

Original article



Strategy for the theoretical and practical training of the Higher Technician in Water and Sanitation

Estrategia para la formación teórico-práctica del Técnico Superior en Agua y Saneamiento

Estratégia para a formação teórica e prática do Técnico Sênior em Água e Saneamento

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ABSTRACT

In Cuba, getting water to the population with quality and evacuating it once used is a priority for all economic actors, which is why there is a need for qualified labor force to respond to this problem. Given this situation, it was decided to create a Higher Technician in Water and Sanitation who is capable of solving professional problems in his or her field of work, with marked theoretical-practical training. Taking into account this background, the present research aims to propose a strategy for the theoretical-practical training of the Superior Technician in Water and Sanitation, based on the shared professional training university-company. To fulfill this objective, theoretical methods such as historical-logical, analysis and synthesis, induction and deduction and modeling were used and empirical methods such as documentary analysis, the interview, survey and observation and for

statistical processing the technique of methodological triangulation. These methods made it possible, with the integration of the applied instruments, to identify the shortcomings in the training process. The main results are expressed in the proposed strategy structured in phases and actions, which, by moving coherently through the model of the professional and shared university-company training, impacts on the theoretical-practical training of this professional, by solving professional problems in their work object

Keywords: training; senior technician; professional problems.

RESUMEN

En Cuba, hacer llegar el agua con calidad a la población y evacuarla una vez utilizada, resulta de prioridad para todos los actores económicos, por lo que se necesita fuerza laboral calificada para dar respuesta a esta problemática. Ante esta situación, se decide la creación del Técnico Superior en Agua y Saneamiento que sea capaz de dar solución a problemas profesionales en su objeto de trabajo, con una marcada formación teórico-práctica. Teniendo en cuenta estos antecedentes, la presente investigación tiene como objetivo proponer una estrategia para la formación teórico-práctica del Técnico Superior en Agua y Saneamiento, sustentada en la formación profesional compartida universidad-empresa. Para dar cumplimiento a este objetivo, se emplearon métodos teóricos como el histórico-lógico, análisis y síntesis, inducción y deducción y la modelación y métodos empíricos como el análisis documental, la entrevista, encuesta y observación y para el procesamiento estadístico la técnica de triangulación metodológica. Estos métodos posibilitaron, con la integración de los instrumentos aplicados, identificar las carencias en el proceso de formación. Los principales resultados se concretan en la estrategia propuesta estructurada en fases y acciones, que al transitar de manera coherente por el modelo del profesional y formación compartida universidad-empresa, impacte en la formación teórico-práctica de este profesional, al dar solución a problemas profesionales en su objeto de trabajo.

Palabras clave: formación; técnico superior; problemas profesionales.

RESUMO

Em Cuba, o fornecimento de água potável de qualidade à população e seu descarte adequado após o uso são prioridades para todos os agentes econômicos, exigindo mão de obra qualificada para enfrentar esse desafio. Em resposta, foi criado o programa de Técnico Superior em Água e Saneamento, concebido para capacitar os graduados com as habilidades necessárias para solucionar problemas profissionais em sua área de atuação, por meio de uma sólida base teórica e prática. Diante desse contexto, esta pesquisa visa propor uma estratégia para a formação teórica e prática de Técnicos Superiores em Água e Saneamento, baseada em um modelo de desenvolvimento profissional compartilhado entre universidade e indústria. Para atingir esse objetivo, foram empregados métodos teóricos como análise histórico-lógica, análise e síntese, indução e dedução e modelagem, juntamente com métodos empíricos como análise documental, entrevistas, pesquisas e observação. A triangulação metodológica foi utilizada para o processamento estatístico. Esses métodos, combinados com a integração dos instrumentos aplicados, permitiram identificar lacunas no processo de formação. Os principais resultados estão materializados na estratégia proposta, estruturada em fases e ações que, ao progredirem coerentemente através do modelo profissional e da formação conjunta universidade-empresa, impactam a formação teórico-prática deste profissional, fornecendo soluções para problemas profissionais no seu objeto de trabalho.

Palavras-chave: formação; técnico superior; problemas profissionais.

INTRODUCTION

In Cuba, the vision of the National Institute of Hydraulic Resources (INRH) is geared towards managing water in an integrated way within society, the economy, and the environment, providing sustainable development and security for the nation (Chapman Waugh, 2021). As a limited natural resource and an essential source of life, water must be managed and disposed of appropriately. This approach underscores the importance of coordinated management and the participation of multiple stakeholders, including educational institutions, in water resource conservation.

Among the most pressing problems facing the population today are the vulnerability of water resources, manifested in the degradation of its quality and the treatment of sewage and wastewater.

However, the skilled labor force for these areas is very depressed, an aspect that is pointed out in the model of the professional as a normative document to be implemented in Cuban universities.

Based on this data, and as a viable alternative to meet these needs, the Higher Technician in Water and Sanitation (TSAS) program began in 2020, expanding to different provinces throughout the country. It started in Pinar del Río in 2022, offering a Short-Cycle Higher Education level that trains individuals for specific positions or occupations required by various organizations that do not demand a university degree, but rather training beyond the level of a mid-level technician.

The TSAS Program operates under a captive enrollment system for the Water and Sewerage Company, given the need for training a skilled workforce, which has been affected by professional mobility. This addresses the needs of this important strategic sector for the local and regional development of the province.

The current TSAS training model aims to solve medium-complexity problems that arise in society, related to the supply, evacuation and treatment of wastewater, based on a high social and patriotic commitment; for the contribution to the development of hydraulic infrastructure, the saving of resources and the protection and conservation of the environment.

The curriculum shows that the training of this professional has a strong theoretical-practical focus and responds to the needs of production and services for solving professional problems that impact local and territorial development. This makes it undeniable that shared responsibilities between universities and the different actors in the economy and services, in the development of training, constitute a requirement for achieving quality and relevance. They must work both on the conditions for generating knowledge in the university and on the capacity to absorb that knowledge and transform it into products and services in companies (Rodríguez Gavilla, 2024).

Consequently, the insufficient theoretical and practical training of the TSAS was identified as a social problem, which prevents them from performing professionally in their field of work.

Regularities were identified that highlight the problem raised, related to:

- The methodological approach taken regarding the integration of the academic, labor, research and extension components lacks sufficient theoretical arguments to explain the education, training and development of the TSAS.

- Fragmented conception of the professional training process based on the lack of conscious and planned projection of the university and work contexts.
- Deficiencies in the contextualized theoretical-practical conception, which restricts the possibilities of knowing and experiencing realities and contexts, preventing students from approaching, becoming familiar with, confronting and solving problems of the profession.

In this regard, and considering that the National Hydraulic Plan until 2030 is the responsibility of the INRH (National Institute of Hydraulic Resources). and has the active participation of different organizations in the country (Chapman Waugh, 2021), the higher education of human resources As an essential part of this plan, it is the responsibility of Ministry of Higher Education. These aspects, added to the growing pressure on water resources and the challenges in basic sanitation, lead to the imprint of shared university-business training, a matter that also makes greater integration into local and territorial development essential.

To fulfill this mandate in Cuba, the entities of the Organs of the Central State Administration (OACE) have the shared responsibility with the university, for the training and development of the qualified workforce, protected by Decree No. 364 (2020).

In this sense, the theoretical-practical training of the TSAS is considered as the management of shared university - company training, which guarantees the appropriation of professional content from the dynamics of the academic, labor, research and extension components, demonstrated in the professional performance in its object of work.

In accordance with these aspects, the research aims to propose a pedagogical strategy for the theoretical - practical training of the TSAS, based on shared university - company professional training, in the province of Pinar del Río.

MATERIALS AND METHODS

The research was based on the dialectical-materialist method, which allowed for a clear and objective analysis of the problem. It employed a system of theoretical, empirical, and statistical methods.

The following theoretical methods were used:

- Historical-logical: allowed the study of the historical, theoretical and conceptual background of the theoretical-practical training process of the TSAS.
- Analysis and synthesis: made it possible to discover the characteristics and relationships between the object of the research and the variable under study.
- Induction and deduction: allowed conclusions and inferences to be made in order to arrive at generalizations regarding the object of the research, which allowed the development of the proposed strategy.
- Modeling: It made it possible to represent the fundamental characteristics and relationships of the research object in order to obtain the proposed strategy.

The following empirical methods were used:

- Documentary analysis: was used for the study of the documents of the Short Cycle Program of the TSAS (Professional Model, Study Plan, Methodological work plan of the program and year group, agreement between the university-company training contexts), which provided necessary elements of the initial state of the object of the research.
- Interview: It was carried out with university and company managers related to the program and allowed to verify information on the initial state of the theoretical-practical training of the TSAS.
- Survey: It was applied to professors, company specialists, students and graduates, which allowed the characterization of the object of the research in its initial state.
- Observation: It was carried out on activities related to the performance of students and graduates, which allowed verifying information on the initial state of the theoretical-practical training of the TSAS.

Statistical methods were used to process the information using descriptive statistical techniques, which allowed for the interpretation, inference and presentation of the results.

The methodological triangulation technique was carried out in order to identify the coincidences and discrepancies regarding the initial state of the object of the research.

It was worked with seven managers from the Water and Sewerage Company, five managers from the University of Pinar del Río Hermanos Saíz Montes de Oca, nine specialists from the company and

11 professors, eight students taking the program and 12 graduates, whose selection was intentional from the entire population involved in the process.

The following methodology was used for the development of this research. First, the historical, theoretical, and conceptual background surrounding the research topic was systematized. This allowed for the establishment of characteristic elements that are synthesized in the research variable, considering its three dimensions, each with its corresponding indicators. Second, the documents governing the TSAS training process were analyzed using a document analysis guide. Interviews, surveys, and observations were then applied and processed according to their respective guides, corresponding to the dimensions and their indicators. This process allowed for methodological triangulation of the results obtained and the identification of regularities in the TSAS theoretical-practical training process. Third, a pedagogical strategy was developed to address the research topic, outlining each phase and the proposed actions within it.

RESULTS

Based on the systematization carried out, and as a result of the methods employed, the characterization of the theoretical-practical training process of the TSAS presents the following regularities:

- The educational potential of university-business training contexts is not being utilized for carrying out academic, work, research and extension activities that guarantee the appropriation and integration of professional content for solving professional problems in their work.
- The theoretical and practical training of the TSAS lacks the necessary systemic character to facilitate the balance between theory, practice and scientific research for the solution of professional problems in their object of work.
- The conception of the theoretical-practical training of the TSAS does not specify the adequate appropriation, integration and transfer of professional content in the solution of the professional problems that characterize the different defined work environments.

In this sense, the following strategy is proposed for the theoretical and practical training of the TSAS.

I. Introduction

The proposed pedagogical strategy takes into account the study of the research object, along with the results of the diagnosis of the current state of the problem and the implementation of the strategy itself.

Consistent with the assumed references, the strategy is defined as the projection of the training process for the transformation of the current identified state to the desired state, based on the theoretical-practical training of the TSAS, which conditions the system of actions proposed in the different phases to achieve the objective.

The proposed strategy includes distinctive elements that condition the theoretical-practical training process of the TSAS, such as:

- The intention is to promote shared professional training between university and business throughout the training process, achieving the integration of the university and business contexts of action.
- The integration of the academic, labor, research and extension components (ALIE) energizes the theoretical-practical training process.
- Organizational forms are used when considering the potential of the training contexts and the dynamics of integration of the ALIE components.
- Solving medium-complexity professional problems contributes to professional performance in their work and to the development of the hydraulic sector in Pinar del Río.

II. Diagnosis

The diagnostic phase of this research aims to identify strengths and weaknesses for implementing the pedagogical strategy. The following strengths were identified as a result of the diagnostic process:

- Motivation for the implementation of the strategy.
- Willingness of the parties involved to collaborate with its implementation.

The weaknesses identified are:

- Technological limitations in the province for the theoretical and practical training of the TSAS, in advanced technologies of the hydraulic sector.
- The overall projection of the process was conditioned on the commitment and shared responsibility of the university-business training contexts, from each of the strategic planning processes (strategic, key and support processes).

The analysis made it possible to formulate the overall objective of the strategy.

III. General objective of the strategy

Implement a system of actions in the theoretical-practical training process of the TSAS, which from the projection of the university-company training contexts and the dynamics of the integration of the ALIE components, contribute to the training of this professional and to the development of the hydraulic sector in the province of Pinar del Río.

IV. Strategic planning and implementation:

Strategic planning is organized around three phases that guarantee its implementation:

Phase 1. Diagnosis and awareness-raising (shared responsibility between university and business)

Objective: to align the expectations, capabilities and needs of the university and the company, projecting the training context towards the reality of the hydraulic sector in Pinar del Río.

Actions:

- Initial diagnosis, based on the theoretical-practical training scenarios of the TSAS.
- Raising awareness among managers of the theoretical-practical training process of the TSAS.
- Participatory diagnosis: conduct joint working groups (managers, teachers, specialists), from both training contexts, to identify operational professional problems, innovation needs, community challenges and relevant learning opportunities from the realities of the curriculum and the specific training needs of the Pinar del Río territory.

- Review of the professional model: in order to contextualize the learning objectives, which make explicit how the ALIE components will be addressed and the projection of the training contexts with shared responsibility between both contexts, the university and the company.
- Selection and preparation of specialists and tutors: includes the categorization process to assume teaching, tutoring and theoretical-practical advice in the TSAS program.
- Formation of the committee of specialists for the TSAS program in Pinar del Río.
- Development of university-business integration agreements, which includes the agreement between the program and the company.
- Key documents are prepared: company activity plan, roles and responsibilities, monitoring mechanisms, evaluation criteria, occupational health and safety protocols, access to relevant technical information from the company and the university based on the organizational forms of the student scientific process.
- The projection of the training context within the work environment is structured, ensuring the dynamic integration of the ALIE components.
- Signing of integration agreements.

Phase 2. Intervention

Objective: to facilitate the practical experience of students in the company, actively mediated by the organizational forms, so that they experience and reflect on the professional problems in the object of work from the integration of the ALIE components.

Actions:

- Identification and selection of the professional problems of your work object.
- Formation of the network of work areas (theoretical-practical training circuit).
- Design the rotation plan through the network of work areas and use the organizational form that allows the theoretical-practical training of the TSAS.
- Methodological projection of the integrative subject.
- Development of the practical class system.
- Projection of the culmination exercise of study based on professional problems in its object of work.
- Application of active methodologies (flipped classroom, case study, development of projects by periods and academic year, focused on professional problems).

- Organize meetings with various actors: operators, engineers, community managers, users, to enrich the multidimensional understanding of the challenges of the hydraulic sector in the province of Pinar del Río.

Phase 3. Evaluation and continuous improvement

Objective: to evaluate the results of the phases and actions planned in the strategy, according to the results achieved in the process.

Actions:

- Conducting the final diagnosis in each training cycle.
- Development of the continuous, systematic and integrative evaluation of the process and its results.
- Implementation of a plan to discuss the results and their potential impact, in each department, program and academic year group, of the partial results to approve and/or redirect the development of the actions.
- Identifying difficulties and opportunities for improvement in the integration of ALIE components, the projection of university-business training contexts and organizational forms.
- Systematic evaluation in the meetings of the expert committee of the progress of the process and its results.
- Evaluation of impacts in the university and business scenarios involved in the theoretical-practical training process, following indicators such as: systematicity of actions; pedagogical and technical results; satisfaction of the program and of the companies; protagonism of the specialists, shared responsibility of the university-business training contexts, social responsibility on the part of those involved in the process.
- Conducting methodological workshops at the end of each academic year to evaluate the results achieved, in order to incorporate new actions according to social needs based on local development in the province.
- Redesign and feedback of the proposed actions.

V. Assessment

It coincides with phase 3 of the proposed strategy to evaluate the development of the theoretical-practical training process.

Implementation methods for putting the strategy into practice and evaluating it.

The implementation methods establish the premises for the organization and interaction of the different phases and actions that influence its practical execution. They comprise a group of actions aimed at creating the organizational, material, and human resource (managers, specialists, teachers) conditions required and necessary to achieve positive results.

- Diagnosis of the strengths and weaknesses of the group of teachers and specialists, in order to implement the strategy.

Completion date: preparation stage of the academic course, maintaining its permanent update and depending on the periods through which the course passes.

Participants: program professors and specialists.

Those responsible: the university program coordinator and the company.

- Methodological meeting within the TSAS program group, for presentation and collective assessment of the strategy.

Completion date: course preparation stage.

Participants: teachers, specialists, tutors.

Those responsible: head of department and coordinator of the university and company program.

- Formation of the program's expert committee.

Completion date: course preparation stage.

Participants: head of department, coordinator of the university and company program, collective head of year, selected professors and specialists.

Those responsible: department head and program coordinator from the university and the company.

- Methodological workshop with the committee of specialists to analyze their functions.

Completion date: course preparation stage.

Participants: department head, university and company program coordinator, members of the expert committee.

Those responsible: department head and program coordinator from the university and the company.

- Meeting with managers, selected specialists from companies and professors of the program to rework the university-company and program-company work agreements, based on the existing potential in the training contexts and to organize the implementation of the actions of the strategy.

Completion date: course preparation stage.

Participants: managers from the companies and the university in charge of the TSAS training process, department head, coordinator of the university and company program, members of the expert committee.

Those responsible: university and company managers, department head, university and company program coordinator, and researcher.

- Formation of action plans for the academic year, progressing through the academic periods and in accordance with the agreements of the conventions and the potential of the university and the company, according to the projection of the training contexts and the dynamics of the integration of the ALIE components.

Completion date: course preparation stage.

Participants: department head, university and company program coordinator, members of the expert committee.

Those responsible: head of department, coordinator of the university and company program and researcher.

- Inclusion of the proposed strategy in the program's methodological work system, so that it goes through each of its components, according to the planned organizational forms, generating the preparation of teachers and specialists who intervene with the objective of projecting, executing and evaluating each of the actions of the strategy on the progress of the process.

Completion date: course preparation stage and verification during training periods and academic years.

Participants: head of department, coordinator of the university and company program, and researcher.

Those responsible: department head and program coordinator from the university and the company.

- Control and evaluation, as part of the methodological work, of the different periods through which the theoretical-practical training process of the TSAS goes, to verify compliance and/or reorientation of the actions planned and developed in the proposed strategy.

Completion date: permanent.

Participants: head of department, coordinator of the university and company program, year group leaders.

Those responsible: department head and program coordinator from the university and the company.

DISCUSSION

The growing demands related to the world of work and The current context of economic and social crisis that Cuba is going through means that the training of professionals is based on their comprehensive training, linked to the development of the territory.

The training of professionals at the Short Cycle Higher Education level it takes shape in a theoretical and practical training in a work profile so that they can perform successfully in the various sectors of the economy and services and in society in general.

In this regard, the following criteria are considered: Alonso Betancourt *et al.* (2020), Paz Reina *et al.* (2025) and Arzuaga Ramírez *et al.* (2025) by incorporating the university-business training contexts and the dynamics of the ALIE components, as necessary elements in the training process to guarantee the theoretical-practical training of the TSAS.

Under these premises, the TSAS is, from its initial training, directly linked to the solution of professional problems in its object of work, in a shared university-company professional training, to respond to the pressing needs of the population for access to quality drinking water and the evacuation of the same.

According to Mena Lorenzo and Mena Lorenzo (2020), a shared process makes the university part of the company and, in turn, the latter part of the former. This results in a combination or transculturation between both contexts, an aspect that has a marked impact on the local development of each territory. Collaborative cultures with a social character of shared responsibility emerge, where managers, specialists, teachers, Students, administrators and other educational actors actively participate in the training process, sharing knowledge, experiences and needs (Peña Ruz, 2023).

For the training of the TSAS (Technical Specialist in Water and Sanitation), the university is integrated into the Provincial Delegation of the National Institute of Hydraulic Resources of Pinar del Río. Its structure includes the entities that work for the hydraulic development of the territory; this training is directly aimed at the Water and Sewerage Company.

However, this shared responsibility between the university and businesses, linked to the hydraulic development of the territory, would by itself be an asystemic and fragmented process. Therefore, it requires the appropriate, coherent, and comprehensive articulation of their substantive ALIE processes (Griego Cairo *et al.*, 2023). This articulation optimizes resources, takes advantage of opportunities, offers efficient and effective solutions to local problems, and strengthens the professional training process.

In addressing local problems, the TSAS resolves moderately complex issues related to its work, such as: installation, operation, construction, utilization, preservation, and hydraulic management, fulfilling its work tasks by responding to professional problems, recognizing that these These are social problems that are part of the processes of production and services (Gómez Quintana & Mena Lorenzo, 2025).

Taking the strategy defined by Valle Lima (2012) as a set of sequential and interrelated actions that, starting from an initial state (given by the diagnosis), allow directing the step to an ideal state, a consequence of planning (p. 157), and that in the educational field strategies vary in typology, the considerations of Rodríguez and Rodríguez (2011, p. 38) are shared, when stating that the pedagogical strategy is the projection of the pedagogical direction that allows the transformation of a system, subsystem, institution or educational level to achieve the proposed goal and that conditions the establishment of actions to obtain changes in the dimensions that are involved in obtaining that goal.

Accepting these definitions in relation to the object of the research allowed us to consider that the proposal has a pedagogical character, since it depends on the specific context on which it is intended to have an impact and the organizational, didactic, material, methodological, educational conditions, among others.

With the development and implementation of the proposed pedagogical strategy, it can be concluded that the training of the TSAS, by coherently progressing through the professional model, based on shared university-business professional training, impacts the theoretical-practical training of this professional, by providing solutions to professional problems in their work object.

The identification, selection, solution and evaluation of the aforementioned professional problems of medium complexity are the result of the implementation of the proposed actions that go through the different stages in the theoretical - practical training of the TSAS.

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Conflict of interest

Authors declare no conflict of interests.

Authors' contribution

The authors participated in the design and writing of the article, in the search and analysis of the information contained in the consulted bibliography.



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