MENDIVE
REVISTA DE EDUCACIÓN

Translated from the original in Spanish

Original article

The professional training of university students through the Inverted Classrooms

La formación profesional de los estudiantes universitarios a través de las Aulas Invertidas

A formação profissional de estudantes universitários por meio das salas de aula invertidas

Luis Aníbal Alonso Betancourt[1]
https://orcid.org/0000-0003-0989-746X
Miguel Alejandro Cruz Cabezas[1]
https://orcid.org/0000-0001-6544-038X
Vadim Aguilar Hernández[2]
https://orcid.org/0000-0003-2690-6380

[1]University of Holguín. Cuba.
lalonsob@uho.edu.cu, mcabeza@uho.edu.cu
[2] University of Pinar del Río "Hermanos Saíz Monte de Oca". Cuba.
vadim.aguilar@upr.edu.cu

Received: December 16th, 2021.
Accepted: February 14th, 2022.

ABSTRACT
In this article, a study is carried out on the need to improve the professional training of middle and higher-level students, considering the current conditions of the country in the face of the COVID 19 pandemic and the changes it has generated in the educational system. In this sense, the main objective of the article was to present a methodology for the professional teaching of students from Polytechnic Centers (be it intermediate and/or higher) in flipped classrooms. It is based on the alternative and interactive method of appropriation of content based on projects, which integrate the face-to-face modality with the virtual modality. The scientific novelty lies in the establishment of a dynamic that integrates the face-to-face modality with the virtual modality, based on the link between academics, work and research. The document review methods, the system approach, direct observation in the field, the pedagogical pre-experiment and the Chi-square (X2) statistical test are used. The favorable impacts on the development of professional competencies were observed in a sample of 100 students of the Mechanics career at the University of Holguín, Cuba, with the application of the result. It can be generalized in any worker training center with flexibility and adaptability to the characteristics of these entities.

Keywords: teaching; professional; Flipped Classroom; methodology; technology.

RESUMEN
En el presente artículo se realizó un estudio sobre la necesidad de mejorar la formación profesional de los estudiantes de nivel superior teniendo en cuenta las actuales condiciones del país ante la pandemia de la COVID-19 y los cambios que esta ha generado en el sistema educativo. En tal sentido, el artículo tuvo como principal objetivo presentar una metodología para la enseñanza profesional de los estudiantes de

nivel superior en Aulas Invertidas. Se sustenta en el método alternativo e interactivo de apropiación de contenidos, basado en proyectos, que integran en el proceso de enseñanza la modalidad presencial con la modalidad virtual. La novedad científica radica en el establecimiento de una dinámica que integra a la modalidad presencial con la modalidad virtual, basada en el vínculo entre lo académico, lo laboral e investigativo y extensionista. Se utilizaron los métodos de revisión de documentos, el enfoque de sistema, la observación directa en el terreno, el preexperimento pedagógico y la prueba estadística Chi-cuadrado (X^2). Los impactos favorables en el desarrollo de competencias profesionales se observaron en una muestra de 100 estudiantes de la carrera de Ingeniería Mecánica de la Universidad de Holguín, Cuba, con la aplicación del resultado. Se puede generalizar en cualquier centro de formación de trabajadores con flexibilidad y adaptabilidad a las características de estas entidades.

Palabras clave: formación profesional; Aula Invertida; estudiantes universitarios.

RESUMO
Neste artigo, foi realizado um estudo sobre a necessidade de melhorar a formação profissional dos estudantes de nível superior, tendo em conta as condições atuais do país face à pandemia de COVID-19 e as mudanças que esta tem gerado na educação sistema. Nesse sentido, o objetivo principal do artigo foi apresentar uma metodologia para o ensino profissional de alunos de nível superior em Flipped Classrooms. Baseia-se no método alternativo e interativo de apropriação de conteúdos, baseado em projetos, que integram a modalidade presencial com a modalidade virtual no processo de ensino. A novidade científica está no estabelecimento de uma dinâmica que integre a modalidade presencial com a modalidade virtual, a partir da articulação entre os aspectos acadêmico, laboral e de pesquisa e extensão. Foram utilizados os métodos de revisão documental, a abordagem sistêmica, a observação direta em campo, o pré-experimento pedagógico e o teste estatístico Qui-quadrado (X2). Os impactos favoráveis no desenvolvimento de habilidades profissionais foram observados em uma amostra de 100 alunos da carreira de Engenharia Mecânica da Universidade de Holguín, Cuba, com a aplicação do resultado. Pode ser generalizado em qualquer centro de formação de trabalhadores com flexibilidade e adaptabilidade às características destas entidades.

Palavras-chave: formação profissional; Sala de aula invertida; estudantes universitarios.

INTRODUCTION

In this century, the processes of professional training of students in universities have used various modalities, methodologies and strategies for educational innovation. These are characterized by the presence, to a large extent, of technological resources in professional training institutions, in labor entities, the home and the community. On the other hand, mobile devices with Internet access are increasing, constituting virtual spaces to promote interactive, autonomous and creative learning in students.

For Bergmann and Sams (2012), the inverted classroom is an andragogic model, which consists of inverting the two moments that intervene in traditional education; that is, to modify the traditional methodological order, leaving the tasks in the classroom and the thematic contents are learned in other settings (home).

A change arises in the way of delivering content to students, so that they learn at their own pace; however, the process begins at home when students make use of Information and Communication Technologies (ICT) and the Internet to access content resources carefully developed by teachers to review, analyze and study them, allowing them to your pre-class preparation. The dedication, motivation and autonomy on the part of the student represent the basis of the learning process in this model.

The word *flip, according* to Salas and Lugo (2019), it comes from "flexible *environment, learning culture, intentional content and professional educator*" (p. 4). Students see the exhibitions and presentations through technological, computer and *online resources.* The face-to-face teaching time is dedicated to socializing, debating, resolving doubts, and analyzing the contents studied with the help of a teacher, acting as a mediating agent of the process and performing an evaluation of the contents.

In the Inverted Classroom (Flipped Classroom), the classes are received at home through audiovisual videos, videoconferences, chats, discussion forums, online tasks and projects, or other existing technological tools in the school, work and community context. The tasks or projects are socialized and discussed in class with the support of the teacher as a mediator of the process and its purpose is the professional training of the student.

In the present work, the professional training process is addressed in a conscious, planned and organized way, which can be developed in educational institutions and labor entities in close ties, in a dynamic that integrates the academic component (teaching) with the labor component (practice and pre-professional) and investigative, by treating the relationships between instruction-education-professional growth and dialogic-reflexive communication between the agents involved (teachers-students-tutors-family members, among others), which aims to develop skills professionals (know, know to do, to be, to be, to live together), in accordance with the profile of the graduate of the career, specialty, profession and trade in question.

Adopting this type of non-traditional scenarios (home) in the teaching process is a necessity in the current times of the COVID-19 pandemic; this allows the virtual modality to be combined with the face-to-face modality as an alternative for university students to continue through virtual teaching environments, training themselves as competent workers.

The result of the review of normative documents, direct observation of classes, as well as the criteria of students, teachers and tutors who work in the Mechanical Engineering career at the University of Holguín, Cuba, has allowed us to verify that it is insufficient the use of the Flipped Classroom in professional training processes; limiting the development of their professional training in the labor context, once they graduate.

The review of the scientific literature consulted on the use of Flipped Classrooms in professional training processes allows us to recognize, among others, the works of Martins and Gouveia (2019); Rooms and Lugo (2019); Aguayo, Bravo, Nocetti, Concha and Aburto (2019); Nuñez and Merchor (2020); Pérez, Jordan and Salinas (2020); Alonso, Cruz and Olaya (2020); Alonso, Cruz, Parente and Del Cerro (2021), as well as Alonso, Ortiz and Cruz (2021) .

All these investigations have provided conceptions, strategies, models for professional training based on Flipped Classroom; however, due to their objectives, they have been aimed fundamentally at classroom theoretical content, the treatment

carried out from the professional approach being insufficient, where a link between the theory and the practice of said process in the training of university students is not achieved. Achieve the professional training of university students in which they express a greater link between theory and practice, guaranteeing the development of knowledge, skills and values to perform with quality in the jobs of the labor context according to the career, specialty or trade they study requires the systematization of a professional training process.

In this sense, Alonso *et al.* (2020) state that vocational training is:

> The process of transmission and appropriation of the content of the profession (whether it is a trade, intermediate technical specialty or university career), through reflective dialogic communication between the agents involved (teacher, tutor, specialist of the labor entity, family and the community) in a dynamic that links and harmonizes in alternating periods teaching, job placement, research and extension work, based on the unity between the instructive, the educational and professional growth, which has as its purpose the initial or continuous vocational training of the worker (p. 21).

For Alonso *et al.* (2021), the flipped classroom is interpreted as:

> A context of professional training for workers, which promotes inverted professional learning, in dynamic and interactive spaces through harmonization, collaboration and face-to-face and contextualized multimedia interaction (use of existing technological resources in classroom, work, family and community settings) between workers with other workers (in initial or continuous training), the teacher, tutor, specialist from labor entities, their families and members of the community, both local, national and foreign (p. 178).

That is why this research poses the following problem: how to contribute to the professional training of university students through the use of flipped classrooms?

In order to contribute to the solution of the problem, the objective is: to propose a methodology for the professional training of university students based on Inverted Classrooms.

The proposed methodology uses the alternative and interactive method of content appropriation based on projects, which integrate the face-to-face modality with the virtual modality provided by Alonso *et al.* (2021).

MATERIALS AND METHODS

A quantitative, experimental type research was carried out and, within it, the pre-experimental type according to Hernández, Fernandez and Baptista (2014), in which an interpretation is offered about the conception of professional training in inverted classrooms and it is evaluated the impact of its implementation in the Mechanical Engineering career at the University of Holguín, Cuba.

According to the criterion assumed by Hernández *et al.* (2014) for a pre-experimental design, the following hypothesis is proposed: the implementation of a methodology in university students allows a flexible and contextualized interaction between the face-to-face and the virtual and contributes to improving their professional training in the work context.

In this approach, the independent variable refers to the methodology for professional training in Flipped Classrooms (cause), which should improve in university students (effect, dependent variable).

The investigation was carried out in the following stages:

1. Develop the theoretical reference framework on professional training in Inverted Classrooms.

2. Design the methodology for professional training in Inverted Classrooms.

3. Validate the methodology through a pedagogical pre-experiment.

The following methods were used: analysis, synthesis, document review, system approach, which allowed the elaboration of the theoretical reference framework of the research, the justification of the problem, as well as the methodology for professional training in flipped classrooms.

The methods of analysis and synthesis: as a logical process of thought, they allowed to identify, organize and summarize the actions to be carried out with the implementation of the methodology, for the professional training of university students through the use of Inverted Classrooms.

The system approach: it was applied in the integration of the research results, as well as in the establishment of the links between the actions that make up the system, establishing their interdependence.

The documentary analysis: The Study Plan, the programs of the Technology of the Specialty and Practices of the Specialty subjects were reviewed, as well as the lesson plans and reports of academic results, allowing verifying to what extent treatment can be given to the use of projects, which integrate the face-to-face modality with the virtual modality.

In addition, the pre-experimental design was used, according to Hernández *et al.* (2014) and direct observation in the field, to evaluate the impact of the implementation of the methodology in improving the professional training of students.

2) Statistician was used to verify the research hypothesis and the significant transformations achieved in the professional training of students, as a result of the application of the methodology.

The universe was made up of 100 students of the Mechanical Engineering career at the University of Holguín, from the last year of studies. The sample was selected by simple random sampling, assuming by statistical recommendation 30.0 % of the volume of the population, in this case 30 students.

RESULTS

The theoretical and methodological foundations allow us to recognize that in the Flipped Classroom a professional training process is produced in interactivity between face-to-face and multimedia (virtualized).

In this sense, it is opportune to limit that the face-to-face focuses on the physical presence of the worker in the classroom scenario of professional training; Meanwhile,

multimedia refers to the different multimedia resources that support the development of each of the contents that the worker learns (whether in initial or continuous training), taking the platform and/or resources as the curricular, or technology resources existing in the school, work, family and/or community context.

In the case of the empirical study, direct observation in the field was applied to the 30 students of the group's Mechanical Engineering career , with the aim of verifying how they interact with the activities guided by the teachers through the use of existing platforms, in addition to the use of the different possibilities in the Flipped Classroom as an *online* , telepresence and interactive way; this allowed to determine the state of professional training in the Flipped Classroom , based on six indicators that allowed it to be evaluated on a scale of High, Medium and Low.

Those indicators where the actions were developed with the characteristics described in the items (see table 1) were considered as Good; like Regular, those that were shown with these characteristics, but were insufficient or not very clear and, like Bad, those where the actions with the mentioned characteristics were not executed or are so insufficient or confusing that they do not achieve their objective.

Table 1- Indicators to evaluate the state of professional training in the Flipped Classroom

Indicators	**Scale**		
	B	**R**	**M**
1. Creation of the Flipped Classroom • Analyze the work to be done. • It establishes the logical actions for the solution of professionals from the Inverted Classrooms.			
2. Diagnosis of access to professional training shown by students through the Flipped Classroom • Interaction in the Flipped Classroom with the teacher through the use of existing platforms in the educational unit and the locality according to levels of connectivity.			
3. Characterization of the content that will be the object of learning by the student in virtual mode			
4. Preparation of tasks and projects designed by the teacher for student learning • Link between the academic component with the labor and research component			
5. Application of tasks and/or projects for learning in the Flipped Classroom			
6. Assessment of the state of professional learning achieved by the student in the Flipped Classroom			

The following table 2 represents the results of the observation carried out following the indicators described in table 1.

Table 2- Results of the observation to assess the state of professional training in the flipped classroom

Students	**1**	**2**	**3**	**4**	**5**	**6**
1	R	R	B	B	R	R
2	M	M	R	M	M	M
3	M	R	B	B	R	R
4	R	R	B	B	R	R
5	R	R	B	B	R	R
6	M	M	R	R	R	M
7	R	M	M	M	M	M
8	M	R	M	M	M	R
9	R	R	B	B	R	R
10	R	M	M	R	M	M
11	M	M	M	R	M	M
12	R	R	B	B	R	R
13	M	R	R	R	M	R
14	R	R	B	R	R	R
15	R	R	B	B	R	R
16	M	M	R	M	M	M
17	M	R	B	B	R	R
18	R	R	B	B	R	R

19	R	R	B	B	R	R
20	M	M	R	R	R	M
21	R	M	M	M	M	M
22	M	R	M	M	M	R
23	R	R	B	B	R	R
24	R	M	M	R	M	M
25	M	M	M	R	M	M
26	R	R	B	B	R	R
27	M	R	R	R	M	R
28	R	R	B	R	R	R
29	R	R	B	B	R	R
30	R	R	B	B	R	R

Once the results were determined by indicators, a general evaluation was made, from which the students were grouped into two groups: those who reached an evaluation in which (M) predominated, not skilled, and in those who prevailed the evaluation of (R), unskillful. Among those evaluated as unskillful are the students identified with the numbers: 2, 7, 8, 10, 11, 15, 20, 21, 23 and 25; as low skill: 1, 3, 4, 5, 6, 9, 12, 13, 14, 16, 17, 18, 19, 22, 24, 26, 27, 28, 29 and 30. It is corroborated that the development of professional training in the Flipped Classroom has notable deficiencies.

The previous assessments denote the need for change in the situation that is perceived and, in this sense, a methodology for the professional training of university students in Inverted Classrooms is presented.

Methodology for the professional training of university students in Inverted Classrooms

The proposed methodology offered the structure, the path and the logic to follow for the appropriation of the content of the profession through the design, implementation and evaluation of projects at an application and creative level, alternating in face-to-face and virtual (multimedia) times. To teaching, with the work and research component, based on the instruction-education-professional growth unit.

Based on these criteria, the methodology provides the following actions:

Action 1. Creation of the Flipped Classroom

Teachers, together with students, will create the Flipped Classroom according to the following aspects:

- The instantaneity, which will allow the involvement of teachers and workers from labor entities, from other nations, which promote and resignify the heritage and professional intercultural exchange to enhance the development of oral expression.
- Innovation, by allowing teachers, workers and students to generate innovative alternatives for the use of virtual environments that provide spaces to develop their oral expression.
- The automation and interconnection, which enables the development of activities in the Flipped Classroom, from the treatment to the unit of instruction, education and professional growth, in an interactivity in which socialization, debate and exchange of information and information prevail as a way to enhance the development of oral expression in students.
- Appropriate use of the Moodle platform or other existing resources and inputs in the context.
- Systematize professional learning tasks in which the content of oral expression is linked to the world of work.

Action 2. State of professional training shown by students in the Flipped Classroom

To do this, students must:

- Interact in the Flipped Classroom with the teacher, through the use of existing platforms in the educational

unit and the locality, according to levels of connectivity.
- Participate in the application of the diagnostic instruments applied by the teacher through *online,* telepresence, interactive, in the Inverted Classroom.
- Carry out a self-assessment of the state of your professional training in a virtualized way.

Action 3. Characterization of the content that will be the object of learning by the student in virtual mode

To carry out this operation, the following actions must be carried out by the students:

- Analyze, through chats created by teachers, interactive *online forums* in a debate with the teacher, how to develop their professional training.
- Understand the meaning and professional sense of the content they learn in the Flipped Classroom.
- Perform a current and prospective self-assessment of their learning

Action 4. Assessment of the tasks and projects designed by the teacher for student learning

The students, under the pedagogical mediation of the teacher and with the interactive participation of workers from labor entities surrounding the technological institute, will value the tasks and projects designed for their learning.

In this aspect, it is important that the teacher does not lose sight of the objectives, contents and the learning situation, considering the following aspects:

- Discuss the relationships between instruction, education, and professional growth.

- Stimulate the treatment to the meaning and professional sense of the content.

- Achieve the link between the academic component with the labor and research component.

· Multimedia resources required

Multimedia resources that will be used are specified, which offer the virtual environment or platform that is used in the Flipped Classroom. The teacher must incorporate videos, photos, didactic materials of productive processes or services of labor entities surrounding the educational unit, to on that basis link the content from a professional approach.

- **Duration time**

The interactive duration time of the task or project is determined. This will depend on the connectivity, the potentialities of the computing medium available and the complexity of the content.

Action 5. Application of tasks and/or projects for learning in the Flipped Classroom

Through the internal structure of the method on which the methodology is based, the following aspects will be taken into account:

The interactivity, which is revealed through the communication exchange system that is presented in the diversity of existing computer resources in the technological platform that is used (Moodle, among others) by the teacher and the student: chats, forums of discussion, learning activities, among others, which always combine the unity between instruction-education-professional growth.

During this action, teachers must:

- Promote motivation to satisfy a need, according to preconceptions and previous ideas that transmit impressive information, group interaction with the multimedia resource used in the Flipped Classroom and allow students to develop oral expression with a professional focus.
- Demonstrate an active role in promoting creativity, interactivity and innovation in problem solving, based on the personal decisions that the student assumes in the execution of tasks aimed at the development of oral expression.
- Treat interdisciplinary by integrating the content of oral expression with content associated with the world of work.
- Address the individual context by articulating and adjusting the training process to the individual characteristics of each student, according to their needs and potentialities and the benefits of the computer resource or platform on which the virtual classroom is mounted.
- Treat the meaning and sense that the content he learns has for the student with a professional approach.
- Promote cooperative relationships by promoting group actions, teamwork, debates, reflections, flexibility and awareness of the importance that personal actions have for the development of society.
- Produce a transformation in students by combining the instructional with the educational.

On the other hand, from this interactive conception of the virtual classroom, students must:

- Talk about various topics related to the world of work; the interests and personal tastes of the different topics addressed in classes and, very particularly, those treated in the texts of the professions and trades of the locality.
- Formulate and answer the questions oriented in the tasks through the multimedia resources used by the teacher.
- Acquire correct pronunciation and articulation.
- Use the appropriate tone and intonation for each type of message that is issued orally during the presentations, the scientific-technical debate, the narrations, the dissertations, the conferences, and the presentation of summaries, which are oriented towards the task that develops with the use of multimedia resources used in the Flipped Classroom.
- Communicate with the multimedia resource and transmit the message in a coherent, clear, precise manner and through the transit through the levels of development of oral expression.
- Comment your opinions, based on the instruction and education that you are achieving during your training process in the Flipped Classroom.
- To talk with the teacher, other students and workers of the labor group, in an emotional way, with simplicity, naturalness, by making appropriate body movements and gestures and an adequate use of vocabulary.

Action 6. Assessment of the state of professional training achieved by the student in the Flipped Classroom

A comparison will be made between the results achieved by the student in the input diagnosis (action 2) and the output diagnosis, to assess the qualitative transformations that they have achieved in their professional training.

This comparison will be carried out collaboratively and through a reflective dialogue between the students, the teacher and the labor entity specialist who participated through interactivity.

In this sense, first of all, the self-assessment of each student regarding the professional training that they manifest during the execution of the tasks and/or oriented projects should be encouraged; secondly, and through co-evaluation, other students will evaluate the results of the tasks and/or projects and, finally, the teacher, through hetero-evaluation, will make their judgments regarding the evaluation given to the student in terms of their professional training.

The criteria and judgments obtained from the self-assessment, co-assessment and hetero-assessment will be socialized and, in a cooperative manner, will allow recognition of the achievements and difficulties that students show in the development of their oral expression.

This activity must be carried out once the application of each task is finished, so that it allows you to evaluate the transformations that occur gradually in the student.

Action 7. Characterization of the professional training process in the Flipped Classroom

From the analysis of the achievements and insufficiencies that occur in the student's professional training, the causes that cause them will be deepened, which are manifested in the treatment in the Inverted Classroom, according to previous suggested actions.

Through workshops, training and reflective and collaborative dialogue between students, teachers, production specialists and services, the insufficiencies found in the student's professional training are correlated with the causes that provoke them, which occur through of their training process in the Flipped Classroom

For this, the following aspects must be addressed:

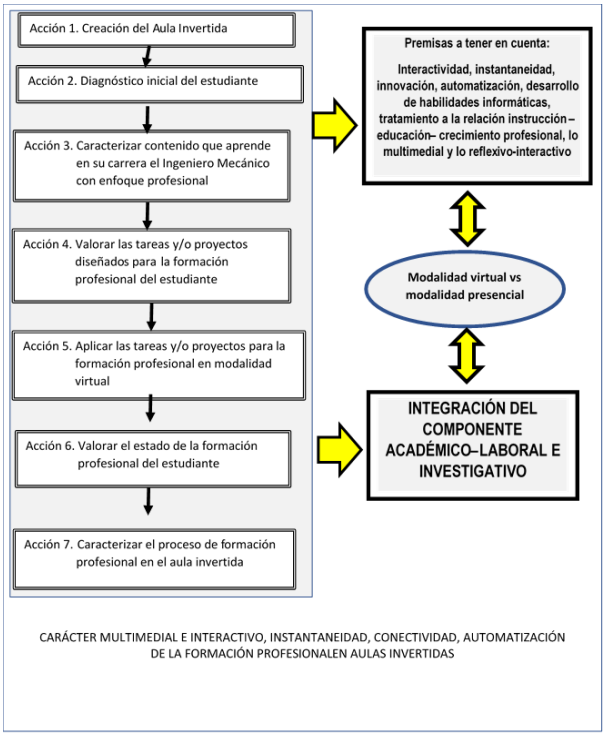
- Interactivity, this is the essential characteristic of performing the task. This guiding condition is manifested in the degree of dependency of configurability, complexity, multifocal, multimedia, diversity of typologies, evaluative and reflective, from the interaction with the multimedia resource or technological means used during the application of the actions of the methodology.

On the other hand, it favors the socialization and exchange of experiences among their fellow students, through interaction with the multimedia resource or technological medium (ICT), in which the proposals for solutions to the proposed learning situation are enriched and perfected and help them develop their oral expression.

- The instantaneity, based on verifying how the temporal and spatial barriers were addressed during the process developed in the Inverted Classroom.
- Innovation, based on the improvement, transformation and qualitative and quantitative improvement of existing technologies in the Flipped Classroom.
- Automation, interconnection used.
- The use of professional learning methods that achieve a link between the content of oral expression and the world of work.
- Preparation of students in the development of computer skills for the use of the multimedia resource and platform used in the Flipped Classroom.
- Treatment of the instruction-education-professional growth relationship.

- The multimedia, when referring to the different multimedia resources used: images or illustrations, locutions or sounds, videos, animations, slide shows, among others, in connection with the world of work.
- The diversity of typologies in which the learning situations of tasks with a professional approach can be focused, so that it is carried out based on a wide variety of questions, in order to develop the professional training of the student.
- The evaluative, when referring to the need to contemplate the professional training of the students in the process of solving the task, in such a way that they take an active role in the control of the results, immediately that they offer the answer and can carry out a comparison between the expected performance (what you should have done) and the evidence of performance shown (what you actually did).
- The reflective-interactive, to the extent that the platform or multimedia resource used in the Flipped Classroom offers students, during the process of solving the task, various forms and formats, in order to give a differentiated treatment to the errors made.

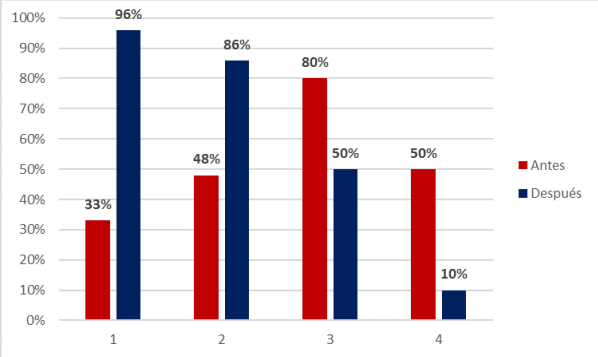
The following figure summarizes the methodology provided:



Pre-experiment. Results obtained

The methodology was implemented during the year 2020 and 2021 in a sample of 30 students of the Mechanical Engineering career. Preparation workshops were held for the career teachers who participated in the pre -experiment and, subsequently, they implemented the actions that are proposed in it with flexibility.

The following graph shows the total computation of registered data, through direct observation in the field of the state of the professional training of the students, before and after the methodology was applied.



Graph 1- Comparison of the state of professional training of students before and after the methodology was applied (Source: authors)

Where 1 is excellent, 2 is good, 3 is fair, and 4 is poor.

p (X^2) = 0.0025541< á (0.05). H_1 is accepted and H_0 is rejected. Significant differences.

As can be seen in the graph, improvements can be seen in the professional training of students with the use of the methodology.

For the analysis and interpretation of whether the differences are significant or not, the Chi-Square (X^2) statistician was applied, according to Villavicencio (2017), and the following statistical criteria: a recommended 95.0% confidence level was used for educational sciences, assuming a degree of reliability of á = 0.05. The following hypotheses were determined:

Nullity hypothesis (H_0): the professional training of the students, before and after applying the methodology provided in the research, is not significant.

Alternative hypothesis (H_1): the professional training of the students after applying the methodology, achieves significant differences with respect to its initial state (before being applied).

The following statistical condition was applied: if the value of the probability obtained ($X^{2)}$ is less than the degree of reliability assumed (á), that is, it is true that: p (X^2) d" á, then H is accepted 1. If the value of the probability obtained ($X^{2)}$ is greater than the degree of reliability assumed (á), that is, it is true that: p (X^2) >á, then H_o is accepted.

When applying the statistical test with the use of Excel, a probabilistic value of p (X^2) = 0.0025541 was obtained, which is below the degree of reliability assumed, which is 0.05; that is: p (X^2) = 0.002< 0.05; so, H 1 is and H o is rejected. This result showed that the differences in the data obtained in graph 1 accepted are significant. Significant improvements in the professional training of university students are achieved with the application of the methodology with 95.0% reliability, an aspect that allows recognizing its validity and testing the research hypothesis.

DISCUSSION

As it has been seen during professional training in the Flipped Classroom, students prepare for professional learning before teaching, by studying the diversity of resources and materials digitized *online* by the teacher. The first contact with the contents that the student learns occurs before face-to-face teaching in the classroom and, during this, work dynamics are created where the student applies the content in connection with the professional profile of the Mechanical Engineering career; research is promoted by carrying out tasks and projects, but this time alternating face-to-face with multimedia.

Systematizing a professional training process requires, according to Alonso, Cruz and Olaya (2020), to recognize the relationships

between the instruction-education-professional growth categories of the Didactics of Technical Sciences ; From the Professional Pedagogy they would be: Professional Technical Education; Comprehensive Technical and Professional Development and Technical-Professional Training, according to Bermudez and Pérez (2014), as well as the study carried out on project-based learning by Alonso, Ortiz and Cruz (2021), as well as Zúñiga, Cruz, Velez, Macias, Mera and Rodriguez (2021).

An instruction should be conceived in which the mechanical engineer appropriates the content of the profession through the solution of professional problems through an applicative and creative level, which enhances his education in values and achieves professional growth expressed in his way of feel, think and act in the work context, according to the performance standards established in the jobs.

For Alonso, Cruz, Parente and Del Cerro (2021), the Flipped Classroom is interpreted as:

> A context of professional training for workers, which promotes inverted professional learning, in dynamic and interactive spaces through harmonization, collaboration and face-to-face and contextualized multimedia interaction (use of existing technological resources in classroom, work, family and community settings), between the workers with other workers (in initial or continuous training), the teacher, tutor, specialist of the labor entities, their relatives and members of the local, national and foreign community (p. 178).

In the Inverted Classroom, an inverted professional training process is developed, interpreted as the process of transmission and appropriation of the content of the mechanical engineer, through the combination and interaction between face-to-face and multimedia (virtual learning environments), promoting the autonomy, creativity and technological innovation, as well as teamwork, from a reflective and interactive dialogic communication between the agents involved (student, teacher, tutor, specialist, family, community), and its purpose is initial or continuous professional training of the worker

From a critical qualitative analysis, the following successes and failures could be verified:

As mistakes, aspects are specified in which it is necessary to continue improving: in connectivity and access to networks in the Mechanical Engineering career during teaching, in increasing the speed of data transfer and internet access in areas with low connectivity.

Despite these difficulties, favorable impacts were seen on productivity, the performance of the labor entities of the municipality of Holguín, as well as on the quality of working life of its workers, as a consequence of the transformations achieved in the professional training of students. .

The main impacts stand out: in productivity and labor performance, an increase in efficiency, effectiveness, quality, profitability of the mechanized processes of typical parts was appreciated; In the quality of work life of the workers, a greater commitment, sensitivity, improved the quality of the production process, but this time with a high sense of added value and humanism, increased work motivation, decreased indiscipline and labor accidents. , mechanical processes were developed with the optimal use of material and financial resources,

oriented to sustainable development and for social benefit and for the health of workers.

From the study carried out, it is concluded that the Flipped Classroom is a context that dynamizes and transforms the traditional conceptions and approaches of professional training of university students, since it improves the autonomy and professional creativity of the student and the use of the potential of resources and virtual learning environments.

The methodology for the professional training of university students in Inverted Classrooms establishes a dynamic that allows integrating the academic component with the work and research component, through the combination of the face-to-face and virtual nature of said process.

The pedagogical pre-experiment allowed us to verify, through the Chi-square ($X^{2)}$ statistician, that, with the application of the methodology, the professional training of the sample of 30 students of Mechanical Engineering of the University of Holguín was significantly improved, as well as the impacts that this generated in the productivity of the companies, in the quality of work life of their workers, allowing to verify its relevance and feasibility.

BIBLIOGRAPHIC REFERENCES

Aguayo, M., Bravo, M., Nocetti, A., Concha, L. y Aburto, R. (2019). Perspectiva estudiantil del modelo pedagógico *flipped classroom* o Aula Invertida en el aprendizaje del inglés como lengua extranjera. *Revista de Educación 43*(1). Disponible en: http://dx.doi.org/10.15517/revedu.v43i1.31529

Alonso, L. A, Cruz, M. A., Parente, E. y Del Cerro, Y. (2021). Concepción didáctica de aula invertida para la formación profesional de los trabajadores. *Revista Científica Medio Ambiente Tecnología y Desarrollo Humano FAREM-Estelí* 10(37) Disponible en: https://doi.org/10.5377/farem.v0i37.1121

Alonso, L. A., Cruz, M. A., Olaya, J. (2020). Dimensiones del proceso de enseñanza-aprendizaje para la formación profesional. *Revista Luz* (19), 2, 7-29. Recuperado de http://www.luz.uho.edu.cu/index.php/luz/article/view/1032

Alonso, L. A., Ortiz, A. L. Cruz y M. A. (2021). Método de aprendizaje profesional basado en proyectos para la formación de los trabajadores. *Revista de Investigaciones Andina 22*(1). Disponible en: http://revia.areandina.edu.co/index.php/IA/article/view/1832/1739

Bergmann, J. & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. Washington DC: International Society for Technology in Education

Bermúdez, R y Pérez, L. (2014). Aprendizaje formativo y Crecimiento personal. La Habana: Pueblo y Educación.

Hernández R., Fernández, C. y Baptista, P. (2014). *Metodología de la investigación*. México: EDAMSA IMPRESIONES S.A. de C.V. (5ta Edición).

Martins, E. R. y Gouveia, L. (2019). ML-SAI: Modelo pedagógico fundamentado na sala de aula invertida destinado

a atividades de m-learning. *Revista Espacios 39*(52). Recuperado de https://www.revistaespacios.com/a19v40n36/a19v40n36p19

Nuñez, J. A. y Merchor, G. A. (2020). Modelo andragógico aula invertida en la asignatura "Histotecnología III." Universidad de Carabobo. Valencia, Venezuela, *Revista Científica De FAREM-Esteli,* (33), 3-11. Disponible en: https://doi.org/10.5377/farem.v0i33.9604

Pérez, V., Jordán E.P. y Salinas, L. (2020). Didáctica del aula invertida y la enseñanza de física en la universidad técnica de Ambato. *Revista Mikarimin. Revista Científica Multidisciplinaria. VI*(1). Recuperado de http://45.238.216.13/ojs/index.php/mikarimin/article/view/931

Salas, R. y Lugo, J. L. (2019). Impacto del aula invertida durante el proceso educativo superior sobre las derivadas considerando la ciencia de datos y el aprendizaje automático. *EDMETIC, Revista de Educación Mediática y TIC, 8*(1), 147

Conflict of interest:

Authors declare not to have any conflicts of interest.

Authors´ Contribution:

The authors have participated in the writing of the work and analysis of the documents.