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EXPERIENCE USING INVERTED CLASSROOM IN ELECTIVE SUBJECT I, IN THE AUTOMATIC ENGINEERING COURSE

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ABSTRACT

The fourth industrial revolution has a strong impact on education and although the initial changes belong more to a purely technological field, the transformations they introduce are directly reflected in the behaviors of society and in the alteration of labor profiles. Faced with this change, Education 4.0 implies a paradigm shift since it is an educational proposal that tries to adapt to the new reality, characterized by connectivity and technology and focuses on the skills that students need to function daily and in their Laboral future. The objective is to present the results obtained in the subject with the application of the Flipped Classroom learning strategy. The inductive-deductive, historical-logical, synthetic analytical and complexity paradigm were used as theoretical methods; the student survey as an empirical method and statistical methods for processing the results of the surveys and the analysis carried out showed that prioritizing systematic evaluation, giving weight to teamwork, the ideas they contribute, the way they are presented and defended is essential to obtain the desired objectives in the training process. As a result, the flipped classroom is used as a learning strategy that achieves a successful link between the use of technology and instructional processes, based on the detection of the students' learning needs.

I. INTRODUCTION

We are currently experiencing the Fourth Industrial Revolution, using disruptive technologies, such as, for example, hyperconnectivity, artificial intelligence, cyber-physical systems, and Big Data, with the aim of certifying total quality, avoiding mistakes in production. Therefore, this fourth revolution is directly influencing the change in educational practices as they were known [1].

In this context, Education 4.0 implies a paradigm shift, having as its central focus technological innovations and the future in the labor field, benefiting students and improving the development of their competencies and skills, hence teaching methodologies acquire great importance. Characterized by the leading role of the student in the challenge of learning. It is not that they did not have it previously, but now it seems that the unit of measurement of academic achievement—the European credit—needs teaching practices that go beyond the master class as a traditional method in university teaching.

As is known, the determination of the amount of work of the student to meet the objectives of the study program is carried out by integrating theoretical and practical teachings, as well as supervised academic activities, with indication of the hours of study and autonomous work by the student. The entry into force of this new unit of measurement makes teaching planning take on great importance and a professional practice that, as a trend, is configured to accompany or guide the student in their learning.

The profile of the university teacher is now characterized by mastering the discipline and a whole series of skills, among which [2] points out, among others, the following: mastering both the knowledge of his discipline and its management , innovate on their own teaching practice, which implies reflecting and researching by integrating disciplinary and pedagogical knowledge as a way for continuous improvement, knowing how to foster a climate of

motivation among students towards quality learning, promoting collaborative learning among students and possess the communication and relationship skills that the teaching function requires.

Of all the teaching competencies, possibly the mastery of teaching-learning methods is concentrating great attention. Some systems, methodological approaches, or teaching techniques such as Cooperative Learning, Problem-Based Learning or the Flipped Classroom are experiencing a significant rise and take root in higher education institutions.

The Flipped Classroom, or also called Flipped Classroom, is a learning strategy in which traditional teaching is turned upside down, since the contents are studied at home and in the classroom, what is learned is applied in significant situations such as debates, or collective projects [3]. According to [4], the educational practice is a learning strategy that consists of reversing the two moments that intervene in traditional education: the first moment that corresponds to the activities of the class such as the presentation of the contents by the teacher and, the second moment, to the performance of the activities outside of school, such as homework. This is how in the flipped classroom the tasks or projects are carried out in the classroom and the thematic contents are learned outside of school.

According to Johnson et al. (2015) point out that in the 2015 Horizon Report, with references to emerging technologies that will impact education in the coming years, there is the flipped classroom approach, which will be increasingly adopted by institutions. The 2015 Horizon Report also highlights that some opinion leaders believe that new forms of teaching and learning require new spaces and mentions that more universities are helping to facilitate these emerging models, such as the flipped classroom, which reorders learning environments. To accommodate more active learning.

From the above, there is a background for the application of the experience, contacts with graduates, who concluded their studies with low qualifications, and inserted in important productive centers, indicate that they are capable of easily mastering technologies not studied during their degree. This shows that, with the traditional teaching system, the potential that exists among our students has not been detected or developed. The elements indicated below are present in the teaching that is taught today in the different careers.

- Mostly teaching activities continue to be carried out in a traditional way. The teacher at the center of the learning process.
- Regardless of the quality of income received, students continue to use reproductive methods and most study to pass and not to learn.
- There is a consensus among teachers that the learning that students receive during their studies is far from being truly significant.
- The student perception has changed and for them electronic devices are part of their own life for all activities, including those associated with learning.
- It is strategic to put most of the devices that are within reach of our students into the educational teaching process.
- An attempt has been made to introduce experiences of student-centered methodologies in the last 4 school years.
- Three of these courses were affected by the pandemic situation that the country has experienced in recent years, which led to them being taught irregularly, since the in-person moment is part of the strategy used.
- The best experiences have been obtained and in each version an attempt has been made to overcome the deficiencies that have been observed.
- The elective subject of the first year has a total of 48 hours, what is learned there is basic and of extensive use from that moment on in all years and in various subjects.
- The work shows an experience in the teaching of the Elective I subject, in the 1st year of the Automation Engineering degree and its general objective: to present the results achieved in the teaching of the Elective I subject with the application of the Flipped Classroom learning strategy.

III. METHODOLOGY

The research was carried out in the second semester of the 2022-2023 school year with the application of a survey to 1st year students studying the Automation Engineering career. According to authors such as [6], the quantitative approach allows the use of reliable and valid technical methods. The design of this research is descriptive. According to the authors, in these designs the variables are not manipulated, but the phenomena are observed as they occur in their natural context, at a specific time, and then analyzed. From these designs, information is collected in a single moment, in a single time.

This research is descriptive in nature. According to [7], descriptive studies analyze what a phenomenon is like and how it manifests with its variables and dimensions. They also allow detailing what was studied by measuring one or more of its elements.

In this way, during the investigative process, the following methods were used:

II.1 THEORETICAL METHODS

Inductive-deductive method: allowed the analysis to be carried out to determine the correspondence between the traditional teaching model and the new teaching-learning strategies.

Historical-logical method: it favored the study of the historical and logical development of the traditional teaching model, as well as the introduction of new teaching-learning strategies that promote the development of skills in students.

Analytical-synthetic method: provided the processing of the information obtained from the consultation of the different bibliographies and in the characterization of the object and field of action of the research.

Complexity paradigm: in the analysis of the integrated expression of the different components that make up the problem studied from the system approach and the complex and dialectical conception of its entirety, which is shown in a more complete way, and which reveals the relational in the educational teaching process, for the application of new learning strategies [8].

II.2 EMPIRICAL METHODS

Surveys: were applied with the objective of determining the level of satisfaction with the experience carried out and elements to consider for improvement.

II.3 POPULATION AND SAMPLE

The total number of students was 35 and the survey was applied to a sample of 23 students, representing 66% of the population. All students who were the subject of the study offered their consent and voluntariness to participate [9].

II.4 DATA COLLECTION

After the sample was selected, a first open interview was carried out with the students to explain the objectives and importance of the research. In this first meeting, collaboration and a detailed explanation of the study were requested.

In a second meeting with the students, the data was collected by applying the proposed survey, to proceed with the triangulation of the information received from the empirical methods applied.

III. RESULTS AND DISCUSSIONS

Among the countless challenges faced by teachers to promote meaningful learning of content, the teaching model occupies an important position. The question that arises is: how to do it differently? Table 1 shows a comparison between the traditional model and the new methodologies. The countries with the best results, when different educational experiences are compared and how much students learn is verified with the same instruments, have banished the traditional way of teaching, the one that has put teachers at the center of the process for centuries. Nordic countries, Korea, Japan, and others no less important, using the resources available to much of their population, are introducing significant changes in involving their students with a leading role in their own training process.

Table 1: Shows a comparison between the traditional teaching model and the new learning strategies.

	Traditional	**New learning strategies**
Students	Learn facts and skills by absorbing content presented by the teacher and technological resources	Acquire knowledge by actively working on content provided by the teacher, technological resources and personal experience
Curriculum	Separate fractional and disciplinary knowledge. Basic knowledge is encouraged and not a high level of research Focused on learning	Multidisciplinary topics and integration of knowledge, emphasis is placed on thinking skills, application of knowledge and its deep understanding
Evaluation	Concrete knowledge and some skills are evaluated. Traditional exams	The application of knowledge is evaluated, they demonstrate their understanding through performance in their task assignments.
Teacher's Role	Presents information and controls the group	Guides students to investigate. Active learning model.

Source: [10].

It is then necessary to give an immediate response in the methodological order to this situation faced in the learning process. The first step to solving a problem is to recognize that it exists.

The reality that characterizes traditional teaching differs from what our university students do or want to do most of them connected to free networks, with easy access to information and accustomed to interactive environments, whether virtual or in-person, [11].

III.1 AN EXPERIENCE, THE RESULT OF APPLYING NEW METHODOLOGIES IN THE TEACHING OF A SUBJECT IN THE 1ST YEAR OF AUTOMATIC ENGINEERING

Initially, the sample taken to apply the experience was 50 students, 35 of them managed to complete it, since, for different reasons, some abandoned the training process at different times during the period. Mostly men, they come from the five central provinces of the country. As enrollment is limited, there are several municipalities in that territory that do not have representatives in the race. Before taking the entrance exams, their average ranking index was higher than 97 points. Once these are completed, they enter university with averages higher than 95 points. About 5 students request the degree in an option higher than the second. They are in the first year of the new E study plan.

The subject is 48 hours and for the first time, using the flipped classroom, it could be taught in the established time. The computer resources used are their property, they all had smartphones, most of them laptops and several tablets, all of these resources were placed according to the learning process. An acceptable level of connectivity and operation of the Moodle platform was available, which greatly facilitated the development of the planned activities.

Limited possibilities with the infrastructure made it difficult to carry out the experience, the teaching spaces are not conducive and overcoming this problem is a challenge for the teacher to overcome when conceiving each of the activities.

- The subject is mounted on the platform in its entirety.
- Students have abundant bibliography in digital format that can facilitate the learning process.
- They have a large group of videos on different topics that they can consult and view until they manage to appropriate their content in the environment and time that is most favorable to them.
- Evaluation is not an instrument, priority is given to the systematic, which results from their performance in each activity and their contribution to the work carried out as a team.
- The platform itself provides for the possibility of consultations through forums and the possibility of uploading the self-preparation they carry out and the exercises that are guided to them.
- The activities are planned for 2 consecutive shifts, which allows checking the orientation, promoting teamwork, exercising the contents until leaving the exercises solved on their laptops.

III.2 SURVEY CARRIED OUT

The possible responses were: very dissatisfied, dissatisfied, neutral, satisfied and very satisfied. The opinions expressed anonymously by the students were quantified and statistical processing was carried out, as shown in tables 2.

Table 2: Statistical data processing.

No	Questions	% Dissatisfaction	% Satisfaction
1	My academic level, knowledge and maturity were adequate	4.35	56.52
2	I have dedicated sufficient time to preparing course assignments, assignments, and evaluations.	4.35	78.26
3	I used the bibliography recommended by the teacher	21.74	47.83
4	I prepared adequately and dedicated enough hours to studying	4.35	78.26
5	I understood the structure of this form of delivery and applied it appropriately.	17.39	69.57
6	It is better to arrive at the classroom knowing about the topic you intend to address.	4.35	47.82
7	There are sufficient mechanisms for students to express their opinion.	0.00	78.26
8	The indications facilitate the assimilation of the contents that must be studied.	4.35	78.26
9	The proposed videos facilitate the appropriation of knowledge	4.35	78.26
10	The rest of the materials provided for self-learning are equally useful	17.39	73.91
11	Increase time efficiency/effectiveness using these methodologies	8.70	69.57
12	You consider the environment in which face-to-face activities take place to be conducive	4.35	78.26
13	The new methodology encourages collaborative work and group work	13.04	82.61
14	Satisfaction with the behavior of the Moodle platform	4.35	82.61
15	Rate the frequency with which you were evaluated during the course of your class	4.35	73.91
16	My academic level, knowledge and maturity were adequate	8.70	78.26
17	I have dedicated sufficient time to preparing course assignments, assignments, and evaluations.	8.70	73.91
18	I used the bibliography recommended by the teacher	21.74	21.74
19	I prepared adequately and dedicated enough hours to studying	8.70	43.48
20	I understood the structure of this form of delivery and applied it appropriately.	13.04	52.17
21	It is better to arrive at the classroom knowing about the topic you intend to address.	17.39	30.43
22	There are sufficient mechanisms for students to express their opinion.	47.83	26.09
23	The indications facilitate the assimilation of the contents that must be studied.	0.00	73.91
24	The proposed videos facilitate the appropriation of knowledge	4.35	78.26
25	The rest of the materials provided for self-learning are equally useful	13.04	78.26
26	Increase time efficiency/effectiveness using these methodologies	8.70	65.22
27	You consider the environment in which face-to-face activities take place to be conducive	4.35	52.17
28	The new methodology encourages collaborative work and group work	17.39	56.52
29	Satisfaction with the behavior of the Moodle platform	13.04	73.91
30	Rate the frequency with which you were evaluated during the course of your class	4.35	56.52

Source: Authors, (2022).

The results obtained are shown in figures 1, 2 and 3, which correspond to the general results of the survey, the percentage of dissatisfaction and the percentage of satisfaction, respectively.

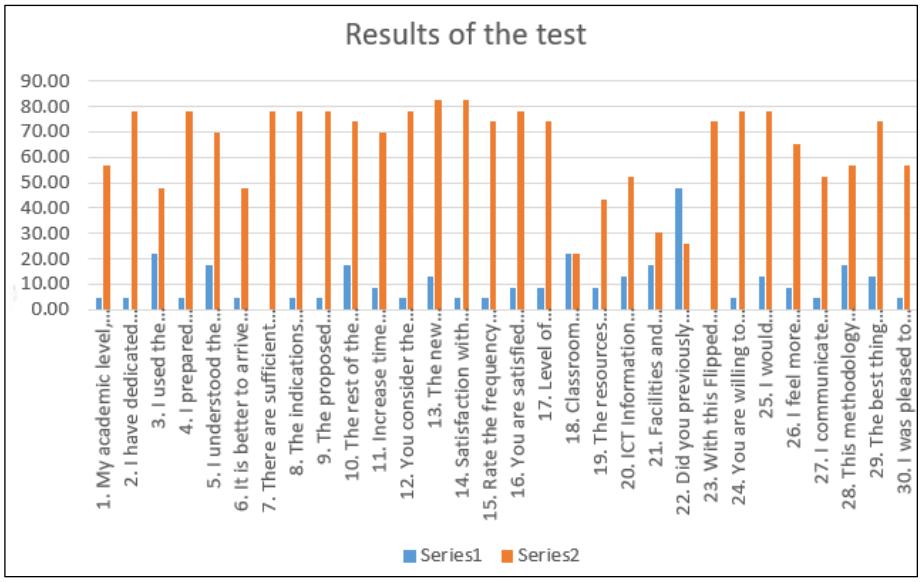

Figure 1: General survey results.
Source: Authors, (2022).

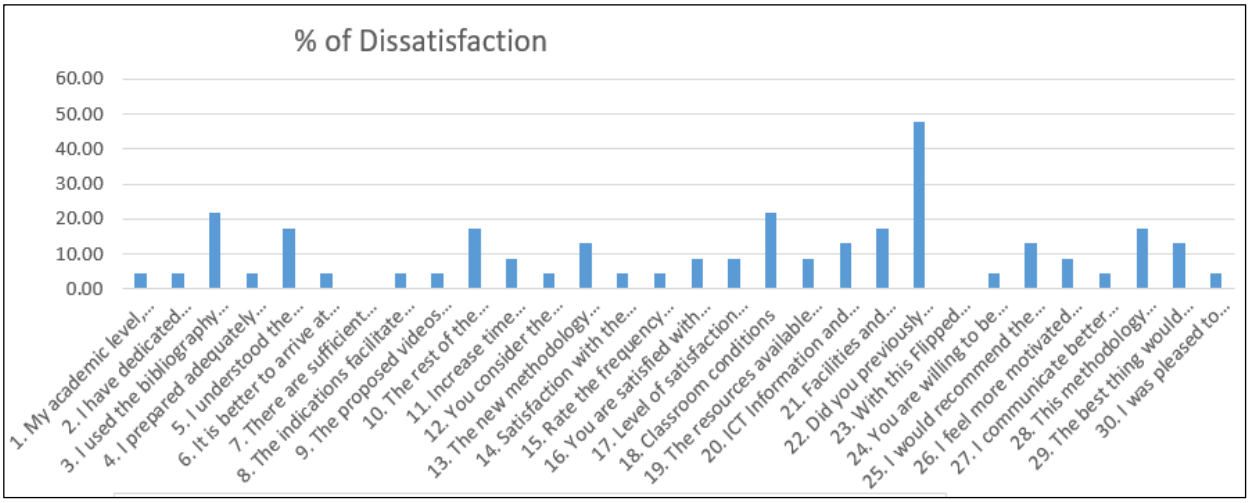

Figure 2: Percentage of Dissatisfaction.
Source: Authors, (2022).

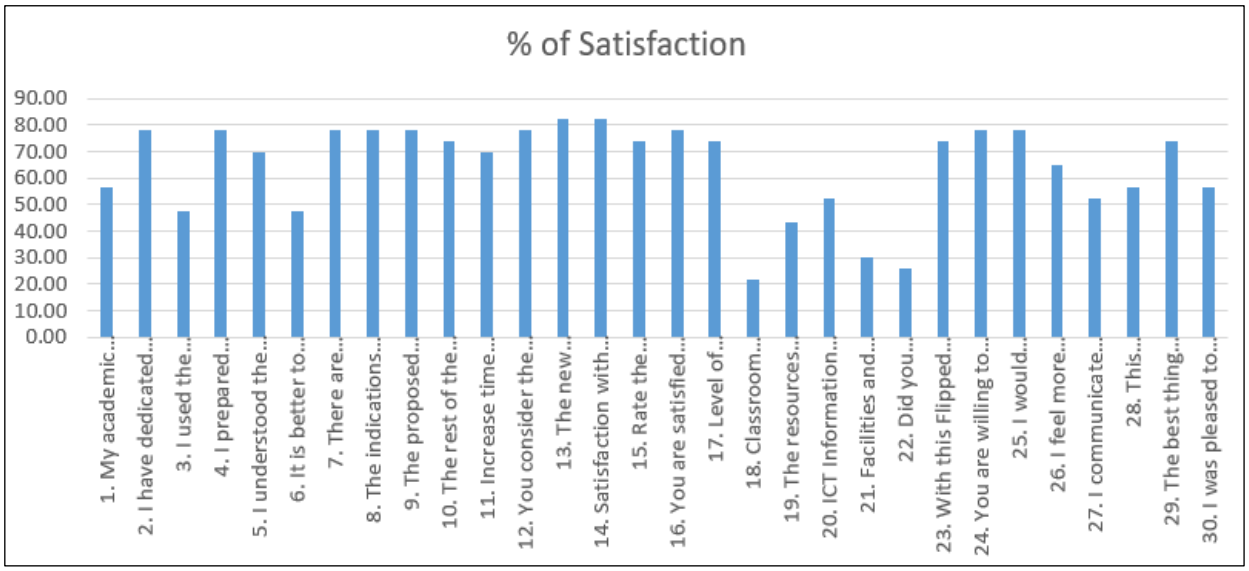

Figure 3: Satisfaction Percentage.
Source: Authors, (2022).

III.2.1 analysis of the results

The 47.83% of those surveyed were unaware of the existence of new methodologies for learning. The preceding level of instruction also uses the traditional class. The international experience introduces them from the primary level and this must be reversed with the participation of all teachers in the established educational spaces and 21.74% of those surveyed consider that the available resources are insufficient to develop this experience, however, The resource issue cannot be seen as an insurmountable obstacle, the experience of the faculty when preparing the materials and precise guidelines can overcome this situation, since the amount of resources, although limited, are not negligible, and not using them optimally is the worst of the variants (see figure 2).

Likewise, 21.74% of those surveyed show dissatisfaction with the bibliography that was provided to them. This criterion is interesting, however, the availability is a small sample of what is possible to use, with the means and good connectivity this obstacle can be overcome and adjusted to the needs of each student (see figure 2).

It stands out in the percentage of satisfaction that 82.61% of those surveyed agree that they consider the environment in which face-to-face activities are carried out to be appropriate and that the use of the methodology of collaborative work and group work is appropriate (see figure 3).

Although figure 3 shows that in general there is a high percentage of satisfaction with the experience carried out, we must continue to refine what should be done at each moment of a class using the flipped classroom strategy and even when the infrastructure is questioned, this element must be taken into account by the teacher who, in the midst of known limitations, must develop actions that mitigate this problem.

III.2.2 Experience of the 2023 school year

This experience has been followed up in the current 2023 school year. The same instrument is applied, on this occasion, to 25 students, who represent 78% of the sample.

Tables 4 and 5 show the indicators that worsened (7) and that had little variation (6), respectively.

Table 4: Indicators that worsened.

Indicator	2022	2023
2. I have dedicated sufficient time to preparing course assignments, assignments, and evaluations.	78.26	52
4. I prepared adequately and dedicated enough hours to studying	78.26	56
7. There are sufficient mechanisms for students to express their opinion.	78.26	72
12. You consider the environment in which face-to-face activities take place to be conducive	78.26	68
23. With this Flipped Classroom methodology I study to learn and not to pass	73.91	56
24. You are willing to be the protagonist of your own learning	78.26	76
29. The best thing would be to combine new methodologies with traditional methods.	73.91	68

Source: Authors, (2023).

Table 5: Indicators that had little variation.

Indicator	2022	2023
1. My academic level, knowledge and maturity were adequate	56.52	56
5. I understood the structure of this form of delivery and applied it appropriately.	69.57	68
14. Satisfaction with the behavior of the Moodle platform	82.61	80
22. Did you previously know the flipped classroom methodology?	26.09	28
26. I feel more motivated to participate in class with the Flipped Classroom methodology	65.22	64
30. I was pleased to participate in this experience.	56.52	56.52

Source: Authors, (2023).

Based on the above, figure 4 shows the indicators that worsened, with the most affected being the fact of being willing to be the protagonist of one's own learning at 76%.

Figure 5 shows the indicators that had little variation, highlighting among them, with 80%, satisfaction with the behavior of the Moodle platform.

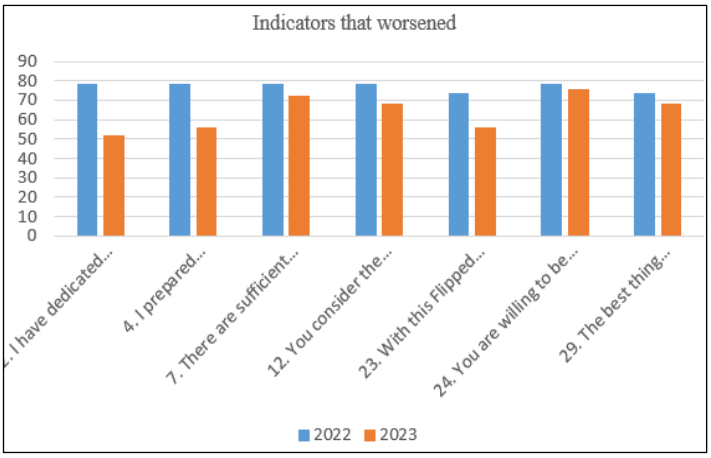

Figure 4: Indicators that worsened.
Source: Authors, (2023).

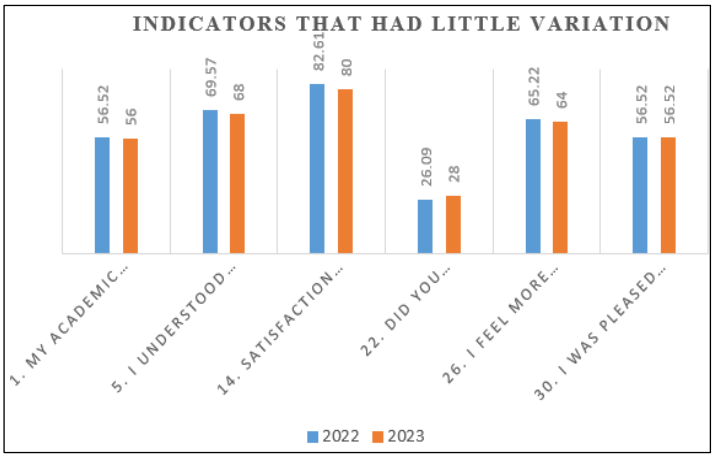

Figure 5: Indicators that had little variation.
Source: Authors, (2023).

A total of 17 questions obtain higher grades compared to the previous course, as shown in table 6.

Table 6: Comparison of the results of the 2022 and 2023 courses.

Questions	2022	2023
3. I used the bibliography recommended by the teacher	47.83	76
6. It is better to arrive at the classroom knowing about the topic you intend to address.	47.82	76
8. The indications facilitate the assimilation of the contents that must be studied.	78.26	84
9. The proposed videos facilitate the appropriation of knowledge	78.26	84
10. The rest of the materials provided for self-learning are equally useful	73.91	76
11. Increase time efficiency/effectiveness using these methodologies	69.57	72
13. The new methodology encourages collaborative work and group work	82.61	88
15. Rate the frequency with which you were evaluated during the course of your class	73.91	76
16. You are satisfied with the evaluation you obtained	78.26	80
17. Level of satisfaction with practical activities	73.91	80
18. Classroom conditions	21.74	44
19. The resources available to implement the methodology are considered sufficient	43.48	56
20. ICT Information and Communication Technologies	52.17	60
21. Facilities and infrastructure in general	30.43	56

Questions	2022	2023
25. I would recommend the use of new methodologies to other students	78.26	84
27. I communicate better with the teacher through Flipped Classroom	52.17	72
28. This methodology motivates more to study	56.52	72

Source: Authors, (2023).

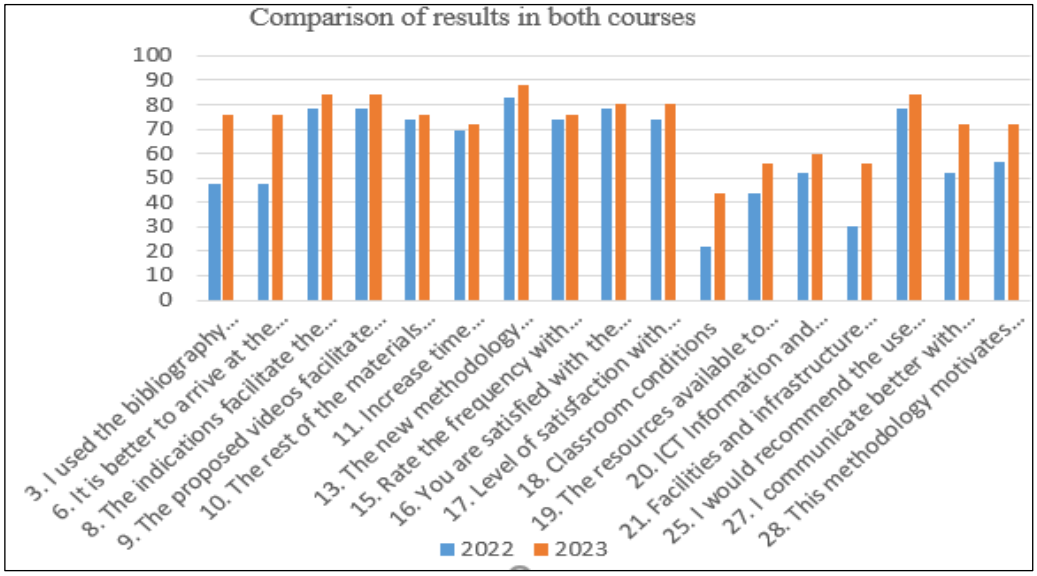

Figure 6: Comparison of the 2022 and 2023 courses.
Source: Authors, (2023).

As can be seen in figure 4, when making the comparison in both courses, the results in general, in this 2023 course, are better. In a total of 17 questions, of the 30 that are asked, superior grades are obtained.

This is because the use of the H5P tool available on the Moodle platform facilitated the self-learning of the students, the presentations, the prepared digital books to which figures, texts, evaluations and videos were incorporated, which were accepted in a better way.

IV. CONCLUSIONS

By using the main teaching strategies in the teaching-learning process systematically in class, it is possible to promote meaningful learning in students.

The flipped classroom is a learning strategy that would support a successful link between the use of technology and instructional processes, based on the detection of students' learning needs.

The results of the survey applied in the brigade generally show a high percentage of satisfaction with the experience developed by applying the flipped classroom strategy.

This experience was developed again in the 2023 academic year, the same indicators were evaluated and in 17 of them results superior to those obtained in the 2022 academic year were obtained.

The use of the H5P tool available on the Moodle platform facilitated student self-learning, presentations and the creation of digital books to which figures, texts, evaluations and videos were incorporated; that were accepted in a better way by them.

V. AUTHOR'S CONTRIBUTION

Conceptualization: Gilberto Juan Machado Burguera, Lamay Rosa Montero Rojas and José Rafael Abreu García.
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Resources: Gilberto Juan Machado Burguera.
Supervision: Gilberto Juan Machado Burguera and José Rafael Abreu García.
Approval of the final text: Gilberto Juan Machado Burguera, Lamay Rosa Montero Rojas and José Rafael Abreu García.

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