement with their children. (García-Barrera, 2013).

The teacher, together with the parents, can diagnose the problem of their children when it comes to learning, together searching for the best interventions that can be implemented to achieve an effective and functional learning (Achútegui, 2014).

According to Jordán, Pérez and Sanabria (2014), the success of the flipped classroom depends on many factors, mainly because it requires the student´s direct and continuous collaboration, which is not always easy to achieve. Therefore, it is important to motivate them by clearly explaining the advantages that this methodology offers, showing them that, through their participation, the result will be more satisfactory, and the work done during the course will be more productive.

The 5 Main Components of a Flipped Classroom According to Bergmann and Sams (2012)

The flipped classroom sounds exhausting and we may think that it is too much work. Let´s describe this and identify the necessary relevant keys to make a flipped classroom work masterfully. There are 5 main components that should be known before starting the methodology, which are:

1.- Establishing clear learning objectives. That these objectives and outcomes be the ones desired by each student. Using state standards, national frameworks and your best professional judgment to determinate what you want your students to know and be able to do.

2.- Determining which of these objectives best achieves the goals and how you can apply direct and clear instructions to be better received. Creating a video that clearly shows our objectives. You need to have produced your own videos or use found others that will teach the content and the way you want to teach it. Remembering that, over time, teachers are increasingly implementing some kind of flipped classroom. Many of these teachers are making their videos available through the Internet, so that you do not need to produce your own videos.

3.- Ensuring the students access to the videos. When you have made or chosen a video, you need to make sure that your students have access to them. There are a variety of ways in which this can be done, such as posting a video online, keeping a file in the school server, and recording files on DVD. If the school has a technology department, working with them will be essential for it to work and seeing what will work best for your situation.

4.- Incorporating the learning activities that will be carried out in class. A packet of activities should be made for each unit, containing a follow-up of notes for both the videos and the experiments that the students will carry out, as well as all the suggested worksheets.

5.- Creating several types of evaluation material for the student to demonstrate their mastery in each learning objective, within each particular unit of study. This is more efficient and effective through the use of an evaluation system bank via a computer and test system. Moodle is one of the platforms that can be used to create and manage tests.

Methodology

One of the main reasons that motivated the researcher to carry out this study was to provide an alternative innovative technological methodology with the aim of improving the students' performance, facilitating their implication and motivation in the secondary school.

This study used a quantitative approach, supported by a quasi-experimental design.

As an independent variable, the flipped classroom teaching methodology was applied to the experimental group in the subjects of Spanish, English and mathematics. Within this dynamic, different communication methods facilitated by the use of ICTs were applied, such as: videos, electronic libraries, PowerPoint presentations, didactic web pages, Edmodo's virtual platform, and the ShowMe system to create virtual videos on the subject to be studied; resources that through their introduction, helped to reinforce and support learning.

The analysis of this variable, on the one hand, tried to identify if there was an academic improvement with the use of ICTs and the Flipped Classroom Methodology with

new didactic methodological strategies for a greater acquisition of knowledge and learning about students.

On the other hand, the academic performance was measured as a dependent variable, through the of academic tests before and after each unit (pre-tests and post-tests). This type of treatment was applied to the control and experimental groups in each study unit.

Similarly, a process of continuous and direct interaction between the researcher, the teaching staff and the students was carried out, which allowed for a systematic view of the individual and collaborative study phenomenon to be carried out immediately.

The sample taken from the population consisted of 116 students, representing 28.4% of the sample studied. 51 students (44%) comprised the experimental group (flipped classroom) and 65 students (56%), constituted the control group (traditional education) of this sample.

The selection criteria carried out in this research were that the intentional selection of the participants belonged to the same class levels (9th grade, 11th grade) and that both control and experimental classes were the same (Spanish 202 (Spanish level 2, English 406 (American Literature for level 2), Mathematics 201, (Geometry 1 for level 2). In the same way, students from the same educational institution were chosen, with both the teaching staff's and the students' participation being voluntary.

The groups were composed randomly in the following way: the third-year Spanish course at the secondary school had 21 students (18%). They comprised the experimental group which participated in the flipped classroom methodology, and 22 students (19%) comprised the control group, with a face-to-face class participation. In addition, the third-year English course was composed of 17 students (15%), who were the experimental group, with 25 students (22%) being the control group. Finally, the second-year Mathematics course was composed of 13 students (11%), who were the experimental group, with 18 students (16%) being the control group.

The experimental groups were given a short introduction with the students being explained why the teachers would apply the inverted methodology for two months as a test, and how the benefits of this innovative learning system would contribute to their performance improvement and, therefore, to their educational capacity. They were also informed that participation was voluntary.

Regarding the academic performance variable, Student t-test was applied for independent samples. The "t-test" is a statistical test to evaluate whether if two groups differ significantly from each other regarding their average score. For this purpose, hypotheses $H_0 1$ and $H_1 1$ were applied to contrast these hypotheses and to detect differences in the variables of the two groups.

Research Procedure

The research procedure phase lasted 10 weeks. It began on the 5 October 2016 and ended on the 15 December 2016.

Concerning the technological tools used in the classrooms, both teachers and students had access to the Internet, image projectors and a sound device for Apple TV.

Students were allowed to use smartphones, iPads and tablets during the required activities. In addition to that, each teacher had a laptop.

In the experimental classes, before beginning with the lessons, the teachers, in order to accredit the students' understanding, provided one or two orientation classes regarding the advantages of the flipped classroom methodology and the use of the Edmodo platform. During these classes, the students expressed their concerns and questions in general.

At the beginning of most of the classes, there was a reflection and general revision of the material exposed in the virtual platforms as a task, to be able to visualize the knowledge and the student's own learning with the sole purpose of being shared in class.

Regarding educational and technological tools, they used posters, the Internet, videos, a video projector, a computer, an iPad and an Apple TV.

As for the mechanisms applied in flipped classrooms, in order for the students to develop critical thinking, the acquisition of new concepts, autonomy, responsibility and learning skills, the Spanish, English and Mathematics teachers followed the procedure of incorporating educational videos created by them, and materials extracted from the Internet. To create a video, the teacher required between 1 or 2 hours, and each attached video lasted approximately between 7 and 12 minutes. These videos were displayed in a virtual platform (Edmodo and some web pages), in which readings, exercises, schedules and days for mentoring and tutoring were included.

Besides that, the teachers used Google Drive and Show Me to create audiovisual materials and upload the videos to Edmodo.

Additionally, the teaching staff employed interactive tech-based games similar to the game show "Jeopardy" as extracurricular activities.

Results

In this section, we analyzed the results obtained from the data collection of the designed instruments (pre and post-academic tests) that were carried out both at the beginning and at the end of each unit.

The main objective was to determine the effect of the flipped classroom methodology on student performance and to respond to the hypotheses $H_0 1$ and $H_1 1$ from the research based on the teaching-learning applied to control groups (traditional teaching) and the experimental groups (flipped classroom methodology) in the Spanish, English and Mathematics subjects. For said purpose, t-test based analyses were performed for independent samples.

Analysis were processed by means of the IBM, SPSS statistic program (version 22). The dependent variable was the academic achievement of the students in the Spanish, English and Mathematic courses. The independent variables were the traditional instruction methodologies and the flipped classroom instruction.

Hypotheses Formulated in the Study

The hypothesis formulated in this research guided the study to determine whether the results established a significant improvement or a significant impact on student academic achievement.

$H_0$1: There were no significant statistical differences in the average academic achievement between those students of Spanish, English and Mathematics who studied under the Flipped Classroom educational methodology against the group that studied under the Traditional Methodology.

$H_1$1: There were significant statistical; differences in the average academic achievements between those students of Spanish, English and Mathematic who studied under the Flipped Classroom educational methodology against the group that studied under the Traditional Methodology.

Results of academic performance improvement using comparisons between pre-post tests and related demonstrations.

Through Student t-test from independent samples, the differences between the pre-post tests for each group of flipped classroom instructions, and the traditional methodology class, were calculated in the two instructional modules for the subjects of Spanish, English and Mathematics. The results of the pre-post academic test from independent samples are reflected in the following results.

A Student t-test of related samples was conducted for the English subject (see Table 1) for students of the inverted instruction group. According to the results, no statistically significant difference was observed between the pre-test ($\bar{X}$= 17.15) and the post-test ($\bar{X}$ = 26.67) in module #1, t = -6.58, p < .001, this implies that that there is a statistically significant difference. There was an improvement in academic achievement. A similar situation was observed for the inverted instruction module #2 between the pre-test ($\bar{X}$ = 5.81) and the post-test ($\bar{X}$ = 41.67) for the instructional module #2 average. The results were significantly different, t = -14.41, p < .001, indicating that there is a significant difference between the ones who received the inverse methodology and the ones who learned with the traditional methodology.

Table 1
Spanish Class. Pre-Post Academic Tests (Flipped Classroom)

	n	$\bar{X}$	S	IC 95%	t	P
Module #1 Pre-Test	21	17.15	7.32			
Post-Test	21	26.67	4.48			
Difference		-9.52	6.63	(-12.54-6.51.)	-6.58	<001
Module #2 Pre-Test	21	5.81	6.04			
Post-Test	21	41.67	11.10			
Difference		35.86	11.40	(-41.05.-67.)	-14.41	<001

Note. n = Sample size; $\bar{X}$ = Average; S = Standard deviation; IC = Interval of confidence at 95% for the difference; t = Test statistic; p = Minimum probability for rejecting hypothesis H_0.

A Student t-test of related samples was conducted for the English subject (see Table 2) for students of the inverted instruction group. According to the results, no statistically significant difference was observed between the pre-test ($\bar{X}$ = 15.47) and the post-test ($\bar{X}$ = 16.29) in module #1, t = -1.72, $p < .11$, this implies that H_0 is not rejected and that there is no significant statistical difference. A similar situation was observed for the inverted instruction module #2 between the pre-test ($\bar{X}$ = 15.94) and the post-test ($\bar{X}$ = 16.29) for the instructional module #2 average. No statistically significant difference was observed. The difference between both averages were 0.82, t = -.82, $p = .42$, which means that H_0 is not rejected and that there is no significant statistical difference.

Table 2

English Class. Pre-Post Academic Tests (Flipped Classroom)

	n	$\bar{X}$	S	IC 95%	t	P
Module #1						
Pre-Test	17	15.47	1.28			
Post-Test	17	16.29	1.93			
Difference	16	-.82	1.98	(-1.84, .19)	-1.72	.11
Module #2						
Pre-Test	17	15.94	1.75			
Post-Test	17	16.29	1.90			
Difference	16	-.35	1.77	(-1.26, .56)	-.82	.42

Note. n = Sample size; $\bar{X}$ = Average; S = Standard deviation; IC = Interval of confidence at 95% for the difference; t = Test statistic; p = Minimum probability of rejecting hypothesis H_0.

A t-Student test for the related samples was carried out for the Mathematics subject (see Table 3) for the flipped classroom students. According to the results, no statistically significant difference between the pre-test ($\bar{X}$= 9.15) and the post-test ($\bar{X}$ = 11.00) in the module #1, t = -1.40, $p = .12$, was observed, meaning that H_0 is not rejected and that there is no significant statistical difference. However, in the instructional module #2, a statistically significant difference between the pre-test ($\bar{X}$ = 4.38) and the post-test was detected ($\bar{X}$ = 7.38). The difference between the averages was 3.00, t = -4.45, $p <.001$. This means that H_0 is turned down and that there is a significant statistical difference. H_1 is thus taken as being true. Only module 2 showed an improvement in academic achievement.

Table 3
Mathematics Class. Pre-Post Academic Tests (Flipped Classroom)

	n	$\bar{X}$	S	IC 95%	t	P
Module #1						
Pre-Test	13	9.15	3.98			
Post-Test	13	11.00	3.92			
Difference	12	-1.85	1.98	(-4.72, 1.03)	-1.40	.12
Module #2						
Pre-Test	13	4.38	2.10			
Post-Test	13	7.38	2.87			
Difference	12	-3.00	2.45	(-4.48, -1.52)	-4.45	< .001

Note. n = Sample size; $\bar{X}$ = Average; S = Standard deviation; IC = Interval of confidence at 95% for the difference; t = Test statistic; p = Minimum probability of rejecting hypothesis H_0.

A Student t-test for related samples was carried out for the Spanish subject (see Table 4) for the traditional classroom students. According to the results, a statistically significant difference between the pre-test ($\bar{X}$= 17.14) and the post-test ($\bar{X}$ = 29.00) in module # 1, t = -10.25, p< .001 was observed. This means that H_0 is rejected and that there is a statistically significant difference. H_1 is thus taken as being true. There was an improvement in the academic achievement. In the same way, a significant statistical difference between the pre-test ($\bar{X}$ = 6.82) and the post-test ($\bar{X}$ = 46.27), t = -21.38, p <.001 was revealed in the module #2. This means that H_0 is rejected and that there is a significant statistical difference. H_1 is thus taken as being true. There was an improvement in the academic achievement.

Table 4
Spanish Class. Pre-Post Academic Tests (Traditional Methodology)

	n	$\bar{X}$	S	IC 95%	t	P
Module #1						
Pre-Test	22	17.14	6.65			
Post-Test	22	29.00	6.12			
Difference		-11.86	5.43	(-14.27, -9.45)	-10.25	<.001
Module #2						
Pre-Test	22	6.82	5.07			
Post-Test	22	46.27	8.75			
Difference		-39.45	8.66	(-44.29, -35.61)	-21.38	< .001

Note. n = Sample size; $\bar{X}$ = Average; S = Standard deviation; IC = Interval of confidence at 95% for the difference; t = Test statistic; p = Minimum probability of rejecting hypothesis H_0.

A Student t-test of related samples was conducted for the English subject (see Table 5) for students of the traditional instruction group. According to the results, a statistically significant difference was observed between the pre-test ($\bar{X}$= 15.52) and the post-test ($\bar{X}$ = 17.60) in the module # 1, t = -9.03, p< .001. This implies that H_0 is rejected and that there is a statistically significant difference. H_1 is thus taken as being true. There was an

improvement in academic achievement. Likewise, in the instructional module #2, a statistically significant difference was detected between the pre-test ($\bar{X}$ = 15.52) and the post-test ($\bar{X}$ = 16.48). The difference between the average values was 3.00, t = -2.01, p = .003. This implies that H_0 is rejected and that there is a statistically significant difference. H_1 is thus taken as being true. There was an improvement in academic achievement.

Table 5
English Class. Pre-Post Academic Tests (Traditional Methodology)

	n	$\bar{X}$	S	IC 95%	t	P
Module #1						
Pre-Test	25	15.52	1.26			
Post-Test	25	17.60	2.08			
Difference		-2.08	1.15	(-2.56, -1.61)	-9.03	<.001
Module #2						
Pre-Test	25	15.52	1.05			
Post-Test	25	16.48	2.84			
Difference		96	2.39	(-1.95, 027)	-2.01	<.03

Note. n = Sample size; $\bar{X}$ = Average; S = Standard deviation; IC = Interval of confidence at 95% for the difference; t = Test statistic; p = Minimum probability for rejecting hypothesis H_0.

A Student t-test of related samples was conducted for the English subject (see Table 6) for students of the traditional instruction group. According to the results, no statistically significant difference was observed between the pre-test ($\bar{X}$= 8.78) and the post-test ($\bar{X}$ = 12.28) in the module #1, t = -4.46, p < .001. This implies that H_0 is rejected and that there is a statistically significant difference. H_1 is thus taken as being true. There was an improvement in academic achievement. Likewise, in the instructional module #2, no statistically significant difference was detected between the pre-test ($\bar{X}$ = 4.56) and the post-test ($\bar{X}$ = 6.61). The difference between the average values was 3.00, t = -3.24, p = .002, this implies that H_0 is rejected and that there is a statistically significant difference. H_1 is thus taken as being true. There was an improvement in academic achievement.

Table 6
Mathematics Subject. Pre-Post Academic Tests (Traditional Methodology)

	n	$\bar{X}$	S	IC 95%	t	P
Module #1						
Pre-Test	18	8.78	2.94			
Post-Test	18	12.28	3.20			
Difference		-3.50	3.33	(-5.16, -1.84)	-4.46	<.001
Module #2						
Pre-Test	18	4.56	1.54			
Post-Test	18	6.61	3.07			
Difference		-2.06	2.69	(-3.40, .-72)	-3.24	<.002

Note. n = Sample size; $\bar{X}$ = Average; S = Standard deviation; IC = Interval of confidence at 95% for the difference; t = Test statistic; p = Minimum probability for rejecting hypothesis H_0.

Results of the improvement comparison between the traditional methodology group and the flipped classroom methodology group.

A comparison was made to see if there was an improvement in the flipped classroom methodology classes compared to the traditional methodology group with the Student t-test from independent samples (see Table 7), in the Spanish classes to see if there was a significant difference. According to the results, no statistically significant difference was observed between the traditional class ($\bar{X}$= -11.86) and the flipped classroom ($\bar{X}$ = -9.52) in module #1, t = -1.26, p = .21. Likewise, in instructional module #2, no statistically significant difference was detected between the traditional class ($\bar{X}$ = -.39.45) and the flipped classroom ($\bar{X}$ = -36.76), t = -3.24, t = -.91, p = .37.

Table 7

Spanish Class. Traditional Methodology Vs. The Flipped Classroom Methodology

	n	$\bar{X}$	S	IC 95%	t	p
Module #1						
Traditional Class	22	-11.86	5.42			
Flipped Classroom	21	-9.52	6.63			
Difference		2.34	6.04	(-1.38, -6.06)	-1.26	.21
Module #2						
Traditional Class	22	-39.45	1.54			
Flipped Classroom	21	-36.76	10.64			
Difference		-2.71	7.05	(7.06, 1.63)	-.91	37

Note. Note. n = Sample size; $\bar{X}$ = Average; S = Standard deviation; IC = Interval of confidence at 95% for the difference; t = Test statistic; p = Minimum probability of rejecting hypothesis H_0.

A Student t-test comparison from independent samples for the traditional class and the flipped classroom in English classes (see Table 8) was carried out to see if there was a significant difference in grade improvement. According to the results, a statistically significant difference was observed between the traditional class ($\bar{X}$=-1.08) and the flipped classroom ($\bar{X}$ = -.82) in module #1, t = -2.60, p = .013. Likewise, in instructional module #2, no statistically significant difference was detected between the traditional class ($\bar{X}$ = -.96) and the flipped classroom ($\bar{X}$ = -35.29), t = -.89, p = .38.

Table 8
English Class. Traditional Methodology Vs. The Flipped Classroom Methodology

	n	$\bar{X}$	S	IC 95%	t	*p*
Module #1						
Traditional class	25	-1.08	1.15			
Flipped classroom	17	-.82	1.97			
Difference		1.25	1.53	(28, -2.23)	-2.60	.01
Module #2						
Traditional class	25	-.96	2.38			
Flipped classroom	17	-35.29	1.76			
Difference		.60.7	12.16	(-77, 2.00)	-.89	.38

Note. n = Sample size; $\bar{X}$ = Average; S = Standard deviation; IC = Interval of confidence at 95% for the difference; t = Test statistic; *p* = Minimum probability of rejecting hypothesis H_0.

A Student t-test comparison from independent samples for the traditional class and the flipped classroom in English classes (see Table 9) was carried out to see if there was a significant difference in grade improvement. According to the results, no statistically significant difference was observed between the traditional class ($\bar{X}$= -3.5) and the flipped classroom ($\bar{X}$=. -1.84) in module #1, t = -1.14, *p* = .26. Likewise, in instructional module #2, no statistically significant difference was detected between the traditional class ($\bar{X}$ = -2.06) and the flipped classroom ($\bar{X}$ = -3.00), t = -.1.00, *p* = .33.

Table 9
Mathematics Class. Traditional Methodology vs. the Flipped Methodology

	n	$\bar{X}$	S	IC 95%	t	P
Module #1						
Traditional class	18	-3.5	3.32			
Flipped classroom	13	-1.84	1.75			
Difference	1.65	1.98	(-1.31, 4.	-1.14	26	
Module #2						
Traditional class	18	-2.06	2.68			
Flipped classroom	13	-3.00	2.44			
Difference		-.94	2.59	(- 2.87, .99)	1.00	.33

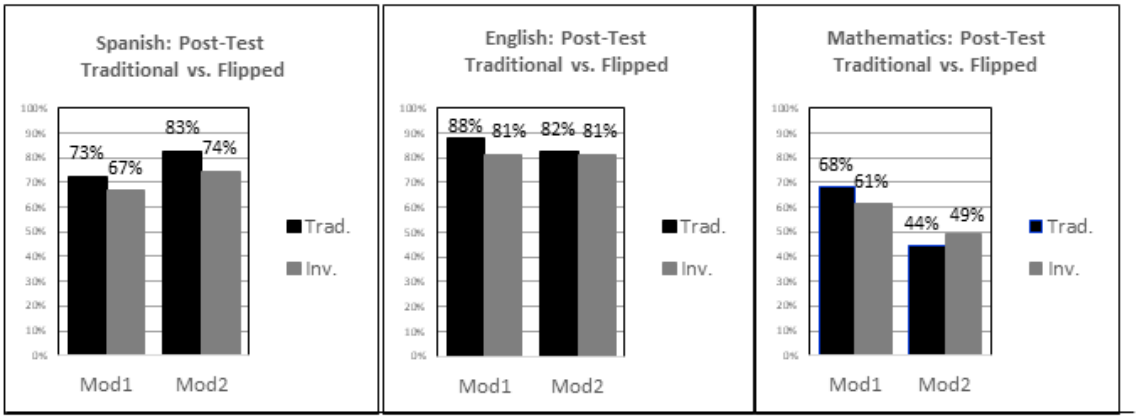
Note: n = Sample size; $\bar{X}$ = Average; S = Standard deviation; IC = Interval of confidence at 95% for the difference; t = Test statistic; p = Minimum probability of rejecting hypothesis H_0.

Results of the comparison between the traditional methodology group and the flipped classroom methodology group.

Concerning the last 3 comparison tables, between the control and experimental groups, the traditional methodology group reflected a greater improvement than the flipped classroom methodology group, but not with a greater statistical significance. This tells us that the research hypothesis of the null H_0 hypothesis is correct, (there is no difference between the improvement averages in the samples from the independent variable).

The only case in which the traditional methodology group had greater improvement than the statistically significant flipped classroom methodology group was in the English module #1 (p = .01) from Table 14. That is, in said case, the difference between the averages would be expected within the observed range of 1-.01 = 99% of the samples.

The only module in which the flipped classroom methodology group had greater improvement than the traditional methodology group was in the Mathematics module #2, but with no statistically significant difference yet (p = .33), Table 15. That is, in said case, the difference between the averages would be expected within the observed range of 1-.33



= 67% of the samples.

In conclusion, these results indicate that there were no statistically significant differences in rejecting the null hypothesis (H_0), i.e. there were no differences between the two teaching methods for both the Spanish, English and Mathematics groups.

Interpretation of Post-Test Results (Academic Test)

As can be seen in Figures 1, 2 and 3, a relevant information for the study carried out by the researcher after obtaining the results was that the use of the traditional methodology had a relatively significant impact on the Spanish classes (unit 2, module 2) and Mathematics classes (unit 1, module 1) after the post-test; no significant difference was detected in the groups of the English classes (control group and experimental group). In general, no statistically significant differences were observed between the groups.

Figure 1. Results for the mean differences between the subjects of Spanish, English, and Mathematics regarding academic performance.

$H_0$1 Hypothesis: There were no significant statistical differences in the average academic performance between students of Spanish, English and Mathematics who studied under the flipped classroom educational methodology against the group that studied under the Traditional Methodology.

Although the experimental group from Spanish at first felt less comfortable with the use of the flipped classroom and presented some obstacles to its full and complete realization, (the tools and technology necessary for its outcome), some students showed interest in continuing with this educational system, arguing that carrying out their activities

at their own pace, provided them with greater focus on the subject and a greater reinforcement of the material studied in class.

It is necessary to indicate that the researcher-teacher was monitoring and observing the entire research process in a meticulous way, so as to be able to determine a possible stable methodological intervention in the future.

Discussion and Conclusions

In sum, the fundamental conclusion that can be drawn from this work, is that, although the intervention of the flipped classroom methodology did not have a great impact on academic performance based on pre-post knowledge test scores, we could see that both the Mathematics and Spanish classes had a slight improvement in grades under the flipped classroom classes. This satisfies the researcher and encourages the diffusion of the use of innovative methods to be used by the teaching staff, establishing a continuous practice of educational search that serves as a basis for carrying out an improvement in school performance.

It is important to point out that the context and circumstances in which the research has been carried out establish limits between results and reality, since the flipped classroom model was implemented through a doctoral thesis, being the first approach to the study of low academic performance and could have been affected by a lack of motivation in students.

Limitations

A more detailed and in-depth analysis of the research could not be done since time was limited, only two months were available.

The sample size was too small, and the object of study only focused on one group of students from one school and one gender, being all males. This does not allow the results to be generalizable or extrapolated to analogous groups from other institutions in Los Angeles, California. However, the instruments used, and the results obtained, can be used and applied to other research with similar populations.

Due to the magnitude of the work involved in the preparation of classes by the teaching staff, the time necessary prior to instructing both students and teachers to develop more effectively and efficiently their teaching-learning lessons was not obtained.

The lack of Internet bandwidth (Wi-Fi), as well as the availability of You Tube didactic material were limiting factors during the class day.

The considerable number of extracurricular activities (sports, projects, meetings, among others) minimized (through fatigue and tiredness) the students' complete study development.

The lack of technological knowledge for a flipped classroom from the teachers, plus the time dedicated to the creation of new videos and programs, hindered the design of more didactic alternatives for the students.

Continuity Proposal

After obtaining the results, the researcher recommends the following:

To continue with new studies in technological strategies within the campus to improve school performance.

To propose workplace training in new methodologies that allows for greater stimulation in the students and the teaching staff.

To propose a follow-up and training to the teachers, according to the subject that they teach, so that in this way, they may attribute to the improvement of teaching-learning, both of the institution and the students, and thus halt the problem presented in the classrooms.

Provide greater follow-up on the teaching staff to verify the use of the methodology with the use of the new teaching-learning technologies and strategies used for teaching these subjects.

Greater participation in communication, in both the classroom and the virtual environment with regards to the students' studies.

The research considered this study as being the beginning for developing an improvement in the research of applied inverse-classroom with the support of new surveys, programs, activities and didactic methodologies based on competencies. In turn, it suggests carrying out new surveys, not only to the student body, but to the teaching staff as well, so as to identify the training and skills required for educational technologies to present a training program in both the classroom and the virtual environment and so establish a structured model based on the previously identified needs for the teaching staff so as to establish a standard teaching-learning model within the academic institution.

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