ISSN: 2661-6831
Vol. 8 No. 3, pp. 50 – 82, July - September 2024

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Dicotomía entre la teoría y la práctica en la enseñanza aprendizaje en el área técnica de agropecuaria en el bachillerato técnico

Dichotomy between theory and practice in teaching-learning in the technical area of agriculture in the technical baccalaureate

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Scientific and Technological Research Article
Sent: 04/09/2024
Revised: 10/05/2024
Accepted: 10/06/2024
Published:05/07/2024
DOI:https://doi.org/10.33262/exploradordigital.v8i3.3073

Please quote: Calvache Simbaña, MI, Robles Robles, LM, & Guzmán Hernández, R. (2024). Dichotomy between theory and practice in teaching and learning in the technical area of agriculture in technical high school. Explorador Digital, 8(3), 50-82.https://doi.org/10.33262/exploradordigital.v8i3.3073

DIGITAL EXPLORER,*and*It is an electronic, quarterly journal, which will be published in electronic format, and has the mission of contributing to the training of competent professionals with a humanistic and critical vision who are capable of presenting their investigative and scientific results to the same extent that positive changes in society are promoted through their intervention.https://exploradordigital.org
The journal is published by Editorial Ciencia Digital (a prestigious publisher registered with the Ecuadorian Book Chamber with membership number 663).www.celibro.org.ec

ISSN: 2661-6831
Vol. 8 No. 3, pp. 50 – 82, July - September 2024

www.exploradordigital.org

Palabras claves: teoría y práctica, educación técnica agropecuaria, concepción dialéctico-materialista, desarrollo profesional docente, integración teoría-práctica.

Resumen

Introducción: esta investigación evaluó la efectividad de estrategias pedagógicas innovadoras para reducir la brecha entre teoría y práctica en la educación técnica agropecuaria. **Objetivos:** Evaluar la percepción y experiencia de estudiantes y docentes respecto a la integración de teoría y práctica en su planificación académica, y medir la efectividad de estrategias pedagógicas empleadas para mejorar esta integración. **Metodología:** utilizando encuestas aplicadas a docentes y estudiantes, los resultados mostraron que, aunque los docentes valoran positivamente estas estrategias, los estudiantes tienen una percepción más neutral. Los docentes perciben que proyectos prácticos, talleres y simulaciones pueden mejorar significativamente la integración de teoría y práctica. **Resultados:** sin embargo, los estudiantes indican que la implementación de estas estrategias no sería tan efectiva como se esperaba, lo que resalta la necesidad de ajustes para maximizar su impacto. La falta de recursos y materiales, la falta de capacitación docente y la desconexión entre el contenido teórico y práctico fueron identificados como las principales barreras para la integración efectiva de teoría y práctica. **Conclusiones:** se propone la implementación del modelo ERCA (Experiencia, Reflexión, Conceptualización, Aplicación) y el uso de TIC, como metodologías clave para mejorar la integración de teoría y práctica. Este enfoque busca no solo mejorar la comprensión y aplicación del conocimiento, sino también preparar a los estudiantes de manera integral para su inserción en el campo laboral, alineándose con las necesidades y desafíos del sector agropecuario. **Área de estudio general:** Educación. **Área de estudio específica:** Pedagogía. **Tipo de estudio:** original.

Keywords: theory and practice; technical agricultural education; dialectical-materialist conception; teacher professional development;

Abstract

Introduction: This research evaluated the effectiveness of innovative pedagogical strategies to reduce the gap between theory and practice in agricultural technical education. Objectives: To evaluate the perception and experience of students and teachers regarding the integration of theory and practice in their academic planning, and to measure the effectiveness of pedagogical strategies used to improve this integration. Methodology: Using surveys applied to teachers and students, the results showed that, although teachers value these strategies positively, students have a more neutral perception. Teachers perceive that practical projects,

theory-practice integration.

workshops and simulations can significantly improve the integration of theory and practice. Results: However, students indicate that the implementation of these strategies would not be as effective as expected, highlighting the need for adjustments to maximize their impact. Lack of resources and materials, lack of teacher training, and the disconnect between theoretical and practical content were identified as the main barriers to the effective integration of theory and practice. Conclusions: The implementation of the ERCA model (Experience, Reflection, Conceptualization, Application) and the use of ICT are proposed as key methodologies to improve the integration of theory and practice. This approach seeks not only to improve the understanding and application of knowledge, but also to prepare students in a comprehensive way for their insertion into the labor field, aligning with the needs and challenges of the agricultural sector.

Introduction

Technical education, characterized by its practical and applied approach, constantly faces the challenge of integrating theory and practice in its teaching-learning process (Cole et al., 2004). This integration is not only essential for the development of technical competencies, but also for the formation of reflective and critical professionals capable of adapting to changing work environments. However, the dichotomy between theory and practice persists as a significant obstacle, affecting the effectiveness of learning and teacher professional development.

Academic literature consistently highlights the relevance of uniting theory and practice within the technical education field. As indicated by Cárdenas et al. (2010), such integration is fundamental for the effective professional development of teachers, allowing them to articulate both components critically in their teaching practice. Perez-Lorcaet al. (2022), underline the importance of practical reflection for this articulation. The challenge of transferring theoretical knowledge to practical applications is particularly acute in agriculture, where the ability to handle real field situations is as crucial as theoretical knowledge (Zapatero et al., 2021). For example, Bermeo & Morillas (2023) and Álvarez et al. (2010), propose that project-based learning and professional internships are effective methods to overcome this gap, by promoting learning that is immediately applicable to the work environment.

Noting that theory provides a conceptual framework necessary to understand agronomic principles, while practice offers direct experiences with problems and situations that

future professionals will face. According to Álvarez et al. (2021), the integration of these components is crucial to developing competencies that respond to current and future market demands. However, the gap between theory and practice remains a persistent obstacle that limits the potential of technical education to train competent and motivated professionals.

The need to address this gap has become increasingly evident in a world that demands advanced technical skills and a solid theoretical understanding to innovate and solve complex problems. Despite the interdependence between theory and practice, the study by Roberts et al. (2021), points out that effective integration into educational curricula remains a challenge, evidenced by the physical and conceptual separation between classroom learning and practical experience. This suggests an urgent need to review and adapt teaching strategies to ensure that they adequately prepare students for the real challenges of the agricultural sector.

Research has shown that the disconnect between theory and practice can lead to a fragmented understanding of knowledge, limiting students' ability to apply what they have learned in real-world field situations. Furthermore, this gap affects the professional development of teachers, who play a crucial role in mediating these two dimensions of knowledge. Recognizing and addressing this dichotomy is not only essential to improving the quality of technical education, but also to preparing students for the challenges of the future.

The article proposes to analyze the dichotomy between theory and practice in the teaching-learning process of technical areas, in order to identify strategies that promote their effective integration. Through an ethnographic approach, the perceptions of teachers and students about this problem and its impact on learning and professional development will be explored. The research will be based on previous studies carried out by Álvarez (2012), whose implications for teaching and teacher professional development offer points of view. valuable for addressing this complex relationship in a broader context of agricultural technical education.

Pedagogical experiences and reflection on practice emerge as key aspects to overcome the theory-practice dichotomy. Studies focused on reflective practice in teacher training (Gaitán-Pedraza et al., 2022) and the importance of fostering reflexivity during initial training (Ortiz, 2021) illustrate the complexity of this integration. Likewise, the research of Campos et al. (2020) suggests that self-determination and self-efficacy are essential components that contribute to the success of these pedagogical approaches.

Additionally, various pedagogical experiences and case studies at an international level provide concrete evidence of the benefits of this integration. For example, programs that have implemented project-based learning or professional practices such as that of Caeiro

et al. (2021), which is based on creation-based learning, have demonstrated notable improvements in student performance and in the application of technical knowledge in real situations. These experiences reinforce the idea that the theory-practice dichotomy is not insurmountable, but that, through innovative pedagogical approaches, it is possible to foster more dynamic and meaningful learning.

Despite growing awareness of the importance of integrating theory and practice, effective strategies to achieve this integration are still insufficient. The literature suggests that collaboration between educational institutions and the productive sector, as well as the adoption of pedagogical approaches that encourage project-based learning and problem-solving, could be promising ways to overcome this dichotomy (Álvarez et al., 2021). This article argues that effectively addressing the dichotomy between agricultural theory and practice is key to optimizing learning, proposing a teaching-learning model that integrates these components in a cohesive manner.

According to Davhana-Maselesele &Tjallinks(2001), the effective integration of theory and practice in educational curricula is essential to ensure meaningful and relevant learning for students. Collaboration between teachers and students, practical training in real environments and a holistic approach to education are key elements to address this challenge and promote comprehensive learning in different educational contexts.

Addressing this dichotomy involves not only reviewing and adapting teaching methods, but also reconsidering the educational objectives of agricultural technical programs to ensure that they prepare students for real-world challenges. This article is therefore intended as a critical contribution to the debate on how to improve technical education, offering a detailed analysis of the problem and outlining strategies for overcoming it. Through this research, we seek to open new avenues for dialogue and pedagogical innovation, with the ultimate goal of enriching the educational experience of students in technical areas and maximizing their potential to contribute to technological and socioeconomic development.

Methodology

Research focus

To effectively integrate theory and practice in agricultural technical education, the adoption of a mixed methods approach, as highlighted by Fetters et al. (2013), is essential. This approach combines semi-structured interviews and focus groups to capture detailed perceptions and community norms, complemented by participatory observation that allows researchers to observe the direct application of theoretical knowledge in practical contexts. Akimowicz et al. (2018) support the use of surveys to quantitatively assess the effectiveness of educational strategies. Furthermore, statistical techniques such as t-test

and ANOVA are crucial to analyze these results. Plano et al. (2010) underline the importance of integrating quantitative and qualitative data, thus improving the robustness of conclusions. This ongoing dialogue between data helps to refine the research, ensuring that qualitative and quantitative methodologies effectively complement each other, leading to a deeper and more complete understanding of the integration of theory and practice in agricultural education.

Type of research

Table 1

Research model

Aspect	Detail
Type of Research	Non-experimental, descriptive, cross-sectional
Add-ons	Literature review, field observation, interviews
Approach	Mixed (Qualitative and Quantitative)
Paradigm	Critical-hermeneutic
Study Population	Second year students and teachers of technical high school in agriculture
Sample	26 students from the second year of Agricultural Technical High School specializing in Agricultural Production, 7 Teachers from the technical area of the San Jacinto del Búa Educational Unit in the canton of Santo Domingo
Sampling	Non-probabilistic (intentional)
Research Methods	Theoretical: content analysis, statistical analysis, semi-structured interviews, focus groups

Description

The proposed study is descriptive and non-experimental in nature, carried out with a cross-sectional approach. This means that data will be collected at a single point in time, without manipulating experimental variables. The main objective is to describe specific characteristics and behaviours related to the integration of theory and practice in agricultural technical education, using both qualitative and quantitative methods to provide a complete picture.

The research will be complemented by a bibliographic review, where existing studies and literature will be analyzed to contextualize the findings within the field of agricultural technical education. In addition, field observations and interviews will be conducted, allowing a direct approach to the experiences and perceptions of the participants.

Adopting a critical-hermeneutic paradigm, the study will seek to interpret and deeply understand the underlying dynamics and structures that influence the relationship between theory and practice. This approach allows for a critique of existing practices and suggests ways to improve pedagogical integration.

The study population will include students and teachers in the second year of technical high school in agriculture. The sample will be non-probabilistic and intentional, selecting participants who can provide valuable data on the phenomenon of study.

Finally, theoretical research methods will involve content analysis for qualitative data collected from interviews and focus groups, and statistical analysis for quantitative data obtained through surveys and evaluations. This combination of methods will help ensure that both the numerical dimensions and the deeper understandings of the topic under investigation are captured.

This comprehensive approach addresses the complexity of integrating theory and practice, providing a solid foundation for educational recommendations.

Research techniques

The study will employ a mixed approach, drawing on both qualitative and quantitative methods to gain a holistic and multifaceted understanding of the integration of theory and practice. Among the qualitative techniques, semi-structured interviews will be key, as according to Bryman (2016) these allow for an in-depth exploration of participants' experiences and perceptions, fostering a flexible and open conversation. Focus groups will facilitate the exploration of social norms and group dynamics in a collective setting, allowing for the observation of how individuals discuss and conceptualize issues in a social context.

Furthermore, participatory observation as suggested by Angrosino (2017) will offer direct views of the application of theories in real practices, capturing interactions in natural settings that are crucial to understanding how pedagogical strategies are effectively implemented. On the quantitative front, we will use surveys to collect broad data, which are essential to assess the effectiveness of large-scale educational interventions and can be adapted to include various types of questions.

In terms of data analysis, both qualitative and quantitative analysis will be applied. Fundamental thematic analysis and coding will allow identifying and analyzing significant patterns and themes in qualitative data. On the other hand, supported quantitative analysis will use descriptive and inferential statistics to describe and examine relationships and differences between variables, facilitated by analytical tools such as SPSS.

This approach not only ensures a rigorous assessment of perceptions and experiences related to theory and practice, but also enriches the understanding of the phenomenon from multiple perspectives.

Materials

Equipment for interviews and focus groups

- Camera to document interviews and focus groups.
- Suitable rooms to carry out these sessions, ensuring privacy and a controlled environment.

Materials for Participatory Observation

- Notebooks or electronic devices to record observations.
- Cameras to document activities, if applicable and with the necessary consent.

Survey instruments

- Printed copies of surveys for those who prefer or need a physical format.

Software and technological tools

- Statistical software such as Microsoft Excel, SPSS or R for processing and analyzing quantitative survey data.

Access to libraries and databases

- Academic databases for access to relevant literature (Google Scholar).
- Resources for the bibliographic review necessary for the theoretical framework and data analysis.

Research methods

- Research design

Type of study: descriptive, non-experimental, cross-sectional.

Mixed approach that combines qualitative and quantitative methods for a comprehensive understanding.

- Qualitative data collection

Semi-structured interviews: Conduct interviews with teachers and students to explore their perceptions and experiences.

Focus groups: Organize sessions with groups of students and teachers to discuss their views on the integration of theory and practice.

Participatory observation: observing in classrooms and laboratories to see the practical application of the theory taught.

- Quantitative data collection

Surveys: Distribute structured surveys to assess perceptions of the effectiveness of theory-practice integration strategies.

- Data analysis

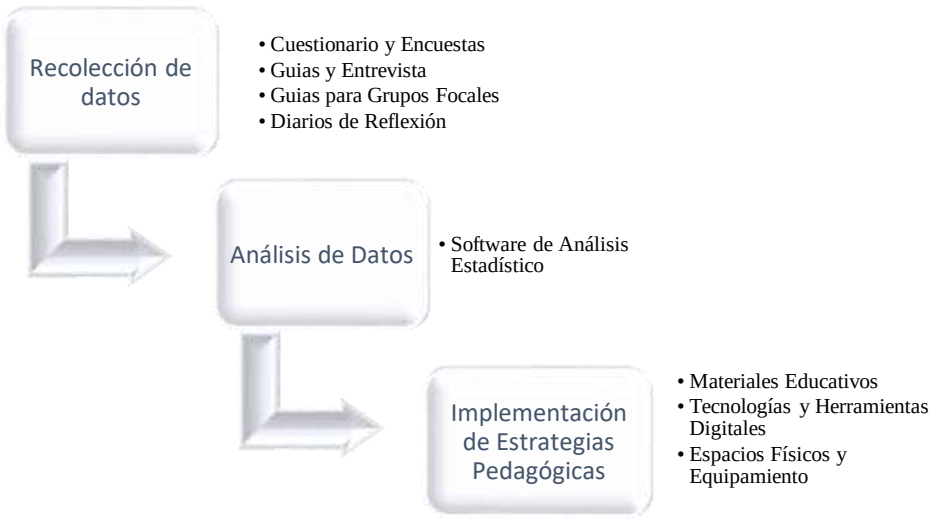
Qualitative analysis: Use thematic analysis and coding to interpret data from interviews and focus groups.

Quantitative analysis: using descriptive and inferential statistics to analyze survey data.

Integrate and compare data from different sources and methods to validate findings and draw robust conclusions.

Figure 1

Materials diagram for research development



Design and application of instruments

General objective

To assess the perception and experience of students and teachers regarding the integration of theory and practice in their academic planning, and to measure the effectiveness of pedagogical strategies used to improve this integration.

To evaluate the implementation and effects of these methodologies, we employed a combination of qualitative and quantitative techniques, including:

- Interviews with teachers and surveys with students

Teacher interviews

1. What is your conception of the dialectic between theory and praxis?
2. Interpret the notion of "dichotomy between theory and praxis" and exemplify your opinion.
3. What is your definition of the theory-praxis relationship? Based on your experience, what strategies would you propose to optimize this relationship?
4. From your perspective, what are the reasons underlying the dichotomy between theory and practice in Technical Vocational Training (FTP)? (Please explain your answer.)
5. What factors do you think cause the dichotomy between theory and practice in FTP?
6. Do you think that the dichotomy between theory and practice is a consequence of insufficient ongoing training for teachers?
7. Based on your teaching career, what recommendations would you make to mitigate the dichotomy between theory and practice?

Student survey

Dear student,

This survey aims to better understand your perception of the integration of theory and practice in your agricultural technical training. The information collected will help us identify strengths and areas for improvement in our educational program, in order to provide a more coherent and effective learning experience. Your participation is crucial to improving the quality of education and ensuring that students are well prepared for future professional challenges.

ISSN: 2661-6831
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Your responses will be kept confidential and used for research purposes only. We appreciate your time and honesty in completing this survey.

Respondent data

Age, Gender, Year of study, Area of specialization

Instructions

Below are several statements related to the integration of theory and practice in your training. Please indicate your level of agreement with each statement, using the following Likert scale:

1. Totally disagree
2. Disagree
3. Neutral
4. OK
5. Totally agree

1. Do you think that the theoretical classes are well integrated with the practical classes in my study program?

☐ ☐ 1 2 3 4 5 ☐ ☐

2. Practical activities help me better understand theoretical concepts.

☐ ☐ 1 2 3 4 5 ☐ ☐

3. Teachers adequately relate theory to practical activities.

☐ ☐ 1 2 3 4 5 ☐ ☐

4. I would like to have more opportunities to apply theoretical knowledge in practical situations.

☐ ☐ 1 2 3 4 5 ☐ ☐

5. I believe that the lack of resources limits the effectiveness of the practices.

☐ ☐ 1 2 3 4 5 ☐ ☐

Multiple choice questions

?What do you think is the biggest barrier to the effective integration of theory and practice in your curriculum?

- ☐ Lack of resources and materials
- ☐ Insufficient time spent on practice
- ☑ Lack of teacher training
- ☐ Disconnection between theoretical and practical content
- ☐ Other (specify): _____

How often do you think practical activities should be updated to stay relevant?

- ☐ Every quarter
- ☐ Every year
- ☐ Every two years
- ☐ When necessary according to technological advances
- ☐ No need to update frequently

What kind of practical activities do you prefer?

- ☐ Laboratory work
- ☐ Field practices
- ☐ Research projects
- ☐ Simulations and modeling
- ☐ Other (specify): _____

Instructions for observation diaries

Write weekly about your experience learning technical concepts and applying them in practice.

Reflect on how classroom activities help connect theory to practice.

Evaluation Criteria

Clarity in the application of theoretical concepts.

Innovation and creativity in solving technical problems.

Reflection on the learning process and the integration of knowledge.

This comprehensive method allows not only to understand the dynamics between theory and practice in technical education, but also to identify effective strategies to overcome

the existing dichotomy, thus enriching the educational experience of students and contributing to the professional development of teachers.

Summary of the methodology

Within the framework of the study on the integration of theory and practice in technical high school, several data collection methodologies were implemented to assess different aspects of technical learning. First, semi-structured surveys were designed with the aim of quantifying students' general perception of the effectiveness of theory-practice integration, as well as measuring meaningful learning among second-year technical high school students. In parallel, reflection diaries and narrative analysis were used to capture the evolution of students' thinking and learning throughout the course, allowing for detailed monitoring of how students integrate theory into daily practice. In addition, an evaluation of projects and solutions generated by students in Problem-Based Learning (PBL) activities was carried out, which helped to analyze how they apply theoretical knowledge in real practical contexts. This approach assesses criteria such as clarity in the application of theoretical concepts, innovation and creativity in solving technical problems, and reflection on the learning process. This comprehensive method not only delves into the dynamics between theory and practice in agricultural technical education, but also facilitates the identification of effective strategies to overcome existing dichotomies, thus enriching the educational experience of students and contributing to the professional development of teachers. The results obtained based on the established questionnaires were the following:

Results

Student perception according to the instruments applied:

Table 2

Likert scale (1: Strongly disagree, 5: Strongly agree)

Ask	Average
I consider that the theoretical classes are well integrated with the practical classes in my study program.	2.77
Practical activities help me better understand theoretical concepts.	3.00
Teachers adequately relate theory to practical activities.	3.27
I would like to have more opportunities to apply theoretical knowledge in practical situations.	3.27
I believe that the lack of resources limits the effectiveness of the practices.	3.31

Note. Interpretation of the means, 1 - 1.99: students disagree with the statement; 2 - 2.99: students tend to disagree, but not strongly; 3 - 3.99: students tend to agree, but not strongly, 4 - 5: students agree with the statement.

Analysis

- Theory-practice integration (2.77): students have a slightly negative perception about the integration of theoretical classes with practical classes, suggesting that there may be areas for improvement.
- Understanding through practice (3.00): Practical activities are helping to understand theoretical concepts, although the average indicates that not all students feel this strongly.
- Theory-practice relationship by teachers (3.27): teachers adequately relate theory to practice, according to the students' perception.
- Opportunities to apply knowledge (3.27): There is a moderate desire for more opportunities to apply theoretical knowledge.
- Limitations due to lack of resources (3.31): The perception that lack of resources limits the effectiveness of practices is slightly stronger, suggesting that this is a critical area for improvement.

Barriers to the effective integration of theory and practice

- Lack of resources and materials (38.5%): Most students consider this to be the biggest barrier, indicating a critical need to improve access to adequate resources and materials.
- Lack of teacher training (23.1%): A significant portion of students perceive that better teacher training could reduce the dichotomy between theory and practice.
- Disconnect between theoretical and practical content (19.2%): This suggests that curricula could benefit from better alignment between theory and practice.
- Insufficient time devoted to practice (11.5%): although less frequent, this aspect remains an important barrier.
- Other (7.7%): Some additional unspecified barriers also contribute to the dichotomy.

Frequency of updating practical activities

- Every quarter (42.3%): Most students prefer frequent updates, suggesting that hands-on activities should be reviewed and updated regularly to stay relevant.
- When necessary based on technological advances (23.1%): A considerable portion of students consider that updates should be aligned with technological advances.
- Every year (19.2%) and every two years (15.4%): Fewer students are opting for these refresh rates, but they still represent a significant proportion.

ISSN: 2661-6831
Vol. 8 No. 3, pp. 50 – 82, July - September 2024

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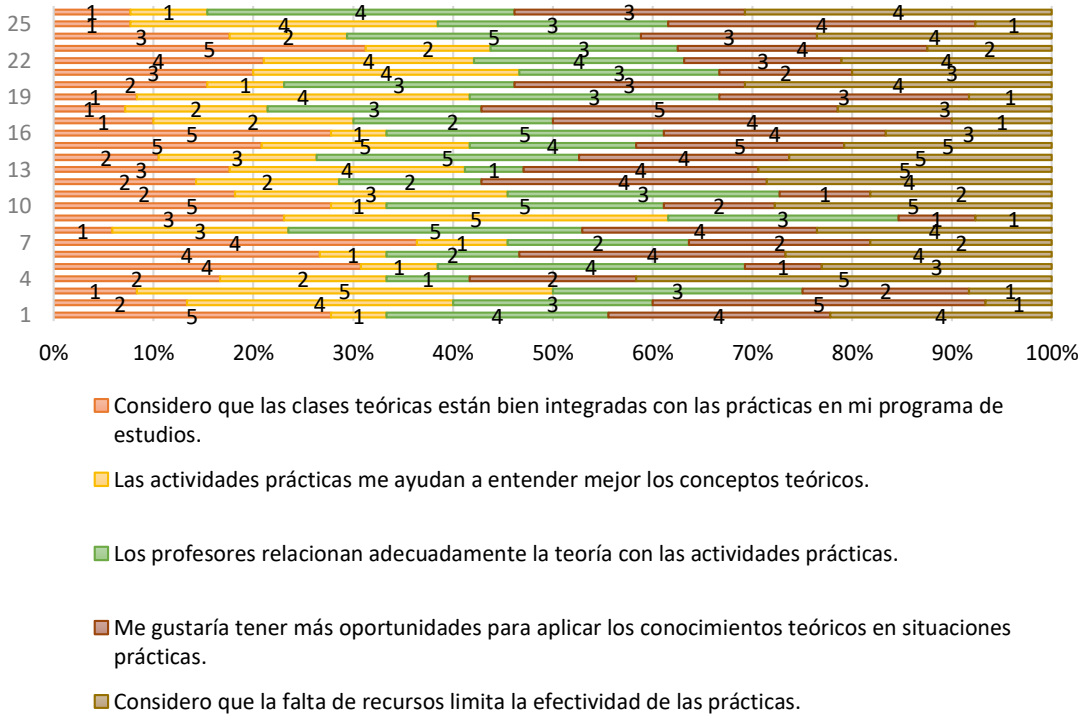
Preferred types of practical activities

- Simulations and modeling (34.6%): This type of activity is the most preferred, indicating an interest in practical and technological approaches that allow experimentation in a controlled environment.
- Research projects (26.9%): Students value opportunities to engage in research, suggesting that these projects could help better integrate theory with practice.
- Laboratory work (15.4%) and field work (11.5%): Although less preferred, these types of activities are still important to many students.
- Other (11.5%): Some additional preferences are also relevant to students

Figure 2

Likert scale of student perception



Analysis of educators' responses

Question 1: What is your conception of the dialectic between theory and praxis?

Summary of answers:

- Integration and application:Educators highlight the importance of integrating theory and practice for meaningful and contextualized learning.

- Balance:Several mention that theory provides the conceptual basis, while practice facilitates the understanding and application of those concepts.
- Real learning:The combination of both is crucial to prepare students for real-world challenges and prevent learning from becoming abstract.

Question 2: Interpret the notion of "dichotomy between theory and praxis" and exemplify your opinion.

Summary of answers:

- Disconnection:Educators identify dichotomy as a disconnect between what is taught (theory) and what is applied (practice).
- Examples:Clear examples are given such as teaching agricultural techniques without field practices, biology without a laboratory, and programming without practical projects.
- Educational gap:This disconnect prevents students from seeing the usefulness of theoretical knowledge and applying it effectively.

Question 3: What is your definition of the theory-praxis relationship? Based on your experience, what strategies would you propose to optimize this relationship?

Summary of answers:

- Complementary relationship:Theory and practice are seen as complementary and must be integrated for effective education.
- Proposed strategies:
    - Project-based learning:integrate practical projects that allow students to apply theory.
    - Workshops and simulations:use of workshops, simulations, and case studies to strengthen practice.
    - Technical visits and field work:implement workplace visits and field activities to contextualize learning.

Question 4: From your perspective, what are the reasons underlying the dichotomy between theory and praxis in training?Professional Technician (FTP)? (please justify your answer)

Summary of answers:

- Lack of resources:Insufficient material and human resources are a recurring cause.
- Teacher training:Educators mention insufficient training of teachers in practical methodologies.

- Curriculum design:A curriculum design that does not adequately integrate theory with practice contributes to this dichotomy.
- Disconnection from the labor market:The disconnect between the educational curriculum and the needs of the labour market is also notable.

Question 5: What factors do you think cause the dichotomy between theory and practice in FTP?

Summary of answers:

- Inadequate infrastructure:the lack of adequate infrastructure for carrying out internships.
- Curriculum update:insufficient updating of the curriculum to reflect practical needs.
- Resistance to change:resistance of some teachers to incorporating new practical methodologies.
- Lack of coordination:the lack of coordination between theoretical and practical components in the curriculum.

Critical analysis

Results obtained through surveys, interviews, and student observation diaries reveal a significant disconnect between theory and practice in agricultural technical training, characterized by an increase in the theoretical load and a decrease in practical opportunities. Students highly value the integration of practical activities in their learning, showing greater understanding and motivation when applying theoretical concepts in real environments, as observed in the practice of sustainable crops. Teachers identify lack of resources, insufficient teacher training, and poor curriculum design as the main barriers to this integration. Furthermore, the lack of adequate practices negatively affects students' insertion in the labor field, as they do not develop the necessary skills to face the real challenges of the sector. The results suggest that strategies such as project-based learning, the use of simulations, workshops, and technical visits can mitigate the dichotomy between theory and practice. In conclusion, an effective agricultural technical education must promote a close relationship between theory and practice, supported by adequate resources and continuous training for teachers, to prepare students for real-world challenges in a comprehensive and meaningful way, facilitating their transition to the labor market.

Methodological proposal for strengthening the integration of theory with practice in technical education

Basis of the proposal

In the field of technical education, the effective integration of theory with practice is essential for the development of professional skills that respond to the demands of the labor market. The traditional dichotomy between these two components has limited the ability of students to apply their theoretical knowledge in real practical contexts, thus affecting their professional preparation and performance. Recognizing this need, a methodological proposal is presented that seeks to strengthen the integration of theory with practice in agricultural technical education. This proposal is based on solid pedagogical foundations and innovative approaches, designed to provide a more coherent, meaningful and relevant learning experience for students. The key foundations that support this methodological proposal are detailed below.

1. Materialist conception - theory with practice

The dialectical-materialist conception of practice is understood as human activity that transforms the world, which implies the indispensable interrelation with theory or knowledge. This approach maintains that human practice cannot be discussed without considering its connection with theory. The didactic principle of the unity between theory and practice seeks to integrate theoretical concepts with practical applications in the educational process, providing students with opportunities to apply their theoretical knowledge in real situations, through practical activities, problem solving, research projects, internships and simulations (Lisle, 2006).

This principle allows students to understand the relevance and applicability of theoretical concepts, develop practical and transferable skills, reinforce their theoretical understanding through practical application, and integrate knowledge from different areas of study in an interdisciplinary way. In this way, learning is enriched by connecting abstract concepts with reality, promoting deeper and more meaningful learning (Andrade et al., 2016).

2. Didactic principle of the unit theory with practice

The didactic principle of unity between theory and practice is an educational approach that seeks to coherently and effectively integrate theoretical knowledge with practical experiences. This principle is based on the idea that learning is more meaningful and effective when students can apply theoretical concepts in real-life practical contexts, and vice versa. A detailed definition and key components of this principle are presented below.

3. Self-determination theory and self-directed learning

We implement learning environments that promote students' autonomy, competence and relationships, allowing them to choose projects aligned with their interests and professional goals. This strategy seeks to intrinsically motivate students and improve their psychological well-being, based on the proposal of Ryan & Deci (2000).

4.- Principle of learning by doing

John Dewey's principle of learning by doing emphasizes the importance of action and practical experience in the learning process, but from a meaningful perspective, which leads to reflection and experimentation. This approach recognizes that students learn best when they are actively involved in meaningful and practical experiences. Associated methodologies include project-based learning, cooperative learning, simulations, laboratories and experiments, and professional practices, all of which encourage student participation in their own learning, allowing them to acquire knowledge, skills and competencies more effectively. The methodology associated with this principle contemplates the articulation with other active methodologies that lead to the protagonism of the student in the construction of his or her learning and his or her learning.

5.-Hermeneutical methods for critical reflection

The scientific-technological and hermeneutic approach complements this relationship. The scientific-technological approach is based on scientific and technological principles to address educational problems, providing a framework for educational research and the evaluation of the effectiveness of pedagogical strategies. The hermeneutic approach, on the other hand, focuses on the interpretation and understanding of meaning in human contexts, encouraging critical reflection and the adaptation of educational practice according to the individual needs and experiences of students.

We encourage critical reflection on practical experiences through discussions and case analysis, allowing students and teachers to connect theory with practice in a meaningful way (Campos & Mesquida, 2021).

6.-Problem-Based Learning (PBL)

We integrate PBL as a key strategy to link theory and practice, engaging students in real-world problem solving and promoting contextualized learning. This approach is based on the research of Ryan & Deci (2000), which highlights its effectiveness in promoting autonomy and critical thinking.

7.-Practice-focused teacher training

The continuous training of teachers oriented towards practice is assumed, taking as a basis the fundamental principles that guide teacher training proposed by Korthagen et al. (2006).

Design of the methodological proposal

Initial Diagnosis

- Needs assessment: Identify areas where the gap between theory and practice is most pronounced through surveys, interviews and observations.
- Curriculum review: analyze the current curriculum to identify the proportion of theoretical versus practical content.

Formulation of objectives

- To improve the quality of agricultural technical education through the effective integration of theory and practice.
- Develop practical skills in students that complement the theoretical knowledge acquired.

Selection of teaching methodologies and their didactic projection for theory-practice integration

a.- Learning by Doing

- Rationale: This method, based on the educational philosophy of John Dewey, maintains that learning is most effective when students actively engage in practical activities that allow them to experiment and reflect on their experiences.
- Application: Incorporate workshops, laboratories, and field practices where students can apply the theoretical concepts learned in the classroom.

Table 3

ERCA model in the pilot chapter "short cycle crops"

Phase	Activities	Goals
Experience	- Soil preparation - Planting and caring for crops - Integrated pest management - Harvest	- Involve students in direct practical activities. - Provide tangible experience.
Reflection	- Reflection journals (weekly log) - Group discussion (weekly sessions) - Guided questions	- Encourage critical reflection on practical experiences. - Share and analyze learnings.
Conceptualization	- Integrated classes - Creation of conceptual maps - Case analysis	- Connect theory and practice. - Visualize relationships between concepts and practices. - Study real cases.

Application	- Extension projects - Practical assessments (assessment rubrics) - Simulations and role-playing	- Apply knowledge to real projects. - Practice decision making and problem solving.

Note. The application of the ERCA model in the chapter "Short Cycle Crops" extracted from the curriculum, facilitates an integrative agricultural technical education, preparing students for professional challenges through experiences

b.-Simulations, modeling and ICT

Rationale: Simulations allow students to experience real-life situations in a controlled environment.

Application: Using simulation software to model agricultural scenarios, online learning platforms, AR, allowing students to make decisions and observe results in real time.

- *Online learning platforms*

1. *Moodle and other Learning Management Systems (LMS):*

    1. Description:use learning management platforms such as Moodle to create an online educational environment.
    2. Features:These platforms allow the distribution of teaching materials, the carrying out of exams and the interaction between students and teachers.
    3. Advantages:They facilitate access to educational resources at any time and place, promoting autonomous and flexible learning.

2. *Massive Open Online Courses (MOOCs)*

    1. Description:integrate massive online courses from renowned universities and organizations.
    2. Features:They offer specialized courses in agriculture, natural resource management and sustainability.
    3. Advantages:They allow students to access advanced and up-to-date knowledge and obtain globally recognized certifications.

- *Digital applications and tools*

1. *Mobile applications for agricultural management:*

    - Description:use applications designed for crop management, soil monitoring and pest control.
    - Features:These applications offer analysis tools, climate predictions and agricultural management recommendations.

- Advantages:They facilitate data-driven decision-making, optimizing the performance of agricultural practices.

2. *Agricultural simulation software:*

- Description:implement simulation programs that allow the recreation of agricultural scenarios.
- Features:crop simulations, water resource management and environmental impact analysis.
- Advantages:They provide a safe environment to experiment and learn without real risks, encouraging practical learning.

❖ *Augmented and virtual reality technologies*

1. *Augmented Reality(AR):*

- Description:use AR to overlay digital information on the real environment.
- Features:applications that allow you to view crop data, identify plant species and analyze plant status.
- Advantages:enriches the learning experience by providing real-time contextual and visual information.

2. *Virtual Reality(VR):*

- Description:create immersive virtual environments for practical training.
- Features:farm simulations, virtual laboratories and agricultural machinery management scenarios.
- Advantages:offers an immersive, hands-on learning experience ideal for technical skills training.

❖ *Online communication and collaboration*

1. *Online collaboration tools*

- Description:use tools like Google Workspace, Microsoft Teams and Slack to facilitate communication and collaboration.
- Features:chats, video conferencing, document sharing and real-time teamwork.
- Advantages:They promote collaboration between students and teachers, allowing for interactive and dynamic learning.

2. *Social networks and discussion forums:*

- Description:create groups on social networks and online forums dedicated to agricultural topics.
- Features:spaces to discuss problems, share experiences and access educational resources.
- Advantages:promotes the creation of learning communities and the exchange of knowledge among peers.

c.- Reflection diaries:

Students will keep a reflection journal where they will record their experiences, challenges and learnings in practical activities.

- Weekly Log: Students will keep a weekly journal documenting their activities, observations, and reflections on crop growth and challenges encountered.

Group discussion

- Weekly sessions: facilitate weekly group discussions to share experiences and reflect on what has been learned.

Guided Questions

- Guided reflection: Provide specific questions to guide reflection, such as "Which pest management techniques were most effective?" and "How did soil conditions affect crop growth?"

Formative evaluation of behavior, the integration of theory and practice in the training process, feedback and continuous improvement

Formative assessment is an ongoing process that aims to monitor and improve student learning through constant feedback and adaptation of teaching strategies. In the context of theory-practice integration in technical education, this assessment focuses on how students apply theoretical concepts in practical activities and how these experiences influence their understanding and professional skills.

Components of formative assessment

1. *Continuous monitoring of student progress*

   - **Reflection diaries:**Students are required to keep reflection journals where they record their practical experiences, the challenges encountered, and how they applied theoretical concepts. This allows for self-assessment and provides teachers with ongoing insight into the learning process.

- **Classroom and field observations:**Teachers should conduct systematic observations during practical activities to assess the application of theory in real-world contexts and provide immediate feedback.

2. *Assessment instruments*

- **Evaluation rubrics:**use specific rubrics to evaluate practical projects, workshops and other activities, focusing on criteria such as theoretical understanding, practical application, innovation and problem-solving ability.
- **Practical assessments:**implement practical assessments that challenge students to apply their knowledge in simulated or real situations, allowing for a concrete measurement of their skills.

3. *Constructive feedback*

- **Immediate feedback:**Provide immediate and specific feedback after each hands-on activity to help students identify their strengths and areas for improvement.
- **Review sessions:**Conduct regular review sessions where students can discuss their progress, receive additional guidance, and adjust their learning approaches as needed.

4. ***Self-assessment and peer-assessment***

- **Self-assessment:**encourage self-assessment where students reflect on their performance and set personal goals to improve their integration of theory and practice.
- **Peer evaluation:**promote peer assessment so that students can learn from each other, share experiences, and receive diverse feedback.

5. ***Use of educational technologies***

- **Learning Management Systems (LMS):**use digital tools to conduct surveys, questionnaires and discussion forums that allow detailed monitoring of student progress and facilitate feedback.
- **Simulations and modeling:**implement simulation software that allows students to practice in controlled environments and receive automated feedback on their performance.

Continuous improvement

1. ***TO****Data analysis and curriculum adjustments*

   - **Data collection and analysis:**analyze data collected from formative assessments to identify patterns, trends, and critical areas for improvement in theory-practice integration.
   - **Curriculum review and update:**use the results of the analysis to adjust the curriculum, ensuring that theoretical and practical activities are appropriately aligned and relevant to educational objectives.

2. *Continuing education for teachers*

   - **Vocational training:**Provide continuing education programs for teachers, focused on new methodologies and technologies that facilitate the integration of theory and practice.
   - **Communities of practice:**promote the creation of communities of practice among teachers to share experiences, effective strategies and educational resources.

3. *Involving students in the improvement process*

   - **Student Feedback:**Regularly collect students' opinions and suggestions on the activities and strategies used, incorporating their contributions to improve the educational process.
   - **Participation in planning:**Involve students in planning practical activities, allowing them to contribute ideas that are relevant and motivating to them.

Formative assessment of the integration of theory and practice in the training process is essential to ensure meaningful and contextualized learning in technical education. Through continuous monitoring, constructive feedback and continuous improvement, a more coherent and effective education can be achieved, preparing students for the challenges of the world of work and ensuring their comprehensive development as competent and reflective professionals.

Validation of the proposal

Assessment

Objective diagnosis

In order to evaluate the effectiveness of the innovative pedagogical strategies implemented to reduce the gap between theory and practice in pilot chapters of the curriculum, validation questionnaires were applied to teachers and students. These

questionnaires sought to obtain perceptions on how these strategies have influenced the integration of theory and practice, as well as the improvement of student learning. An analysis of the responses obtained is presented below.

Teachers' responses

Response averages

1. Innovative pedagogical strategies (practical projects, workshops, simulations) are considered to significantly improve the integration of theory and practice in the technical subjects of the curriculum.
    - Average: 3.71
2. In general terms, the proposed innovative strategies would be effective in reducing the dichotomy between theory and practice in the training of students.
    - Average: 3.57

Analysis

- Teachers perceive that innovative pedagogical strategies would have a positive impact on the integration of theory and practice, with an average of 3.71, indicating a tendency towards agreement.
- The overall effectiveness of innovative strategies in reducing the dichotomy between theory and practice is also valued positively, with an average of 3.57.

Student Responses

Response Averages

1. Practical activities (projects, workshops, simulations) would help you better understand the theoretical concepts.
    - Average: 2.92
2. In general, the innovative strategies that were proposed in socialization believe that they would help you reduce the differences between theory and practice.
    - Average: 2.88

Analysis

- Students show a neutral perception about how practical activities would help them better understand theoretical concepts, with an average of 2.92.

- The general perception about the effectiveness of innovative strategies to improve learning and reduce the gap between theory and practice is also neutral, with an average of 2.88.

Conclusions

- **Teachers:**Teachers positively value the proposals for innovative strategies implemented, highlighting the possibility of a significant improvement in the integration of theory and practice and in the reduction of the theoretical-practical dichotomy.
- **Students:**Students have a more neutral perception about the impact of these strategies on their theoretical understanding and on reducing the gap between theory and practice, suggesting the need to adjust or improve the implementation of these strategies to maximize their effectiveness.

Discussion

The results obtained from this research reveal a notable disconnection between theory and practice in agricultural technical training, perceived by both students and teachers, although with differences in nuances. Teachers show a positive assessment regarding the use of innovative pedagogical strategies to strengthen the integration of theory and practice. This positive perception is in line with the findings of Cárdenas et al. (2010) andPerez-Lorcaet al. (2022), who underline the importance of practical reflection and continuous professional development to critically articulate both components in teaching practice. Furthermore, the perception that innovative strategies can reduce the dichotomy between theory and practice reinforces the proposals of Álvarez et al. (2021) andBermeo & Morillas (2023), who suggest that methods such as project-based learning and professional internships are effective in overcoming this gap.

On the other hand, students show a more neutral perception about the effectiveness of the pedagogical strategies implemented, indicating that, although innovative strategies are well received, their implementation may not be as effective as expected from the student perspective. This finding is in line with the study by Roberts et al. (2021), which highlights the need for a more integrated and coherent approach between theory and practice.

The methodological proposal defends the criterion of dialectical unity between theory and practice, based on the dialectical-materialist conception of practice. This conception sees practice as the principle, essence, beginning and end of human knowledge. From this perspective, the approach that maintains a strict separation between theory and practice is rejected, promoting instead a continuous and recursive integration that transforms both theoretical knowledge and professional practice.

Conclusions

- The results of this research indicate that, while innovative pedagogical strategies are positively valued by teachers, students' perception of their effectiveness is more neutral. To close the gap between theory and practice, it is necessary to adjust and improve the implementation of these strategies, ensuring an adequate balance between both components and providing sufficient resources.
- The adoption of an ERCA model, together with a focus on problem-based learning and critical reflection, can offer an effective avenue for improving the integration of theory and practice in agricultural technical education.

Conflict of interest

There is no conflict of interest in relation to the submitted article.

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ISSN: 2661-6831
Vol. 8 No. 3, pp. 50 – 82, July - September 2024

www.exploradordigital.org