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Original article

Didactic management for the development of skills in educational research

Gestión didáctica para el desarrollo de habilidades en la investigación educativa

Gestão didática para o desenvolvimento de competências em pesquisa educacional

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ABSTRACT

The Curriculum E in the Bachelor of Science in Agricultural Education program has Research-Based Work Training as its guiding discipline, harmonizing the integration of academic, work-based, research, and outreach components. This paper aims to propose a didactic approach for developing research skills that guide the solution of scientific problems within the discipline. Using a mixed-methods approach, a document review was conducted, along with observation of the performance of 45 students and evaluation by expert criteria (Delphi method). The results revealed shortcomings in the planning, guidance, execution, and evaluation of research tasks, limited use of collaborative work, and difficulties in socialization, dissemination, and use of digital technologies. A didactic approach was developed, characterized by its integrative focus on linking research and teaching, the

promotion of student autonomy, a balance between mandatory and flexible requirements for submitting research products, and a progressive design for developing skills in educational research. It integrates three components: theoretical-categorical (philosophical, sociological, psychological, and didactic foundations), regulatory (characteristics of flexibility, operability, contextualization, and integration), and practical (methodology with progressive stages across academic years). The proposal was evaluated by experts as highly suitable. This result enabled students to develop effective approaches and solid knowledge for solving problems encountered in the performance of their work duties.

Keywords: self-management; university autonomy; didactics; science education; educational research.

RESUMEN

El Plan de estudio E en la carrera Licenciatura en Educación Agropecuaria tiene como disciplina rectora la Formación Laboral Investigativa, que armoniza la integración de los componentes: académico, laboral, investigativo y extensionista. El presente trabajo tiene como objetivo proponer una concepción didáctica para el desarrollo de habilidades investigativas que orienten a la solución de problemas científicos desde la disciplina. Mediante un enfoque mixto, se realizó la revisión de documentos, la observación del desempeño de 45 estudiantes y valoración por criterio de expertos (método Delphi). Los resultados evidenciaron insuficiencias en la planificación, orientación, ejecución y evaluación de tareas investigativas, limitado aprovechamiento del trabajo cooperado y dificultades en habilidades de socialización, difusión y uso de tecnologías digitales. Se elaboró una concesión didáctica que se caracteriza por su enfoque integrador para la vinculación investigación-enseñanza, el fomento de la autonomía del estudiante, el balance entre lo obligatorio y flexible en la entrega de productos de investigación y un diseño progresivo para el desarrollo de habilidades para la investigación educativa. Integra tres componentes: teórico-categorial (fundamentos filosóficos, sociológicos, psicológicos y didácticos), regulatorio (características de flexibilidad, operatividad, contextualización e integración) y práctico (metodología con etapas progresivas por años académicos). La propuesta fue evaluada por criterio de expertos como muy adecuada. Este resultado permitió formar modos de actuación en los estudiantes, con sólidos conocimientos para la solución de los problemas que acontecen en el cumplimiento de sus funciones laborales.

Palabras clave: autogestión; autonomía universitaria; didáctica; educación científica; investigación educativa.

RESUMO

O Currículo E do programa de Licenciatura em Educação Agrícola tem como disciplina norteadora o Estágio Supervisionado em Pesquisa, harmonizando a integração de componentes acadêmicos, práticos, de pesquisa e de extensão. Este artigo tem como objetivo propor uma abordagem didática para o desenvolvimento de habilidades de pesquisa que orientem a solução de problemas científicos dentro da disciplina. Utilizando uma abordagem de métodos mistos, foi realizada uma revisão documental, juntamente com a observação do desempenho de 45 alunos e a avaliação por critérios de especialistas (método Delphi). Os resultados revelaram deficiências no planejamento, orientação, execução e avaliação de tarefas de pesquisa, uso limitado do trabalho colaborativo e dificuldades na socialização, disseminação e uso de tecnologias digitais. Uma abordagem didática foi desenvolvida, caracterizada por seu foco integrativo na articulação entre pesquisa e ensino, na promoção da autonomia do aluno, no equilíbrio entre requisitos obrigatórios e flexíveis para a entrega de trabalhos de pesquisa e em um desenho progressivo para o desenvolvimento de habilidades em pesquisa educacional. A proposta integra três componentes: teórico-categórico (fundamentos filosóficos, sociológicos, psicológicos e didáticos), regulatório (características de flexibilidade, operacionalidade, contextualização e integração) e prático (metodologia com etapas progressivas ao longo dos anos acadêmicos). A proposta foi avaliada por especialistas como altamente adequada. Esse resultado permitiu aos alunos desenvolver abordagens eficazes e conhecimento sólido para a resolução de problemas encontrados no desempenho de suas atividades acadêmicas.

Palavras-chave: autogestão; autonomia universitária; didática; educação científica; pesquisa educacional.

INTRODUCTION

Contemporary society demands that universities generate innovative theories, knowledge, and alternatives that enable the development of science by effectively applying solutions to the problems of the context in which humans develop as social beings. This constitutes a challenge for higher

education institutions (Prudencio Coreas, 2022), in order to graduate competent professionals. for the labor and productive sphere. Intellectual production based on scientific and methodological principles is mediated by various types of research activities.

However, preparing students at the undergraduate level presents a didactic challenge for the teaching staff, who must promote processes of observation, analysis, reflection, and interpretation, as well as creativity and innovation for the generation and production of new knowledge. It is frequently observed that the component is assumed in most curricula across different areas of knowledge and professions. investigative as a transversal element that permeates most subjects (Rueda Milachay *et al.*, 2022).

In Cuba, this pursuit is revealed in the commitment to the continuous improvement of university teaching and training curricula, based on systematic methodological work and research as an objective necessity to produce competent graduates capable of solving problems inherent to the profession, with an integrated vision of the content. The teaching-learning process is the starting point for stimulating inquiry, discovery, and the satisfaction of contributing to solutions for problems in pedagogical practice, whether reflected in learning situations or the systematization of pedagogical practices mediated by information and communication technology resources in educational contexts (Castro Sandoval & Silva Monsalve, 2023). Therefore, it is a formative necessity to promote a research culture and the corresponding skills inside and outside the university, since this will stimulate intellectual production in different ways, where professors play a main role in teaching, research and extension activities (Dávila Morán *et al.*, 2022)

The Study Plan E for the bachelor's degree in Agricultural Education allows for curricular adjustments in subjects with more integrated designs and developed resources, facilitating competent training and the acquisition of effective teaching practices. Research work is guided by the Research-Based Professional Development course, with the participation of other subjects in each academic year, enabling students to utilize scientific and technical information, English, computer skills, and written and oral communication in diverse contexts. This core integrative course also encompasses the content of professional practice, Educational Research Methodology, and Agricultural Didactics.

This discipline integrates all educational components, thus constituting the backbone of the training process. Integration is assumed with the purpose of consolidating theoretical and practical knowledge, professional skills, and ethical and professional values, in accordance with the modes of

action. To achieve this goal, a professional approach is adopted across all subjects (Fornaris Méndez *et al.*, 2023) from an interdisciplinary perspective, which has undoubtedly led to the constant evaluation of its didactic conception through research and pedagogical practice (Arzuaga Ramírez *et al.*, 2023).

Resolution No. 47/2022, Article 284.1, recognizes that student research work is the organizational form of teaching that aims to develop skills specific to technical and scientific-research work through practical experience or other tasks requiring the application of scientific research methodology. As part of the process designed for the professional development of students in pedagogical programs in general, and those specializing in Agriculture in particular, a significant number of academic, practical, and research activities are established. These activities largely aim to innovate the educational environment in which the student learns, by transforming their own experience.

An exploratory study within the program allowed for some empirical inquiries (observations of student performance in the work component and a review of methodological and research documents) of the different groups. These inquiries revealed limitations in the planning, guidance, execution, and evaluation of research-based teaching tasks aimed at solving problems inherent to the profession within the main integrative discipline. Furthermore, the potential of the content for collaborative teamwork is not being fully utilized, which limits experimentation and critical analysis of the material. Analysis of the final year's graduation projects revealed a tendency to establish, in these projects, the same parameters required for master's and doctoral degrees. This is inconsistent with the levels of professional training and presents methodological limitations in ensuring compliance with the established guidelines for student research work.

Considering everything mentioned above, the objective is established as: to propose a didactic conception for the development of investigative skills that guide the solution of scientific problems from the discipline of Investigative Labor Training.

MATERIALS AND METHODS

The research has a mixed approach, considering scientific observation for obtaining the data and the processes of information triangulation, which allowed searches in the theoretical and empirical fields to diagnose the dynamics of development of investigative skills based on scientific problems.

Data collection was carried out through a review of documents such as curricula, methodological plans, course syllabi, and research papers from different years. Performance observations were conducted with 45 students enrolled in the Bachelor of Agricultural Education program, organized into five dimensions: basic research skills, structural research development skills, research socialization and dissemination skills, technological and digital research skills, and skills related to a specific technological discipline. Qualitative analysis was performed using triangulation.

Based on the results obtained, a didactic conception for the development of investigative skills was designed, which was evaluated by the expert criteria method.

The following requirements were considered for the selection of experts: years of experience, scientific degree and academic title, having 15 or more years of professional experience in higher education and/or research experience in the agricultural field and being willing to collaborate with the results of the research.

After the 35 potential experts were selected, they were given a self-assessment questionnaire, asking them to rate their competence, and the result was that they all had a high level of competence coefficient, based on the ranges established by the Delphy method.

RESULTS

The analysis and review of the methodological documents of the career (study plans, methodological plan and preparation of the subjects carried out from 2016 to the present, made it possible to verify the lack of a systemic conception for the development of research skills in the different academic years, structured by levels of assimilation.

The curriculum for the Research-Based Work Training discipline reflects the knowledge system for the academic subjects: Introduction to Agricultural Specialties, Agricultural Didactics, and Educational Research Methodology; however, it does not reflect the knowledge system for the subjects within the work and research component (systematic, intensive, and teaching practicums). The program indicates that the content of the practicums is determined by integrating the year's technical training subjects, leaving the selection of these subjects to the faculty, which may limit the systematization of research skills throughout the program.

The preparation of 50 research projects was reviewed, yielding results that indicate that all indicators, expressed as percentages, are generally moderately satisfactory. Teachers plan and guide research tasks, fostering the skills of observing, describing, analyzing, synthesizing, and interpreting, which are consistently used in the teaching-learning process. However, the potential of the content to solve integrative scientific problems is not always fully utilized. It is also necessary to strengthen study guides and orient students toward developing more creative intellectual production, as expressed by 36% at the low level and 32% at the medium level.

Through observation of the performance of the 45 students in the defense of research activities (14 course works and 25 diploma papers and six professional exercises) it was determined that the most affected skills are those related to socialization and dissemination, expressed in that 40% of the students are at a medium level and 28% at a low level; this also happens with the digital technologies of research, which leads to limiting the modes of action of the students, expressed in 57.7% of medium level and 6.75% of low level.

A didactic conception was developed where the essential components (theoretical-categorical component, regulatory component and practical component) were established, which participated in the process of developing investigative skills.

Theoretical-categorical component

Within the theoretical-categorical component are the foundations that serve as the basis for the didactic conception.

For the development of this research, Marxist-Leninist philosophy is adopted (objectivity, concrete historical analysis, and the universal interconnectedness of objects, facts, phenomena, and processes). These requirements are addressed from a dialectical-humanistic perspective, contributing to the development of research skills in interaction with social factors and educational contexts. The Theory of Knowledge serves as the philosophical foundation, explaining how knowledge is the result of the dialectical interrelation between the subject and the objects of study, and between subjects themselves; knowledge is considered a reflection of the educational reality that must be transformed.

From the perspective of the sociology of education, it is significant to consider student development under the influence of the university-workplace integration, as a dialectical unity between

subjectivation (assimilation) and objectivation (materialization). From the perspective of educational psychology, the historical-cultural approach is adopted, emphasizing the student's appropriation of content through cooperative work based on the interaction of activity and communication. It is recognized that skills are psychological structures of thought, which, through systematization, allow for the conscious assimilation of actions and procedures for working with content and solving theoretical and practical tasks (Estrada Molina *et al.*, 2022).

Furthermore, the didactics of higher education are assumed, and appropriate productive methods are used to carry out the process, which, due to their degree of activation, develop the knowledge, skills and values for the formation and development of the investigative skills necessary for their professional performance. It is assumed that research skills (Barbachán Ruales *et al.*, 2021) must be analyzed and developed in five dimensions, which act simultaneously or complement each other in the same research process; these are: basic research skills, structural research development skills, research socialization and dissemination skills, technological-digital research skills, and skills of specialization or technological discipline.

The category refers to the concept that reflects the most general and essential characteristics and relationships of a process. The following categories are considered in the conception:

Development of research skills

They constitute a necessity for the development of the university's core processes. Research embodies the professional work that prepares graduates to successfully navigate modern scientific and technological development. Research skills are related to the actions of planning, executing, evaluating, and communicating results, empowering students to problematize, theorize, and verify their approach within the educational environment.

Levels of assimilation of investigative skills

The training process for educational research enables students to provide feedback to self-diagnose and, in the same way, transform scientific and investigative development appropriately, favored by the transition from different levels of observation, understanding, explanation, modeling, interpretation of facts and phenomena, and communication of results that lead to the building of knowledge.

Considering the theoretical considerations assumed above and the results of the diagnosis, the following scientific ideas are established:

Scientific research leads to the early formation of professional modes of action from an integrative contextual framework.

The process of developing research skills is structured in stages, one of training and another of systematization.

The relationship between the didactic components of the subjects of the Investigative Work Practice discipline energizes the teaching-learning process of investigative skills, taking into consideration the formulation of problems, the search for solutions and the verification of their effectiveness.

The regulatory component is comprised of a system of characteristics and regularities that allow for the realization of the scientific ideas described above. The key characteristics of the didactic approach are flexible, operational, interactive, contextualized, dynamic, and integrative. The regularities are:

- The mutual correlation between educational research and the use of Information and Communication Technology tools.
- The relationship of interdependence between university-polytechnic center-work entity-community takes on a leading role in the development of research skills.
- The development of investigative skills operates from the systematization and integration of actions and operations to solve scientific problems of educational practice.
- The systematic projection of study guides normalizes the development of research activities

The practical component is conceived from a methodology with the procedures to be implemented in the teaching-learning process of the subjects within the main integrating discipline and the other subjects in the curriculum. Figure 1 establishes the relationships between the stages of educational research and the skills to be developed in each academic year.

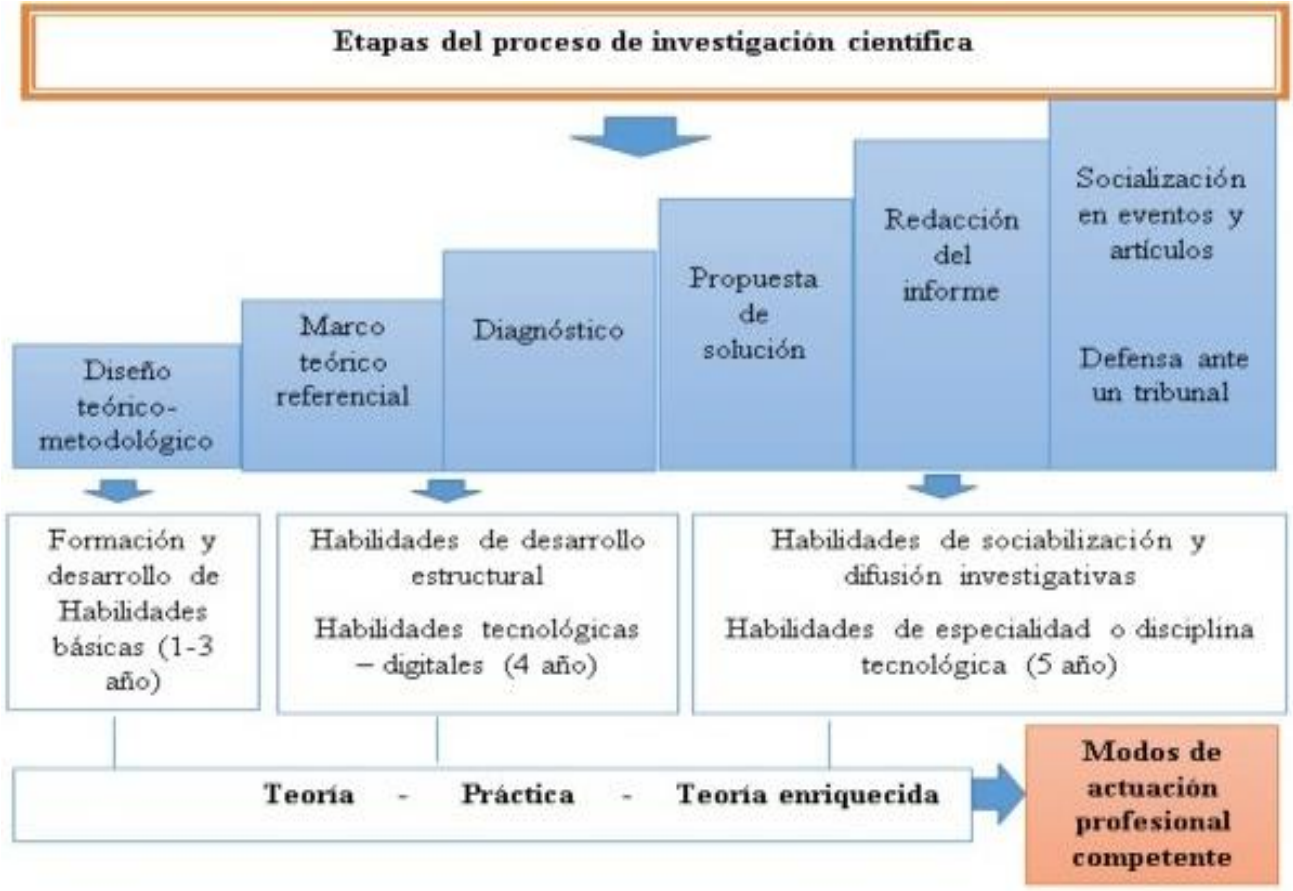

Figure 1. Stages of the scientific research process

Resolution No. 47/2022 establishes fundamental types of work. Extracurricular research work, according to Article 290.1, consists of the diverse research tasks carried out by students that are not part of the curriculum and depend on the knowledge acquired and skills developed by the student, according to the academic year. These tasks are primarily developed in the first, second, and third years, depending on the study modality, and their general objective is to develop a pedagogical approach centered on a research style, through the identification and transformation of professional problems in the development of the teaching-learning process that takes place in Technical and Vocational Education, and particularly in agricultural specialties.

As part of the final assessment for the Educational Research Methodology course, students will present a theoretical and methodological design related to an educational problem. This design will be grounded in fundamental theoretical and methodological elements, as well as empirical evidence, of a scientific problem connected to the educational reality. Students will defend their design before

a panel of professors appointed by the program and the instructor who taught the course. Students will submit a digital copy of their design, which will be presented using essential technological tools.

The coursework (Article 287) allows students, through the resolution of professional tasks or problems, to deepen, broaden, consolidate, and generalize the knowledge acquired; to independently and creatively apply the techniques and methods learned in other organizational forms of the teaching and learning process corresponding to the third or fourth year, depending on the study modality. The general objective is to defend a previously prepared coursework that demonstrates the existence of the problem within the group where they work as non-graduate teachers, evidencing the development of research skills as education professionals, as it articulates:

- A theoretical foundation for the identified research topic, considering the main trends and theories in their logical historical development, all critically analyzed by the author, who then selects those to which they subscribe. The importance and practical significance of the work should also be highlighted.
- Diagnosis of the current situation of the variable that is intended to be transformed, highlighting the state of the sample.
- A proposed solution to the research problem and expert opinions on the possible application of the proposal.

In the final year, the proposal is validated as a scientific contribution through a diploma thesis, applying appropriate research methods. The program also includes professional practice as another way to culminate studies. This involves presenting the rationale for a lesson within a program the student is teaching during their practicum in Technical and Vocational Education, demonstrating to the program's faculty the professional pedagogical approach they have achieved.

The professional exercise aims to argue a class based on the integrity of its didactic components with pedagogical professionalism that demonstrates mastery of the content (theoretical or practical) of a basic or specific professional training subject, corresponding to one of the specialties of Technical and Professional Education.

The results obtained from the theoretical evaluation using the expert criteria method allowed us to verify the importance that experts attribute to each aspect of the didactic conception, as well as to corroborate its functionality in educational practice on a theoretical level and to make the necessary corrections. Thirty-two experts (91.42%) rated the degree of justification supporting the didactic

conception for the development of research skills in Higher Education Didactics as very adequate; however, three experts (8.57%) considered it quite adequate.

Regarding the necessary components that underpin the didactic approach for developing research skills, with the levels of integration and relationships required for this level of education, 31 experts (88.57%) rated it as very adequate, 3 (8.57%) as quite adequate, and 1 (2.85%) as adequate. The structuring and description of the didactic approach is sufficient and relevant for developing research skills through the integration of educational and agricultural processes to address the scientific problems of Technical and Vocational Education. According to the criteria of 32 experts (91.42%), it is very adequate, 2 (5.71%) consider it quite adequate, and 1 (2.85%) rate it as adequate.

The systemic, interdisciplinary, integrative, transformative and practical nature The process of developing research skills in accordance with the transformations taking place in Technical and Vocational Education was considered very adequate by 30 experts (85.71%), quite adequate by 4 (11.42%), and adequate by 1 (2.85%). The accuracy of the stages for developing research skills, with a gradual and progressive development through the academic years and a high degree of social and scientific relevance, was considered very adequate by 32 experts (91.42%), while 3 (8.57%) assessed it as quite adequate. The experts' contributions focused on further developing the implementation of the methodology's actions within the subjects of the main integrative discipline.

DISCUSSION

Research is the core process of the university, where all other processes are interconnected, and it represents one of the functions of the professor's professional work. This aligns with Rojas Gutiérrez and Tasayco Jala (2021), who emphasize the need to characterize research skills for the systemic relationship of other core processes in the production of academic work. It is recognized that research is a constant and gradually growing activity in university education, ensuring competent professionals through the integration of science and innovation within the university and the workplace.

Learning each new research skill influences the development of thinking, creativity, and the student's intellectual development. The potential of teamwork for the responsible distribution of scientific tasks, as well as responsibility oriented toward social commitment and teaching, is recognized, coinciding with Cristi González *et al.* (2023) in their systematic review on the topic. These results are also similar to those of Álvarez Gómez *et al.* (2022), highlighting the construction of learning through the

analysis and interpretation of problems, which, in the formative process, enables students to reach higher levels of understanding by progressing through the stages of scientific research in the educational environment.

The content of the Research-Based Labor Training discipline is considered relevant to the curriculum. Its subjects sequentially enhance the development of research skills, valuing the criteria of Romaní Romaní *et al.* (2022) in their publication, highlighting four attributes of this experience: the integrative approach of research-teaching linkage models, the promotion of student autonomy, the balance between mandatory and flexible delivery of research products, and a progressive design in the development of research skills.

Based on their experience, the faculty of the program values the relevance of the didactic approach to achieving a training process that better aligns with the professional goals of graduates, focusing on collaborative teamwork for the development of research skills, assuming that communication enables relevant feedback for the appropriation and transfer of new knowledge in educational research (Chávez Ayala *et al.*, 2023). Similarly, Pozo Camacho *et al.* (2023) refer in their results to the skill of data collection and interpretation, and presentation, as part of the communicative skills inherent in educational research.

Developing research skills is essential in the training of future education professionals. It enables them to achieve effective approaches within their field, grounded in scientific research, to solve problems encountered in their work and demonstrate competent professional performance.

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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.