Methodology for the formation of transversal competences in students of technological institutes based on projects

Luis Aníbal Alonso-Betancourt¹, Fredy Patricio Erazo-Rodríguez², Amanda Elizabeth Bonilla Bonilla³, Pedro Andrés Peñafiel-Arcos⁴, Karem Yael Cazares-Carrión⁵

¹Universidad de Holguín, Cuba. Doctor en Ciencias Pedagógicas. Profesor e Investigador Titular. http://orcid.org/0000-0003-0989-746X

²Escuela Superior Politécnica De Chimborazo (ESPOCH) Sede Orellana, Ecuador. https://orcid.org/0000-0002-2515-7042

³Escuela Superior Politécnica De Chimborazo (ESPOCH). Grupo de Investigación CAUSANA YACHAY, Sede Orellana, Ecuador. https://orcid.org/0000-0002-9429-1245

⁴Escuela Superior Politécnica De Chimborazo (ESPOCH) Sede Orellana, Ecuador. https://orcid.org/0000-0002-8723-1041

⁵Universidad Estatal Amazónica - Puyo, Pastaza, Ecuador. https://orcid.org/ 0000-0001-8415-7723

ABSTRACT

Competence development is a contemporary approach to the vocational training process. From this perspective, the objective of the research was to propose a methodology for the formation of transversal professional competences in students of technological institutes, based on projects that support a dynamic for their development based on the systematization of the principle of professional transferability and on the integration between the academic with the labor and investigative aspects from the instruction, education and professional growth unit, was oriented towards a quantitative approach, with a type of pre-experimental investigation. The sample under study was made up of 60 students from the Holguín Institute of Technology. Documentary analysis, systemic approach, observation, pre-pedagogical experiment, and the Chi-Square statistician (X²). After analyzing the data, it was found the existence of favorable impacts in the improvement of these competences in said students, as well as in the productivity and quality of working life of the workers of the companies where they developed the projects, which attest to the novelty. scientific research, concluding that training transversal skills allows articulating the basic and specific knowledge of a profession to solve professional problems with greater integrity, autonomy, professional creativity, quality, efficiency and oriented towards sustainable development.

Keywords: Training, skills, methodology.

1 Introduction

The continuous changes in science, technology, production systems and services condition new ways of life, production and work, which demands that the technological institutes that train qualified workers, mid-level technicians and professionals graduated from university careers, guide their purposes to the formation of fully developed subjects, creative individuals, researchers, with skills to face the great challenges of a society in constant change and transformation, so that they can participate creatively and innovatively in solving problems professionals associated with their object of work.

In this sense, the United Nations Educational, Scientific and Cultural Organization (2012) considers that a flexible and diversified curricular design should be promoted, based on local realities, cultural traditions, social projects and where the models' educational projects are based on the proposal of learning to know, learning to live together and learning to be. From this perspective, it is important that the higher education system regulates and implements an integrated curricular process that promotes a comprehensive and quality education of university students in the context of accelerated changes in its global context. (Garcia, 2016, p.1).
It is necessary to know the current situation of the technological institutes in the face of the reality of the environment that involves technological, economic, social, political and environmental aspects, to project and direct their educational work towards the fulfillment and achievement of the objectives and goals established based on train professionals who demonstrate through the versatility of their performances in the work context, competencies in correspondence with the standards and socio-labour demands of the jobs.

Due to all these aspects, it is convenient and a priority that professionals who graduate from technological institutes have basic, specific and transversal competencies, which include theoretical and practical knowledge, skills and professional values that allow them to participate and advise all those involved in their professional activity, in order to improve production and therefore the social, economic and environmental condition of all communities.

According to the current curricular project of the specialties and technical careers that are studied in the technological institutes, nowadays the national and foreign literature emphasizes the need to form transversal competences (also called generic) through their professional performances, which allows them to articulate the basic and specific knowledge associated with their tasks and functions.

Therefore, to achieve the objectives, students from technical institutes must develop special, basic and comprehensive competencies during professional training, which, integrated and unified, form their corresponding professional qualification to the demands of working life.

Thanks to the results of the final projects carried out as the culmination of the research work of the students of the Technological Institute of Holguín, Cuba, and the follow-up of the results of their work, the following difficulties were identified: Insufficiencies in the interpretation of economic demands, environmental and technological, functional that characterize the jobs in which they perform; in economic management, which does not always guarantee the optimal, efficient and rational use of time and material and human resources used to solve professional problems; limited use of research, which limits the proposal of technological innovation alternatives to professional problems associated with the object of their profession; in environmental management through which they do not always take into account the care, conservation, sustainable development of the environment in the solution of professional problems through the application of technological work methods; they do not always use computing as a learning object and work tool; the teamwork that they carry out with an inter and transdisciplinary character during their professional performance in the production and services process is insufficient; They do not always assume an entrepreneurial attitude during the work they do, which makes it difficult for them to search for alternatives that are feasible, from the social, economic, financial, technological and environmental point of view, to improve the positioning of the labor entity on a local scale, national and foreign.

This result made it pertinent to find a contradiction between the need to professionally train students in technological institutes with professional skills to respond to the demands of the social mandate of the profession they study and the insufficiencies that they present in the development of their transversal skills, which makes it difficult to comply once they graduate in the work context.

The analyzes of research consulted in recent years on the formation of competencies, among which Tejeda (2011); Tejeda and Sánchez (2012); Zorob (2012); Tobon (2013); Villarroel and Bruna (2014); Manrique and Sadornil (2015), Tejeda (2016); García (2016), Sopo, Salazar, Guzmán and Vera (2017), Fonseca, Amaya and Gómez (2017), Maury, Marín, Ortiz and Gravini (2018); Cedeño, Sánchez and Alonso (2018); Salcines, González, Ramírez and Martínez (2018); Castillo, Samaniego, Chew, Gaytán, Rodríguez and Lizárraga (2018); Ronquillo, Cabrera and Barberán (2019); Mosquera, Bayona and Vergel (2019); Zholdasbekov, Aymenov, Shagataeva, Esimkhanova, Dzharrybaeva & Kolyeva (2019); Seckel and Font (2019), Moya, Alonso, Vera, Corral and López (2019), Silva and Mazuera (2019), as well as Machado and Montes de Oca (2020), Quijije (2021), Alles (2021), Guillen, Alonso, Tejeda and Cedeño (2022), as well as Alonso, Cruz and Ronquillo (2022), have made it possible to recognize the existence of models, strategies, projects and methodologies aimed at the formation of basic, specific and transversal (generic) competences, but without deepen the use of the project as a form of organization for the formation of transversal competences in students of technological institutes.
That is why the objective was to propose a methodology for the formation of transversal professional competences in students at technological institutes, which contributes to improve their professional performance once they graduate from a more inclusive perspective.

2 Materials and methods

The type of research that is assumed is quantitative, experimental and within it, the pre-experimental type according to Hernández, Fernández and Baptista (2014) since in the first place it explains the logic, the path and the way to follow to the formation of transversal professional competences in the students of technological institutes and later shows the data obtained with its introduction through a case study in the same sample before and after its application.

This quantitative and quasi-experimental approach, starts from the idea of the problem and approach, visualizing the scope of the methodology as a scientific result that is provided in the research, elaboration of the hypothesis and determination of the variables and development of the research design.

The research hypothesis proposes that the application of a methodology for the formation of transversal professional skills in students of technological institutes based on the principle of professional transferability and the establishment of a project development dynamic that harmonizes and integrates the academic component (teaching), with labor (internships and internships) and research associated with technological innovation from the unit between instruction - education - professional growth, contributes to improving their performance to solve professional problems with greater comprehensiveness, autonomy, professional creativity, quality, efficiency and oriented towards sustainable development.

In this hypothetical approach, the dependent variable refers to the professional performance of the students of technological institutes and the independent variable refers to the methodology for the formation of transversal professional competences based on projects.

Of the scientific methods assumed in this research, the bibliographic analysis and synthesis method based on the collection, study and extraction of knowledge and good practices associated with training based on transversal competences (also recognized as generic) are cited.

The pre-experimental design is appealed when validating the methodology that is provided accompanied by the Chi-Square statistician ($X^2$) according to criteria of Villavicencio (2017) to verify the research hypothesis and therefore the significant transformations achieved in students and their impacts on the productivity and work performance of companies.

Observation was also used to verify the behavior of the formation of transversal competences in students of technological institutes, as well as the introduction of the methodology from the integration of the academic, labor and investigative component.

The population object of the case study carried out to validate the methodology proposed in this research, was made up of 200 students from the technological institute of Holguín, Cuba. Through a simple random sampling by statistical recommendation, a sample of 60 fourth level students was selected, which represents 30.0% and makes it representative of the volume of the population.

3 Analysis and discussion of results

The methodology that is provided in the research establishes a set of interrelated actions, aimed at the formation of transversal professional skills in students of technological institutes, which is based on the principle of professional transferability and expresses as scientific novelty (uniqueness). the establishment of a dynamic based on the systematization of projects that integrate the academy (teaching) with labor practice and research work and technological innovation.

For the elaboration of the methodology, the alternative suggested by Alonso, Leyva and Mendoza (2019) was used, which recognizes that it is structured in a cognitive theoretical apparatus and another instrumental one.

The theoretical apparatus of the methodology that is provided in the research is made up of: the categories: competence, entrepreneurship competence, instruction, education and professional growth, the principle of professional transferability, as well as the use of problematic learning methods established by (Ortiz, 2017) and training projects established by (García, 2016), which are implemented from the actions that are provided. The
instrumental apparatus provides the actions to be carried out jointly between teachers, tutors and students aimed at training the latter, transversal professional skills through the systematization of their cognitive theoretical apparatus.

One of the contributions made in the cognitive theoretical section of the methodology is constituted by the **professional transferability principle**, which bases the formation of professional competences from empowering in the professional the quality to adapt, reconcile, adjust and apply the contents of the profession (basic, transversal and specific) that are the object of appropriation during teaching in the educational institution, to solve professional problems and guarantee compliance with the socio-labor requirements of the jobs of the labor entities in which they work, based on the use of scientific research associated with technological innovation and/or educational processes.

4 **This principle establishes two essential theoretical postulates:**

Recognize the appropriation of the contents of the profession through the integration of the potentialities and educational influences of the diversity of professional training contexts: educational institution, labor entity, family, community with their meanings and professional training experiences.

Recognize the character of deepening and systematization of professional practice, through its performances in line with the socio-labor demands and the professional problems of the diversity of jobs associated with the object of the trade, specialty, or profession.

In a general sense, it is based on the objective need to interpret the formation of transversal professional competences, from meaning the relationship between the appropriation of contents of the profession from the diversity of contexts: educational institution, labor entity, family, community with its meanings and professional training experiences and the deepening and systematization of professional practice, through its performances in line with the socio-labor demands and the professional problems of the diversity of jobs associated with the object of the trade, specialty or profession.

All of this makes it possible to achieve, through integrating training actions, this professional training process, since it directs the achievement of professional performance levels as an expression of the appropriation of the contents of the profession with the meanings and experiences of professional learning, since they constitute aspects that are essential bases that directly affect those who are in the process of professional training, from the interaction of theoretical and practical thought.

The professional meanings constitute the aspects contained in the relationships of the professional training process that are apprehended and are a synthetic expression in the subject (student) that is being trained, capable of assigning a professional value from their convictions, ideas and worldviews, that is, from the thought, action and their motivations.

The meaning and professional sense constitutes the expression of cognitive and affective relationships established by the worker in initial or continuous training between the characteristics of the contents of the profession object of appropriation through the professional learning task or the training project that he carries out and his motivations, interests and needs, by means of which it confers or not importance and usefulness to be transferred in the solution of professional problems and to guarantee compliance with the socio-labor demands of the diversity of jobs associated with the object of their profession, specialty and trade.

Addressing this category is essential when it comes to developing transversal competencies, since each student will establish their own relationships between the content of the profession (whether basic, transversal or specific) that they learn in each task or project they carry out with their needs, interests and motivations, an aspect that will allow him to demonstrate if he has understood the meaning it has for him, to achieve the transversal competences for his future professional performance, so that he can transfer them to solve the professional problem.

This means that professional transferability allows the objectification of epistemological, functional, procedural and logical processes that are an expression of professional reality and move a diversity of interpretive subjectivities, in achieving the ascent from the abstract to the concrete.

The foregoing enables the deepening, deepening and systematization of professional practice, through its performances in line with the socio-labor demands and the professional problems of the diversity of jobs associated with the object of the trade, specialty, or profession, as another feature of the professional transferability that is revealed as a component that is conditioned and in a dialectical relationship with the first postulate of the principle.

The deepening and systematization of professional practice constitutes the component that activates the creative process of the subjects involved in professional training since they are committed to raising their training, based on
their own analysis, experiences, values and concepts, with the purpose of preserving, disseminating, and developing the professional learning inherent to its work object.

When the content of the profession is transferred to the solution of professional problems and to guarantee compliance with the socio-labor demands of the jobs, it is achieved that the worker in initial or continuous training deepens and systematizes his professional culture expressed in each of the pillars that characterize him as a competent worker.

5 This principle is based on the following premises:

Systematization of the relationship between professional mobility and the transfer of knowledge with professional meanings and formative experiences.

The professional mobility constitutes the expression of the availability that the worker has to perform in the diversity of jobs related to his profession, specialty or trade, which allows him to guarantee compliance with his socio-labor demands that emerge from the diversity of technologies, inputs and resources that are used continuously and systematically in work contexts in an ever-changing environment and work environment (functional and geographical).

The transfer of knowledge with professional meanings and formative experiences constitutes the expression of the integration of daily and scientific knowledge, experiences and group and individual experiences, as well as skills, values, attitudes, aptitudes, professional interests and motivations (competences) that the worker in initial or continuous training must adjust, adapt, reconcile and contextualize during their professional performance in the work context, in a way that allows them to adjust and interact with the existing contextual technological diversity in a certain job position associated with the object of their profession, specialty or trade.

The transfer of knowledge (knowledge, skills, and professional values) that are linked and articulated in the logic of basic, transversal, and specific interaction of the professional, arises precisely from the synergy that results as a result of the cognitive relationships established by the worker in initial training, or continuous on knowledge related to teamwork, entrepreneurship, economic, efficient and rational, environmental management, the use of research and information technology from their professional know-how, with their motivations, professional interests and intrinsic training needs, through which it confers or not importance and utility, that is, a meaning with a humanistic, professional and social sense that will allow its application or not during its interaction with the diversity of technological work methods that it uses to solve professional problems in the diversity of jobs in which the professional performs rally.

The humanistic, professional and social sense is expressed to the extent that the worker in initial or continuous training demonstrates an added value in his professional performance that makes him more versatile in meeting the demands of his social order, by demonstrating knowledge in an integrated manner, skills, attitudes, motivations, sensitivity and professional interests that allow teamwork, being entrepreneurs, guaranteeing the saving of materials and resources, the care and conservation of the work environment (environment), the use of information technology and research to the introduction of innovative alternative solutions to professional problems.

Hence, there is an interaction between the technological changes that operate in the diversity of jobs in the labor context in which the worker in initial or continuous training works through their professional mobility and the integration of knowledge that must be of appropriation to adjust to said technological changes, in which they must transfer knowledge of a basic, specific and transversal nature such as: teamwork, leadership, entrepreneurship, economic and environmental management oriented towards sustainable development, research and information technology. required to interact with the technological diversity that expresses the socio-labor demands of the jobs through their professional mobility.

That is why between professional mobility for jobs and the transfer of knowledge with meanings and formative experiences there is a relationship that constitutes an essential premise of the principle of professional transferability, which is expressed in the need to professionally train the worker in training initial or continuous through the transfer of the contents of the profession (basic, specific and transversal) that you learn while teaching at the educational institution (polytechnic school, trade school, university, training center, etc.) for problem solving professionals and compliance with the socio-labor demands of the diversity of jobs in which they will perform as an expression of the professional mobility that they carry out during labor insertion, an aspect that will allow them to offer meanings and professional senses and achieve formative experiences expressed in their growth professional.

Important in this transfer to promote the use of research and information technology by the worker in initial or continuous training, which allows him to transform and enrich the knowledge associated with the socio-labor
demands of the jobs, raise the quality of working life of workers, as well as increasing the quality, efficiency, sustainability and productivity of production and service entities.

Another essential premise of this principle is the following:

Address the professional training effect from teaching, job placement and research.

The professional training effect is the expression of the process and result of the professional growth achieved by the worker in initial or continuous training, singled out in their basic, transversal and specific competences (which will be studied in the next chapter), which is generated as a result of the evidence of the professional performance that it shows and the level of impact (objective or distorted reflection) that it generates in the production process and services in pursuit of raise the quality of working life of workers, as well as increase the quality, efficiency, profitability, sustainability and productivity of production and service entities, which maintains and cultivates relationships of balance and harmony with nature and society to guarantee a full existence

Based on this principle and the problematic learning methods provided by (Ortiz, 2017), the actions to train transversal competences in students of technological institutes are presented below. They are the following:

Action 1. Diagnosis of the initial state of the formation of transversal competences presented by the student (input diagnosis).

- In the first place, the current state that students present in the formation of their transversal competences (leadership, teamwork, entrepreneurship, research, information technology, decision-making, professional creativity) must be diagnosed.
- The diagnosis is aimed at describing, explaining, and assessing the causes of the difficulties, needs, achievements and potential that the student has in the formation of the transversal competences that must be achieved to perform with quality and in a more inclusive way in the work context.
- The diagnosis is aimed at identifying the professional needs that students have, that is, the problems they present in terms of the formation of transversal competences that they possess before starting the Internships and Internships.
- The student's problems constitute the material and/or spiritual deficiencies (of motivation, interest and affective - volitional behavioral) that make it difficult for them to appropriate and apply the knowledge that is linked and articulated during their basic and specific professional performance that they carry out in the solution of professional problems that manifest themselves in the work context.

The instruments that are designed for students must meet the following requirements: Their contents must be directly related to the transversal competence or competences that will be the object of diagnosis. They must be realistic and practical. Be valid and reliable. Adjust to the type of transversal competence that is diagnosed. Be applicable under the conditions and time established (before starting the practices). Be complex, but as brief as possible. Be precise, but clear in your wording.

As instruments for the diagnosis of the state of the formation of transversal competences, the following are recommended: observations, questionnaires, interviews, surveys, professional performance tests, group meetings, among others.

Action 2. Design training projects.

The projects to be carried out by the students will have the following structure:

- Theme of the project: Which must be original, motivating and novel, as well as be directed to the knowledge that configures the transversal competence that will be formed.
- Professional problem: The professional problem that the student must solve during the project is declared, which must encourage the student to apply the knowledge that is linked and integrated with his basic and specific professional performance required for the solution in his solution. of this.
Transversal competences:

The transversal competences that will be the object of training are declared, among them the following are suggested in a generic way: leadership, entrepreneurship, teamwork, investigative, computer science, decision-making, economic, legal, environmental, energy education, among others, whose knowledge that configures it is interconnected with the basic knowledge associated with the exact and humanistic sciences, as well as the specific knowledge of the profession itself in question.

Knowledge that configures transversal competence:

The knowledge that is linked to the basic and specific professional performance of the Agricultural Engineer is specified in due depth, based on the demands of the job where he performs the rotation and the productive or service process to which the project responds.

System of professional tasks to be carried out:

Each of the professional tasks to be carried out must have a period, that is, delimit the space-time relationship of execution depending on the nature, rigor and complexity of the knowledge that makes up the transversal competence that is being trained.

In professional tasks, problematic situations must be considered in which students have to combine the knowledge that makes up the transversal competences with the basic and specific knowledge associated with the magnitude and complexity of the professional problem. On the other hand, they must foster the link between the teaching they receive with their practices and internships, as well as weigh the use of research, all of which will be carried out based on the relationships between instruction - education and professional growth.

In addition to the above, the job position for which the student must rotate to perform it must be specified, as well as the material and human resources required to allow interactivity and adequate professional communication between the student with other students, their tutor, the supervisor and the teacher during its execution, control, and evaluation.

Approach to the transversal competence assessment rubric

Finally, the rubric to follow to evaluate the students will be presented, that is, to assess the state of the formation of the transversal competence that has been the object of training during the realization of the project. In it, the indicators must be established to assess the knowledge that configures it and guarantee its formation in the short, medium and long term.

Action 3. Application of projects for the formation of transversal competences.

The students proceed to execute the conceived projects, starting from systematizing the problematic learning methods that contribute to:

- Stimulate the treatment of the instruction-education-professional growth unit.
- Systematize the principle of professional transferability from its theoretical postulates.
- Link the academy (teaching) with work and research.
- Promote a professional heuristic socialization based on reflective dialogical communication between students, the tutor, the supervisor and the multimedia and technological resources used during the project.
- Require students a prospective self-assessment of the experiences acquired during the project they are carrying out, through professional tasks in which they express the new meaning and professional sense that they have had in their professional training, the acquisition of transversal skills.
- Promote group relationships (teamwork), respecting individualities.
• Stimulate the best results and offer differentiated attention according to the achievements achieved and develop the student’s self-esteem during the training of their transversal competences.

• Promote student autonomy, creativity, and professional motivation.

Once the projects are completed, the fifth action is carried out:

**Action 4. Evaluation of transversal competences.**

We proceed to jointly evaluate the result of the transversal competences that the students achieve once the projects have been completed, based on the rubric established in them and the following recommendations:

• Promote the collaborative nature of the assessment of transversal skills through self-assessment, peer-assessment and hetero-assessment that occurs between students, the supervisor (teacher) and the tutor who attends them in the workplace.

• Promote reflective dialogue between the subjects involved (supervisor, teacher, tutor and students).

• Recognize the continuous reflective nature of pedagogical decision-making to improve the training of transversal skills.

Based on these recommendations and the evaluation rubric established in the project, the state of the transversal competences that the students have achieved is evaluated.

It is also recommended to reapply the instruments designed in the first action and compare the initial diagnosis with respect to the diagnosis that emerges as a result of the evaluations achieved by the students in carrying out the projects and/or in the application of the instruments itself. designed. Subsequently, the result obtained in the professional growth demonstrated by the student will allow continuous improvement of the methodology.

As part of the evaluation, the economic, environmental, and social effect generated by the alternative solutions to professional problems solved by students in training projects should be considered. It should be assessed what innovative, original, and novel alternatives were generated by the students through the investigative method in solving professional problems that manifest themselves in the productive and/or service process.

The indicators for the evaluation will be established on the scales of very good: when it combines the knowledge (knowing, doing, being, being and living together) in a totality to solve the professional problem raised in the project, good: when it demonstrates three of them, specifically, knowing how to do and being, regular when it only demonstrates knowing how to do and deficient when it does not reach the category of regular. Those in charge of designing the projects will systematize these criteria based on the nature of the knowledge associated with the transversal competence that they evaluate, which allows verifying their professional growth because of the instructive and educational actions carried out in the professional tasks established in the projects.

Finally, it is valued how they made proposals for alternative solutions to professional problems, in which they contributed to the sustainable development of the productive process or services, as well as to the optimal use of the material and human resources used, which contributed to the improvement of the quality of working life and increasing the quality, efficiency and productivity of the process in which they are inserted in the work context.

**Action 5. Redesign of the actions for the reorganization and improvement of the training process of transversal competences in future periods.**

Derived from the achievements and existing difficulties in the formation of transversal competences that students reach, organizational, administrative, training and research actions are proposed, aimed at improving this process for future periods. The organizational actions will be aimed at perfecting the organizational order and selection of work scenarios with conditions to develop transversal skills in students; while administrative actions involve both managers and teachers in compliance with the actions suggested in the methodology. Figure 1 summarizes the proposed methodology.
Figure 1. Representation of the methodology for the formation of transversal competences

The methodology was applied through a pedagogical pre-experimental carried out in a sample of 60 students from the technological institute of Holguín, Cuba.

Through direct observation in the field, the professional performance of the students was assessed, using the indicators and evaluation criteria suggested by García (2016), in which they demonstrated evidence of the transversal competences they had before the application of the methodology. Table 1 shows the result obtained.

Table 1. Initial state of the transversal competences that the students at the technological institute demonstrated to have before applying the methodology (September 2021).

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<thead>
<tr>
<th>Assessment</th>
<th>Amount</th>
<th>Percent (%)</th>
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<tbody>
<tr>
<td>Very Good (VG)</td>
<td>2</td>
<td>3,4</td>
</tr>
<tr>
<td>Good (G)</td>
<td>5</td>
<td>8,3</td>
</tr>
<tr>
<td>Regular (R)</td>
<td>35</td>
<td>58,3</td>
</tr>
<tr>
<td>deficient (D)</td>
<td>18</td>
<td>30,0</td>
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As can be seen in the input diagnosis of the sample of 60 students, 2 were evaluated as very good for 3.4%; 5 good for 8.3%; 35 regulars for 58.3% and 18 deficient for 30.0%.

The methodology was applied during the period from September 2021 to June 2022 (one semester), evidencing the following transformations that attest to its novelty:

- Systematization of the development of transversal competences of students during their professional training process, based on the instruction-education and professional growth unit.
- The projects carried out by the students are introduced to the treatment of the development of their transversal competences from the know-how that characterizes their professional performances, in a new dynamic that links teaching with practices and internships and research work.
- The established professional training programs incorporate in their methodological orientations, the new dynamics offered in the methodology for the formation of transversal competences from the systematization of the principle of professional transferability.

Through direct observation in the field, the professional performance of the same sample of students was evaluated again after applying the methodology. Table 2 shows the result obtained.

Table 2. State of the training of transversal competences of the students at technological institutes (June 2022) (after applying the methodology in a training semester)

<table>
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<tr>
<th>Assessment</th>
<th>Amount</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Good (VG)</td>
<td>20</td>
<td>33.3</td>
</tr>
<tr>
<td>Good (B)</td>
<td>33</td>
<td>55.0</td>
</tr>
<tr>
<td>Regular (R)</td>
<td>5</td>
<td>8.3</td>
</tr>
<tr>
<td>Deficient (D)</td>
<td>2</td>
<td>3.4</td>
</tr>
</tbody>
</table>

It is observed that, this time the same sample of 60 students, 20 reached the category of very good for 33.3%; 33 were evaluated as good for 55.0%; 5 reached a regular evaluation for 8.3% and 2 were deficient for 3.4%. The comparative data is established in the graph of figure 2.

![Figure 2. State of the formation of transversal competences of the students of technological institutes before and after applying the methodology.](image)

For the analysis and interpretation of whether the differences are significant or not, the Chi-Square statistic ($X^2$) according to Villavicencio (2017) and the following statistical criteria: The 95.0% confidence recommended for education sciences was used, assuming a degree of reliability of $\alpha = 0.05$. The following working hypotheses were outlined:
Null hypothesis (H₀): The formation of transversal competences in students at technological institutes before and after applying the methodology is not significant.

Alternative hypothesis (H₁): The formation of transversal competences in the students at technological institutes after applying the methodology achieves significant differences with respect to its initial state (before it was applied).

The following statistical condition was applied: If the value of the probability obtained (X²) is less than the assumed degree of reliability (α), that is, it is true that: p (X²) ≤ α, then H is accepted; and H is refused. If the value of the probability obtained (X²) is greater than the assumed degree of reliability (α), that is, it is true that: p (X²) > α, then H is accepted and H is refused.

When applying the statistical test with the use of the SPS package, a probabilistic value of p (X²) = 0.00235, which is below the degree of reliability assumed to be 0.05, that is: p (X²) = 0.002 < 0.05; so, H is accepted, and H is refused.

This result demonstrated that the differences of the data obtained in the graph of figure 2 are significant, that is, it is inferred that with the application of the methodology, a 95.0% reliability is achieved, significant improvements in the formation of transversal competences in students of technological institutes, an aspect that allows recognizing its possible validity.

As transformations achieved in the professional performance of students as evidence of their transversal competences, we have the following:

- They improved compliance with the economic, environmental and technological, functional requirements that characterize the jobs in which they worked during the projects.
- They raised the quality of economic management, an aspect that contributed to achieving a more optimal, efficient and rational use of time and material and human resources used to solve professional problems.
- They improved in the use of research and information technology, an aspect that allowed them to generate, from their creativity, innovative alternative solutions to professional problems associated with the object of their profession.
- They generated alternative solutions to environmental problems caused by the application of technological work methods, which contributed to the care, conservation and sustainable development of the environment.
- They achieved improvements in teamwork of an inter and transdisciplinary nature during their professional performance in the production and services process.
- They were more entrepreneurial during the projects they carried out, an aspect that contributed to improve to a certain extent the positioning of the labor entity at the local level.

It was interesting in this experience, the favorable impacts on productivity, the performance of companies in the municipality of Holguín, as well as the quality of working life of its workers, as a consequence of the transformations achieved in the training of transversal skills of students. In this sense, it was found that:

- It was possible to increase the efficiency, effectiveness, quality, profitability of the productive processes associated with the technical specialties of the sample of students participating in the pre-experimental, which contributed to the fulfillment of the goals and strategic objectives foreseen in the period that the projects were developed.
- Improvements were appreciated in the labor relations of the workers, due to the added value impregnated in the performance of the students, which contributed to an increase in work motivation, a decrease in indiscipline and work accidents. On the other hand, improvements were introduced in the technologies that they used, guaranteeing greater sustainability of the work environment, as well as the optimal use of the material and financial resources that they used in carrying out the projects.

The idea of working in Technical and Professional Education in undergraduate and postgraduate training processes from a perspective of transversal competences, has an almost unanimous understanding from the significance that these contribute to the specific competences that give identity to the professional training of the student who graduated from technological institutes.

On this subject it is stated that:

When epistemologically analyzing the term transversal competence, one must start from the etymological origin of the term “transversal”, which comes from the Latin formed by the union between the prefix trans– which
means “from one side to another”, the word versus which can be translated as "gizado" or the suffix -al which is equivalent to "relative to". Meanwhile, in the Dictionary of the Royal Spanish Academy (1992) the term <transversal> is “what is found or extends from one side to the other”. (Tejeda, 2016, p.36).

The transversal competence, affirm the authors of this research, is part of the profile of a professional competence, which is one:

Human quality that is configured as a dialectical synthesis in the functional link of knowledge (various knowledge), know-how (skills, habits, skills and capacities) and knowing how to be (values and attitudes) that are mobilized in an ideal performance based on resources, personological characteristics of the subject, which allow them to know how to be in a socio-professional and human environment in correspondence with the characteristics and complex demands of the environment (Tejeda and Sánchez, 2012, p.21).

Professional competence constitutes a quality that should be formed in students of technological institutes from a social and human psycho-pedagogical perspective and not a neoliberal one, in which it expresses the integration of knowledge (being, doing, living together, being and being) that manifests in a creative way and transcendent through their professional performance.

"(...) The skills model is the answer to today's capitalist society." Silva and Mazuera (2019) (p.9) point out that: it is appropriate to note that the competency approach assumed in this research is based on human social development, focused on humanism, recognizing that a worker is competent when not only knows how to do with quality, but also integrates attitudes, moral values associated with social equality, justice, equity, collaboration, respect and mutual aid (being a fair person), knowing how to be and coexist, all of which He expresses it in a totalizing way in his professional performance, which to say:

It is the way of expression by the professional of the development reached in the competences, which qualify and distinguish the fulfillment of the socio-labor demands in the contexts where he fulfills the activities, tasks or roles inherent to the performance of the functions and processes of the profession (Tejeda, 2011, p.6).

Therefore, professional performance is the form of manifestation by the student of technological institutes, of the professional competences that are gradually and progressively formed in their personality.

Forming professional competences implies anticipating their act, by integrating the following: knowing how to be, knowing how to do, knowing how to know and knowing how to live together, with this the social worker presents a first resource to solve problems with creativity, understanding and entrepreneurship, where it is shown on stage higher levels of thinking, metacognitive for continuous improvement and ethical commitment (Mendoza, Amaya and Gomez, 2017, p. 51).

Tejeda and Sánchez (2012) classify the competencies into: “specific, basic and transversal professionals.” (p.10).

The transversal competences are those that are articulated in the logic of the interaction of the professional in his specific and basic performance. They are interconnected with the levels of performance of the professional in the various social and professional contexts by interacting with the logic of the basic processes, functions, and activities of the profession (Tejeda and Sánchez, 2012, p.10).

The transversal competences are configured by knowledge that is linked and articulated with the knowledge associated with the area of basic and specific training that configure the content of the disciplinary diversity of programs that are developed in the curricular mesh of a specific career, profession, specialty and trade. The transversal competences "express an added value to the training, to its contextual performance and have a shared, integrated and synergistic character between the career, profession, science, society and technology with the university or educational context Tejeda (2016)." (p.32).

This added value gives a more inclusive and transcendent character to the professional performance of students who graduate from polytechnic institutes, since it allows them to take into account the economic, environmental, energetic, teamwork, leadership, entrepreneurship, decision decisions, as well as the use of research and information technology during the application of the technological work methods used in the diversity of jobs in the labor context.

The transversal professional competences from the assumed theoretical position are characterized by the following fundamental aspects:

They crystallize in the interactive logic of the professional in their specific and basic actions, expressing added value to education and their contextual activity, they have a common, integrated and synergistic character between career, profession, science, society and society. technology with a university or educational context, is applied through changes in professional processes, functions and contents and requirements and the creativity and
innovation of the practitioner, promotes comprehensive training (more versatile activity) in the educational institution of the subject, according with the mission and purposes of the educational model in its theoretical and methodological perspective, and are transferable in various social, professional and labor fields (Tejeda, 2016).

These general characteristics that transversal professional competence has that differentiate it from specific professional competences (the ones that give identity to one profession that differentiate it from another) and basic ones (which are common to all professions), make it possible to recognize that their training in the students of technological institutes must achieve an adequate synergy between the categories instruction - education and professional growth.

Teaching is interpreted as a process aimed at developing the knowledge (knowing) and the intellectual and professional skills of the employee (doing skills) in basic or higher education, integrating the subject of study and the contents acquired during work, socialization of the tasks of work units related to the professional profile of the office, the department of the average technician or the university career of the student (Alonso, Cruz and Ronquillo, 2020).

Education is a process that aims to develop the student's values, motives, positive attitudes, and professional interests (knowing, being and living together) with the help of the educational potential of learning and the educational effects of the parts involved, teachers, students, supervisors, experts, family, community and employees of the work community itself Alonso, Cruz and Ronquillo (2020).

The formation of transversal competences constitutes the process through which the student of technological institutes appropriates knowledge that is linked and interconnected with the basic and specific knowledge of a certain profession, hence its transversal nature, which occurs through the systematization of projects. assumed as

The form of organization that the student acquires in professional training (..), which enables the acquisition, deepening, consolidation and application of knowledge related to their special and main work and articulated during the solution of professional problems through an exam. tasks in a defined space-time relationship with the support of material and human resources (Garcia, 2016).

The project based on the reflections of Valera and Téllez (2019), is considered an evaluative criterion that is inclusive and interdisciplinary, promotes research, the development of creativity, the integration of theory and practice, as well as the link between the academic component (teaching), labor (internships and internships) and research associated with technological innovation, an aspect that allows recognizing its use to train transversal skills in students of technological institutes.

An analysis of the state of the art and the existing theory allowed us to recognize that:

The investigations of Tejeda (2011), Tejeda and Sánchez (2012) and Tejeda (2016) make proposals for models, principles, and strategies for the training of university professionals based on competences, although they recognize and address the study of transversal competences, they do not go into depth. in the systematization of projects for their training through the relationships between instruction - education - professional growth from the link of the academic with the labor and investigative aspects.

Interesting studies are carried out on the formation of generic (transversal) competences and although it recognizes the need to use training projects as an alternative for their training, it does not delve into how to achieve synergistic relationships between instruction - education and professional growth (Tobón, 2013).

Zorob (2013) investigates the transversal entrepreneurship competence, without delving into the use of methods for its project-based training.

Villarroel and Bruna (2014) although they address entrepreneurship as a transversal competence, their studies do not delve into the establishment of a methodology for their training based on projects from the unit between instruction, education, and professional growth.

The authors Maury, Marín, Ortiz and Gravini (2018) propose generic (transversal) competences in higher education students, without delving into the methodology to follow for their training from the link between teaching with labor insertion and research work. and the unity between the instructional, the educational and the professional growth.

For their part, Cedeño, Sánchez and Alonso (2018) study and propose the transversal competence of entrepreneurship, without delving into the methodology for its project-based training.

Others, such as Ronquillo, Cabrera and Barberán (2019), recommend the study of research aimed at the formation of transversal professional skills.
Zholdasbekov, Aymenov, Shagataeva, Esimkhanova, Dzhartybaeva & Kolyeva (2019), offer an analysis of the experience of training transversal skills associated with business entrepreneurship, without delving into the use of projects by harmonizing teaching with work practices and work. Technological innovation scientist.

For their part, Machado, and Montes de Oca (2020) reflect on competencies and recognize the need for their training in university students.

Quijije (2021) provides a methodology to develop professional didactic competence in university teachers, in which it focuses from the specific character, without delving into the transversal competences that characterize it.

Alles (2021) proposes a job position profile by competencies, an aspect that has similarities with the study carried out, but differs in that it does not delve into the transversal competencies that characterize the performance of the student of technological institutes in the workplace.

Guillén, Alonso, Tejeda and Cedeño (2022), propose the family conflict medication competence that constitutes a transversal competence, which has points of contact with the present study, but differs since its singularity does not focus on the characteristics of the training of students at technological institutes.

As can be seen, the investigative studies consulted in the national and foreign literature, although they are like the research carried out in the present work, differ in that due to their objectives, they denote the absence of methodologies for the formation of transversal competences in high school students. technological institutes, an aspect that contributes to raising the quality of the training of these professionals.

6 Conclusions

A methodology was proposed for the formation of transversal competences in the students of technological institutes that offers a new dynamic based on the design, development and evaluation of formative projects that integrate the academy (teaching) with the practices and internships and the work of investigation and Technological innovation based on the principle of professional transferability.

The training of transversal competences in students at technological institutes must be conceived from the prism of human social development, it has a complex, holistic, contextual, flexible, conscious and developer character, which requires the systematization of training projects based on the use of methods learning problems that allow linking the academy with work and research from the unit between instruction - education - professional growth.

The pedagogical pre-experiment allowed us to verify through the Chi-square statistician ($X^2$) that, with the application of the methodology, the transversal competences were significantly improved in the sample of 60 students of the technological institute, as well as the impacts that this generated on the productivity of the companies and the quality of working life of their workers. which allowed verifying its possible validity in contextualized pedagogical practice.

References


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