Flipped Classroom Methodology in Students at Technological Institutes

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Abstract

This study aimed to explore a methodology for the professional teaching of students of technological institutes (whether it is middle and/or higher level) in inverted classrooms. It is based on the alternative and interactive method of content appropriation 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 academic, labor, and research. Document review methods, the system approach, direct observation in the field, the pedagogical pre-experiment, and the Chi-square statistical test (X2) are used. As a result, the favorable impacts on the development of professional skills 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.

Contents

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1 Introduction

In this century, the teaching-learning processes of students of technological institutes have used various modalities, methodologies, and strategies for educational innovation. These are characterized in contemporary times by the presence, to a large extent, of technological resources in professional training institutions, 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 (Lu et al., 2002; McMullan, 2006).

The term flipped classroom, also known as flipped classroom or flipped learning, was introduced in a Colorado institute (Woodland Park High School), because some students did not attend face-to-face classes for various reasons (Strelan et al., 2020; Awidi & Paynter, 2019). This motivated me to generate didactic videos for students to watch before class, an aspect that allows them to clarify doubts and develop learning projects. Adopting this type of classroom scenario in the teaching process is a necessity in the current times of the COVID-19 pandemic; that allows combining the virtual modality with the face-to-face as an alternative so that the students of technological institutes continue through virtual teaching environments, training themselves as competent workers (Vescio et al., 2008; Postareff et al., 2007).

The result of the review of normative documents, direct observation of classes, as well as the criteria of students (workers in initial professional training), teachers, and tutors who work in the Mechanical Engineering career at the University of Holguín, Cuba, has made it possible to verify that the use of the inverted classroom in its teaching-learning processes is insufficient; 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 the teaching-learning processes allows recognizing, among others, the works of (Bergmann & Sams, 2012; Quiroga ,2015; Tourón & Santiago, 2015; Fernández Gámez& Guerra Martín, 2016; Vidal et al., 2016; Hernández & Tecpan, 2017; Salas & Sánchez, 2017; La Madriz & Mendoza, 2018; Sánchez et al., 2018; Santiago & Bergmann, 2018; Martins & Gouveia, 2019; Salas y Lugo, 2019; Torres, 2019; Aguayo et al., 2019; Gaviria Rodríguez et al., 2019; González Fernández & Huerta Gaytán, 2019; Chávez et al., 2019; Puebla, 2019; Nuñez & Merchor, 2020; Pérez et al., 2020; Alonso et al., 2021), as well as (Alonso et al., 2021).

All these investigations have provided conceptions, strategies, models for teaching-learning based on flipped classrooms, however, due to its objectives, the treatment carried out from the professional approach of said process in the training of students of technological institutes is insufficient. That is why the present investigation poses the following problem: how to contribute to the teaching - professional learning of students of technological institutes through the use of inverted classrooms? To contribute to the solution of the problem, the objective is: to propose a methodology for teaching-learning of students of technological institutes based on inverted classrooms (Voller & Prakash, 1987; Snyder, 2019).

2 Materials and Methods

A quantitative, experimental research was carried out and within it, the pre-experimental type according to Hernández et al. (2014), in which an interpretation is offered about the conception of teaching - professional learning in inverted classrooms and the impact of its implementation in the Mechanical Engineering career at the University of Holguín, Cuba, is evaluated. According to the criteria assumed by this author for a pre-experimental design, the following hypothesis is proposed: The implementation of a methodology for teaching-professional learning of students at technological institutes, which allows a flexible and contextualized interaction between face-to-face and virtual, contributes to improving their professional training in the labor context.

In this approach, the independent variable refers to the teaching-learning methodology in flipped classrooms (cause), which should improve the professional training of students at technological institutes

(effect, dependent variable). The research was carried out in the following stages: preparation of the theoretical reference framework on teaching-professional learning in flipped classrooms, design of the methodology for teaching-professional learning in flipped classrooms, validation of the methodology through a pedagogical pre-experiment.

It was used as methods: analysis, synthesis, document review, system approach that allowed the elaboration of the theoretical referential framework of the investigation, the justification of the problem, as well as the methodology for teaching - professional learning in inverted classrooms and direct observation. in the field, to assess the impact of the implementation of the methodology in improving the professional training of students.

The Chi-square statistician (X2) was used to verify the research hypothesis and the significant transformations achieved in the professional training of students because of the application of the methodology. The universe was made up of 100 students of the Mechanical Engineering career of the University of Holguín of 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.

3 Results and Discussions

In the teaching processes, some teachers are using flipped classrooms in polytechnic institutes as a teaching methodology. For Bergmann & Sams (2012), the inverted classroom is an andragogic model that consists of reversing the two moments that intervene in traditional education, that is, modifying the traditional methodological order, leaving the tasks in the classroom and the thematic content. They are learned at home. A change arises in the way of delivering content to students so that they can learn at their own pace, however, the process begins from home when students make use of information and communication technology (ICT) and the Internet, to access content resources carefully developed by teachers to review, analyze, and study them, allowing them to prepare them before class (Selwyn, 2003; Guston & Sarewitz, 2002; Arianggara et al., 2021). The dedication, motivation, and autonomy on the part of the student represent the basis of the learning process in this model. An inverted classroom is a pedagogical approach in which the instructional processes are carried out in a collective virtual learning space towards a virtual individual learning space, which is transformed into a dynamic and interactive learning environment, where the teacher guides the students. through interaction with existing multimedia resources.

The word "flip" according to Salas & Sánchez (2017), comes from a "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 evaluating the contents.

In the Flipped Classroom, 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 debated in class with the teacher's accompaniment as a mediator of the process, which has as its purpose the professional training of the student (Diachenko et al., 2021; Hardianti et al., 2021).

The professional training process is one that in a conscious, planned, and organized way is developed in educational institutions and labor entities in close connection, in a dynamic that integrates the academic component (teaching) with the labor component (work practice, internships, pre-service training). professional) and investigative by treating the relationships between instruction - education - professional growth and dialogic - reflective communication between the agents involved (teachers-students-tutors-family members, among others), which aims to develop professional skills (knowing, do, be, be, live together) in line with the profile of the graduate of the career, specialty, profession, and trade in question. Achieving the professional training of students from technological institutes in which they express 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 process of teaching – professional learning (Lytvyn et al., 2021).

In this sense, Alonso et al. (2020), state that the teaching-professional learning process aims to transmit and personalize the content of a profession (whether it is an intermediate technical profession or a university

profession), through communication. reflective dialogue between the participating actors (teachers, educators, business professionals, family, and community). In a dynamic that links and coordinates teaching, placement, research, and intensive learning, alternating unit times between training, education, and professional growth, with the main or permanent purpose of staff training.

Systematizing a teaching process - professional learning requires, according to Alonso et al. (2020), to recognize the relationships between the category's instruction-education-professional growth of the Didactics of Technical Sciences, as well as the study carried out on learning based on projects by Alonso et al. (2021), as well as (Zúñiga et al., 2021; Nga, 2021).

Instruction must be conceived in which the student appropriates the content of the profession, occupation, or trade through the solution of professional problems through an applicative and creative level, which enhances their education in values and achieves professional growth expressed in their way of feeling, thinking, and acting in the work context according to the performance standards established in the positions of job. For Alonso et al. (2021), the inverted classroom is interpreted as a professional training environment for workers that promotes inverted professional learning, in a dynamic and interactive space, through harmony, collaboration, and interaction. of face-to-face and contextual multimedia (using the technological resources available in the school, professional, home, and community spheres), workers and other workers (in initial or continuous training), teachers, mentors, specialists of the work unit, their families, and members of local, national, and foreign communities.

In the flipped classroom, students prepare before teaching for professional learning 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 career or specialty that he or she is studying and promotes research, by carrying out tasks and projects, but this time alternating face-to-face with multimedia

In the inverted classroom, a teaching process is developed - inverted professional learning, interpreted as the process of transmission and appropriation of the content of a certain trade, specialty, or university profession, through the combination and interaction between face-to-face and multimedia (virtual learning environments), promoting 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 a, community), and its purpose is the initial or continuous professional training of the worker.

Methodology for teaching - professional learning

From the criteria observed above, the methodology for teaching-professional learning of students at technological institutes using the inverted classroom can be presented. The proposed methodology offers interrelated actions aimed at teaching - professional learning of students at technological institutes, directed from the theoretical by the alternative and interactive method of content appropriation based on projects, which integrate the face-to-face modality with the modality virtual provided by Alonso et al. (2021).

This approach shows the structures, paths and logic followed to design, implement, and evaluate projects at both an applied and creative level, alternating face-to-face and virtual time. (Multimedia), teaching, with work and research components, based on the Teaching-Education-Professional Development unit (Alonso et al., 2021; Widana et al., 2021).

Contributions of the methodology

Action 1. Create the inverted classroom

Teachers together with the students will create the inverted classroom according to the following aspects contributed to the didactic conception by Alonso et al. (2020):

- The instantaneity that will allow the involvement of teachers and workers of the labor entities, from other nations that promote and redefine 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 that enables the development of activities in the inverted classroom, from the treatment to the unit of instruction, education, and professional growth in interactivity in which socialization, debate, and exchange of 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. Diagnose the state of professional training shown by students in the flipped classroom.

For 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 connectivity levels;
- 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. Characterize the content that will be the object of learning by the student in virtualized mode.

- To carry out this operation, the following actions:

Students must:

- 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 meaning of the content they learn in the flipped classroom;
- Carry out a current and prospective self-assessment of their learning.

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

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, taking into account the following aspects:

- Treat the relationships between instruction, education, and professional growth;
- Stimulate the treatment of meaning and professional sense of the content;
- Achieve the link between the academic component with the work and research component.

Required multimedia

resources Specify the multimedia resources to be used, which are offered by the virtual environment or platform 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.

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

- Promote motivation so that it satisfies 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 the development of oral expression with focus professional in students;
- 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 interdisciplinarity 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 it has for the student, the content that he learns 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.

For its part, from this interactive conception of the virtual classroom, students should:

- Talk about various topics related to the world of work; the interests and personal tastes of the different topics addressed in classes and very particular, 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 that are oriented in the tasks that it 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;
- Conversing with the teacher, other students, and workers of the labor group emotionally, with simplicity, naturalness, by making appropriate body movements and gestures and adequate use of vocabulary.

Action 6. Assess the state of professional learning that the student reaches in the flipped classroom.

A comparison will be made between the results achieved by the student in the entry diagnosis (action 2) and the exit diagnosis, to assess the qualitative transformations that he has achieved in his professional training. This comparison will be carried out collaboratively and through a reflective dialogue between the students, the teacher, the labor entity specialist who participated through interactivity.

In this sense, firstly, 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 stimulated, secondly and through co-evaluation, other students will evaluate the result of the tasks and/or projects and finally the teacher through the hetero evaluation will issue their judgments regarding the evaluation that they confer 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, cooperatively, 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. Characterize the teaching-learning process in the flipped classroom.

From the analysis of the achievements and insufficiencies that occur in the professional training of the student, the causes that cause it will be deepened, which are manifested in the treatment of the teaching-learning process in the flipped classroom, according to previous actions. suggested. 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 cause them, which are given to through their training process in the inverted classroom.

For this, the following aspects must be addressed:

- Interactivity, which is the essential characteristic of carrying out the task;
- This guiding condition is manifested in the degree of dependency of configurability, complexity, multi-focus, 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 contribute to developing in them their oral expression;
- The instantaneity in the function of verifying how the temporal and spatial barriers were attended 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 inverted 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 focus can be focused so that it is carried out based on a wide variety of questions 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 make a comparison between expected performance (what you should have done) and evidence of performance shown (what you did);
- The reflective-interactive to the extent that the platform or multimedia resource used in the flipped classroom, offers students various forms and formats during the process of solving the task, to give a differentiated treatment to the errors made.

| Action 1. Creation of the flipped classroom |
| Action 2. Initial diagnosis of the student |
| Action 3. Characterize content you learn in your career, specialty, or craft with a professional focus |
| Action 4. Assess the tasks and / projects designed for the professional training of the student |
| Action 5. Apply tasks and/or projects for vocational training in virtual mode |
| Action 6. Assess the state of the student's vocational training |
| Action 7. Characterize the teaching-learning process in the flipped classroom |

Premises to keep in mind: Interactivity, instantaneity, innovation, automation, development of computer skills, treatment of the relationship instruction – education – professional growth, multimedia and reflective – interactive

Virtual modality vs face-to-face modality

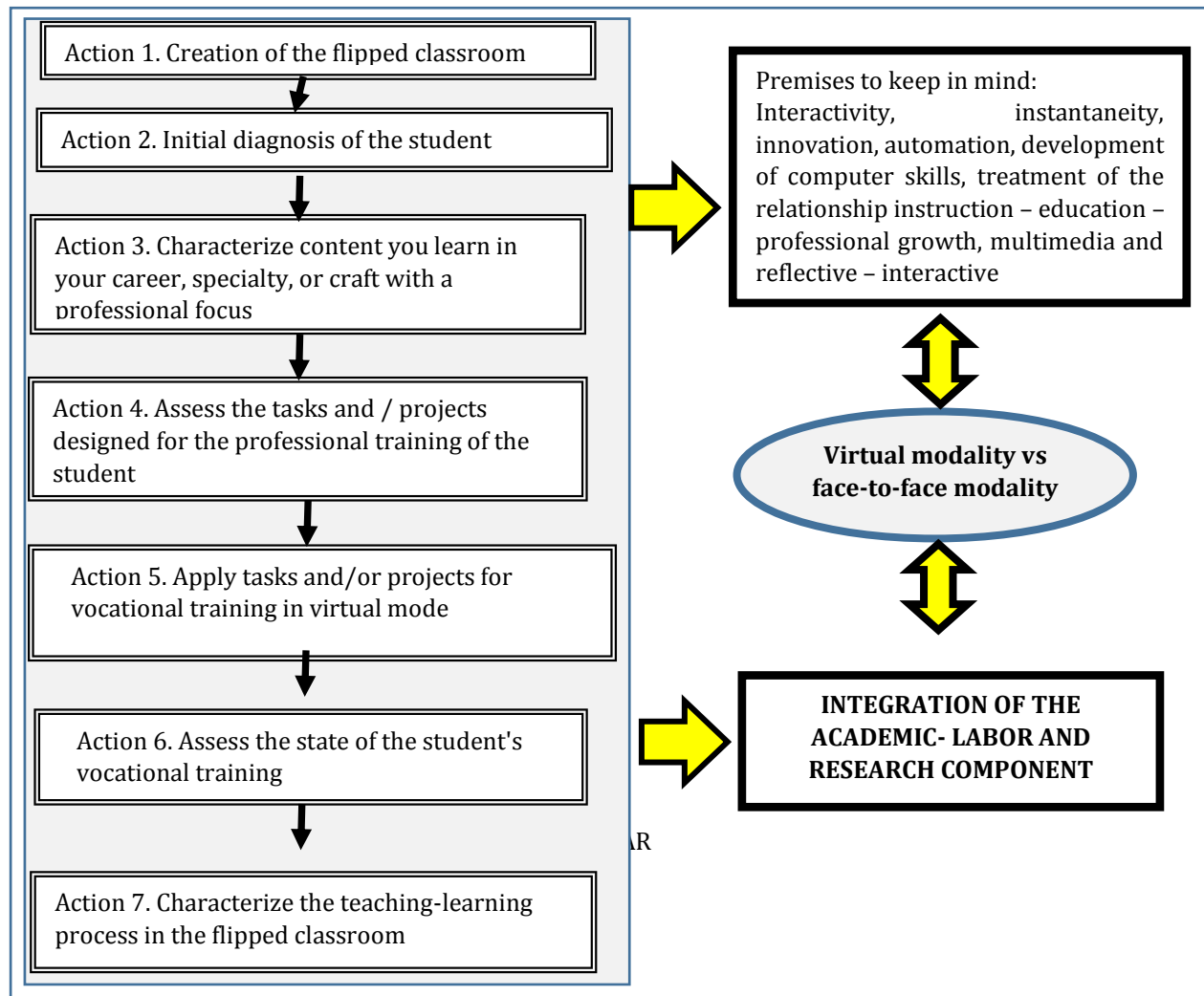**INTEGRATION OF THE ACADEMIC- LABOR AND RESEARCH COMPONENT**

Figure 1. Proposed methodologic

This methodology has multimedia and interactive character, instantaneity, connectivity, automation of teaching - professional learning in flipped classrooms. The methodology was implemented during the years 2020 and 2021 in a sample of 30 students of the Mechanical Engineering career. Preparation workshops were held for the teachers of the career who participated in the pre-experiment and later 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. Figure 2 shows the comparative graph of the state of the professional training of the students before and after the methodology was applied.
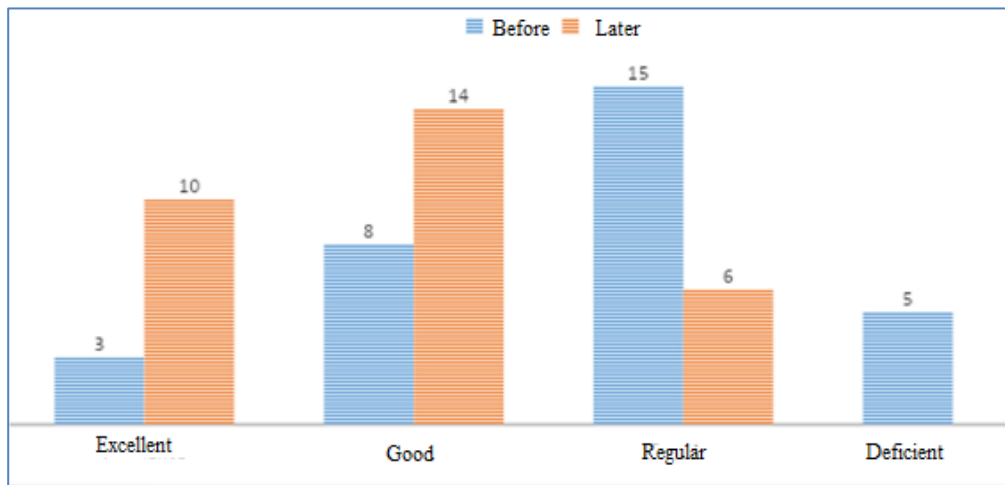
Figure 2. Status of the professional training of the students before and after the methodology was applied

When p (X^2) = 0.0025541 < α (0.05).is accepted1 is rejected for0 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 95.0% confidence level recommended for sciences was used. of education, assuming a degree of reliability of α = 0.05. The following hypotheses were determined:

(H0)→The professional training of the students before and after applying the methodology provided in the research is not significant.

Alternative hypothesis (H1)→The professional training of the students after applying the methodology, achieves significant differences 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 (α), that is, it is true that: p (X^2) ≤ α, then H is accepted1. Si el valor de la probabilidad obtenida (X^2) es mayor que el grado de confiabilidad asumido (α), es decir, se cumple que: p ($X2$) > α, entonces se acepta a Ho. 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 ($X2$) = 0.002 < 0.05; so H1 is accepted, and Ho is rejected. This result showed that the differences in the data obtained in graph 1 are significant. It is achieved with the application of the methodology in a 95.0% reliability, significant improvements in the professional training of students at technological institutes, an aspect that allows recognizing its validity and testing the research hypothesis. 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 the connectivity and access to networks in the Mechanical Engineering career during teaching, in the increase in the speed of data transfer and access to the Internet 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, because of the transformations achieved in the professional training of students. The main impacts stand out in productivity and work performance: an increase in efficiency, effectiveness, quality, the profitability of the mechanized processes of typical parts was appreciated.

In the quality of work-life of the workers: greater commitment and sensitivity were evidenced, the quality of the production process improved, but this time with a high sense of added value and humanism, work motivation increased, indiscipline and accident rates decreased. labor, mechanical processes were developed

with the optimal use of material and financial resources, oriented towards sustainable development and for the social benefit and health of workers.

4 Conclusion

The flipped classroom is a context of teaching-professional learning that dynamizes and transforms the traditional conceptions and approaches of professional training of students of technological institutes since it improves the autonomy and professional creativity of the student and the use of the potential of the students. resources and virtual learning environments. The methodology for teaching-professional learning of students from technological institutes in inverted classrooms establishes a dynamic that allows integrating the academic component with the work and research component through the combination of face-to-face and virtual nature of the said process. The pedagogical pre-experiment allowed to verify through the Chi-square statistician (X^2) 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 working life of their workers, helps to verify its relevance and feasibility

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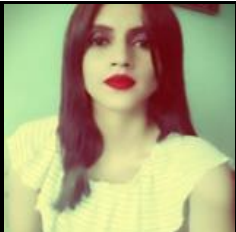Aguayo Vergara, M., Bravo Molina, M., Nocetti de la Barra, A., Concha Sarabia, L., & Aburto Godoy, R. (2019). Perspectiva estudiantil del modelo pedagógico flipped classroom o aula invertida en el aprendizaje del inglés como lengua extranjera. *Revista Educación*, *43*(1), 97-113.

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