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Pedagogical innovation and its contribution to the training of technical agricultural high school graduates for implementing sustainable practices

La innovación pedagógica y su aporte en la formación de bachilleres técnicos agropecuarios para implementar prácticas sostenibles

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Received: 18-07-2024
Accepted: 12-09-2024

How to cite this text:

Dueñas Basurto, C. G., & Zambrano Vera, E. M. (2025). Pedagogical innovation and its contribution to the training of technical agricultural high school graduates for implementing sustainable practices. *Revista Panamericana de Pedagogía*, 39, e3214. https://doi.org/10.21555/rpp.3214

Abstract

Agricultural education faces environmental and social challenges in the 21st century and needs a profound transformation in the training of its future professionals. Pedagogical innovation and the use of strategies such as PBL and ICT, among others, promote a holistic vision of sustainable development. This article aims to analyze the potential of pedagogical innovation in the training of agricultural technical graduates in sustainable practices. The present investigation, carried out with the participation of 30 students, 20 parents, and 10 teachers of the Agricultural Technical Baccalaureate program of the San Isidro Fiscal Educational Unit, yielded significant results. This study, which used methods ranging from bi-

bliographic analysis to statistical techniques, was quasi-experimental, mixed, exploratory, and descriptive in nature. Throughout the research, it was found that satisfaction with the pedagogical strategies increased; in general, parents felt very satisfied with the pedagogical strategies used, increasing 10%, from an initial 55%. This positive indicator reflects the parents' confidence in the training their children receive. This increase was observed when pedagogical innovation tools were implemented. However, despite these advances, some barriers persist that limit the full integration of these practices. Highlighting the need to adopt pedagogical strategies to specific contexts and continue research to improve rural education and promote sustainable development.

Keywords: Technical agricultural high school; Pedagogical innovation; Sustainable development.

Resumen

La educación agropecuaria afronta desafíos ambientales y sociales en el siglo XXI, necesita una transformación profunda en la formación de sus futuros profesionales. La innovación pedagógica y el uso de estrategias como el ABP (Aprendizaje Basado en Problemas) y las TIC´S (Tecnologías de la Información y la Comunicación) entre otras, promueven una visión holística del desarrollo sostenible. Se analiza el potencial de la innovación pedagógica en la formación de bachilleres técnicos agropecuarios en prácticas sostenibles. La presente investigación llevada a cabo con la participación de 60 estudiantes, 45 padres de familia y 14 maestros de la oferta de Bachillerato Técnico Agropecuario de la Unidad Educativa Fiscal San Isidro, arrojó resultados significativos. Se emplearon métodos que van desde el análisis bibliográfico hasta técnicas estadísticas de tipo cuasiexperimental, mixto, de naturaleza exploratoria y descriptiva. A lo largo de la investigación, se vio que la satisfacción con las estrategias pedagógicas aumentó. En general los padres se sentían muy satisfechos con las estrategias pedagógicas utilizadas, con un crecimiento. Este indicador positivo refleja la confianza de los padres en la formación que reciben sus hijos. Este aumento se observó cuando se implementaron herramientas de innovación pedagógica. Sin embargo, a pesar de estos avances, persisten algunas barreras que limitan la plena integración de estas prácticas. Destacando la necesidad de adoptar estrategias pedagógicas a contextos específicos y seguir investigando para mejorar la educación rural y promover el desarrollo sostenible.

Palabras clave: Bachillerato técnico agropecuario; Innovación pedagógica; Desarrollo sostenible.

INTRODUCTION

For centuries, agricultural education has developed with many limitations in the transmission of knowledge and practices applicable to the environment. Therefore, a horizontal approach has been maintained in the development of practical techniques and tools, giving rise to the need to seek alternatives that are in line with new educational models.

Agricultural education is at a crucial moment. The environmental and social challenges of the 21st century demand a profound transformation in the training of future professionals in the sector. In this context, pedagogical innovation emerges as a valid tool for training agricultural technical graduates capable of implementing sustainable agricultural practices.

Thus, we can say that traditional pedagogical strategies, based on the passive transmission of knowledge and memorization, are insufficient to meet current needs. Pedagogical innovation, on the other hand, proposes a dynamic, student-centered approach, where learning becomes an active and meaningful process. This innovative approach seeks to develop students' technical and analytical skills, as well as a deep understanding of the principles of sustainable development. The goal is to train professionals who are not only efficient in agricultural production but also environmentally responsible and committed to social well-being. The research presented in this article was conducted in 2023 at the San Isidro Fiscal Educational Unit in the San Isidro parish of the Sucre canton, Manabí, Ecuador. The sample consisted of 30 students, 20 parents, and 10 teachers from the Technical Education area specializing in agriculture.

The integration of innovative technologies, the promotion of collaborative learning, and the resolution of real-life problems are some examples of innovative pedagogical strategies that can contribute to this goal. However, the implementation of these strategies is not without challenges. A lack of teacher training, insufficient resources, and resistance to change are some of the obstacles that must be overcome.

This article aims to analyze the potential of pedagogical innovation in the training of agricultural technical bachelor's degrees in sustainable practices. It will address the challenges and opportunities presented by this innovative approach, as well as successful experiences developed in different contexts

DEVELOPMENT

To understand the need for this research, it is necessary to state that pedagogical innovation stands out as an essential pillar in the education of students in this century, like no other, where education in general faces challenges of a globalized society. This principle has been extended with special relevance in the training of agricultural technical bachelors, in a contemporary context marked by the search for sustainable practices in the agricultural sector (Martínez Tomás & Rodríguez Guardado, 2022). However, traditional education, in many cases, appears outdated in the face of current sustainable develop-

ment needs, focusing more on the exploitation of resources than on the adoption of responsible and sustainable agricultural practices (Martínez Tomás & Rodríguez Guardado, 2022). This mismatch presents a significant challenge in the education of students, who are ill-prepared to face the environmental and social challenges facing the agricultural sector today.

The integration of innovative pedagogical strategies into the educational field offers a solution to this dilemma, providing a dynamic and relevant approach focused on the development of technical and analytical skills fundamental to the implementation of sustainable agricultural practices. By adopting methods such as project-based learning, through projects, the resolution of real problems, and collaborative work, students not only acquire theoretical knowledge but also develop practical and analytical skills essential to address the challenges of sustainable development in the agricultural sector (Bernal Serpa & Santander Patiño, 2020).

This teaching method promotes a holistic approach to sustainable development, integrating economic, social, and environmental aspects into the learning process. By connecting theoretical concepts with the reality of the agricultural sector and encouraging critical reflection on the implications of agricultural practices, students acquire a deeper and more complete understanding of sustainability and its importance in the agricultural context (Lara-Tambaco, 2022; Mendoza-Saltos & Bolívar, 2022).

Worldwide, various studies support the importance of pedagogical innovation in the training of agricultural technical graduates, highlighting the need for education geared toward academic success and sustainable development in rural contexts. The use of innovative technologies in agricultural technical education not only has a positive impact on students' learning processes but can also significantly contribute to their empowerment and the promotion of sustainable development in their communities (Aguirre Velasco, 2023).

Through comprehensive and contextualized training that integrates technological tools, students not only acquire technical skills and specialized knowledge in agriculture and livestock, but also develop a deep understanding of sustainability principles and the importance of adopting responsible agricultural practices.

First, access to online educational resources and the use of digital tools allow students to expand their knowledge of sustainable agricultural practices and innovative technologies in the agricultural sector. This provides them with the skills and knowledge necessary to implement more efficient practices that are respectful of the environment in their future professional activities (Mendoza-Saltos & Bolívar, 2022; Zhauanaula González & Erazo Álvarez, 2022).

In addition, the development of digital skills and mastery of advanced technologies gives students the ability to use data management tools, geographic information systems, and other technological solutions to monitor and evaluate the environmental impact of their agricultural practices, as well as to optimize management of natural resources like water and soil, because in this information society the management of metadata and its compilation represents a great advance in any area because better decisions can be made (Monleón-Getino, 2015).

The focus on collaborative learning and problem-solving through technological tools promotes teamwork and student participation in the search for solutions to the environmental and social challenges facing the agricultural sector. This allows them to develop leadership and teamwork skills, as well as foster values such as social responsibility and commitment to sustainable development (Aguirre Velasco; Rodríguez Macías et al., 2016; Salas Fontalvo & Meneses, 2023).

Finally, the use of innovative technologies in agricultural technical education can raise students' awareness of the importance of adopting a comprehensive and holistic approach to sustainable development, taking into account not only economic aspects but also social and environmental ones. By promoting a culture of sustainability, ability from an early age, a change in attitude and behavior can be generated among future professionals in the agricultural sector, thus contributing to the construction of more resilient and sustainable communities in the long term.

Similarly, research in countries such as Nicaragua and Colombia underlines the crucial role of technical education and the integration of ICTs in the development of labor skills and the empowerment of rural communities (Salas Fontalvo & Meneses, 2023). At the national level, in Ecuador, there is a significant gap in access to education between rural and urban areas, which highlights the importance of strengthening agricultural technical training as a tool to promote sustainable rural development (Mendoza-Saltos & Bolívar). The lack of knowledge about agricultural processes and the aging of the population dedicated to the agricultural sector are challenges that agricultural technical education can address through innovative and contextualized approaches (Tomaselli, 2018).

At the regional level, educational institutions face the challenge of preparing students for their transition to agricultural technical education, which requires innovative pedagogical strategies, such as the implementation of school gardens, to improve the conceptual understanding of relevant topics in agricultural education and prevent student dropouts (Zambrano Rodríguez & Barzaga Sablon, 2023).

In this context, pedagogical innovation to promote sustainable development faces significant challenges that require detailed attention. A crucial aspect lies in the creativity and adaptability of teachers to effectively implement relevant pedagogical techniques. The diversity of students and educational contexts demands a wide range of approaches, highlighting the need for robust and ongoing teacher training. Furthermore, the effective integration of education for sustainable development into existing curricula entails reviewing and adapting curricula to ensure comprehensive coverage of sustainable development principles across all areas of study, rather than treating them as additional topics (Bernal Serpa & Santander Patiño, 2020; Blanco-Brenes et al., 2020; Scotta et al., 2022).

Another important challenge is institutional support and adequate resource allocation to support the implementation of innovative pedagogical practices. Teachers need access to adequate educational resources and dedicated time to developing materials and planning lessons. Furthermore, a comprehensive evaluation of the impact of education for sustainable development is required, going beyond simply measuring acquired knowledge to assess how these pedagogies are influencing students' behaviors and attitudes toward the environment and society (Blanco-Brenes et al., 2020). It is essential to ensure that in-

novative pedagogies are inclusive and respect student diversity, adapting them to meet the needs of all learners, regardless of their cultural background, abilities, or learning styles.

Within this framework, the question arises: how can pedagogical innovation in the agricultural technical baccalaureate effectively contribute to the training of students capable of implementing sustainable agricultural practices? This question will guide the objective of the study, which will focus on analyzing the impact of innovative pedagogical strategies on the development of competencies related to sustainable development in the agricultural context. It is believed that agricultural technical baccalaureate students who participate in spaces with pedagogical innovation, based on experiential learning and the use of digital technologies, will demonstrate a greater understanding of the principles of sustainable development and a greater willingness to implement sustainable agricultural practices in their future projects, compared to those who do not.

MATERIALS AND METHODS

To answer the questions raised in the research and validate the hypothesis, data were collected before and after the implementation of certain pedagogical innovations to assess their effectiveness in the students' understanding of sustainable development.

The population of this study comprises 60 students, 45 parents, and 14 teachers from the Agricultural Technical Baccalaureate of the San Isidro Fiscal Educational Unit, in the Sucre canton, Manabí Province. Simple random probability sampling was used, taking 100% of the population as a sample due to the number of individuals in the population.

In developing this case, a mixed-methods approach is appropriate, as it explores both numerical data that measure the impact of pedagogical innovation and the adoption of sustainable practices, as well as the qualitative experiences and perceptions of students and teachers.

The research design was descriptive and experimental, which allowed the description of the current situation of the pedagogical branch that intervenes in the training of agricultural technical bachelors. On the other hand, experimentation allows for the evaluation of the effect of applying these innovations in terms of sustainable practices. To this end, a pre-test and a post-test were applied for a correct analysis of the impact generated.

This analysis was carried out in three phases, which allowed for the collection of the necessary information in a timely and efficient manner. Techniques such as questionnaires, interviews, and observation sheets were applied to the selected population. Each phase of the analysis was carefully designed to ensure the validity of the results and a comprehensive understanding of the phenomenon studied.

These techniques were carried out in these three interconnected moments as follows:

A pre-test was administered to 60 students, 45 parents, and 14 teachers from the Agricultural Technical Baccalaureate program at the San Isidro Fiscal Educational Unit in the Sucre canton of Manabí Province. This instrument provided information on the initial situation regarding the understanding of sustainable development and the perception of pedagogical strategies.

Over 12 weeks, innovative pedagogical strategies were carefully implemented, selected based on a literature review and expert consultation. These strategies focused on experiential learning, the use of digital technologies, and collaborative work, seeking to foster a more active, participatory educational experience that was connected to the needs of the agricultural sector.

A post-test was administered to the same participants to assess changes in their understanding of sustainable development and perception of pedagogical strategies after the intervention.

Descriptive statistics were used to compare pre- and post-intervention outcomes on the study variables. This allowed us to determine whether the implementation of innovative pedagogical strategies had a significant impact on students' knowledge, dispositions, and practices related to sustainable development and sustainable agricultural practices.

RESULTS

The research was based on data collection through questionnaires, interviews, and observation sheets, allowing for an in-depth analysis of the variables. To answer the questions posed and validate or refute the hypothesis, a mixed-method approach was implemented, combining quantitative and qualitative techniques and methods. In this way, several aspects were highlighted.

Once the described moments were developed and the quantitative and qualitative information was gathered, interesting data were obtained on the questions raised, which allowed for a global analysis.

Students' perceptions of the use of innovative practices

Table 1

Which of the following technologies do you use in your agricultural technical high school classes?

Options	Pre-Test	Post-Test	Difference
Online educational platforms (Moodle, Google Classroom, etc.)	20%	10%	-10%
Mobile applications for agriculture	20%	40%	+20%
Simulators and digital tools for learning	50%	30%	-20%
Open educational resources (OER)	40%	20%	-20%
Social networks to share information and experiences	40%	50%	+10%

Source: survey conducted among students of the U.E.F.S.I. agricultural technical high schooI.

The use of online educational platforms decreased by 10%. This could be because students found other tools more useful, or the teaching method changed after the pre-test. A 20% increase was observed in the use of mobile applications related to agriculture, indicating that these applications gained popularity or were promoted during the intervention. The use of simulators and digital tools fell by 20%, which could indicate less reliance on these tools or their replacement by other technologies. Similar to the simulators, the use of OER decreased considerably. This may indicate that students moved away from

these resources or prioritized other tools. There was an increase in the use of social media, suggesting that students found value in using these platforms to share information and experiences related to learning.

Technologies related to social interaction and mobile applications for agriculture have increased in use, suggesting a greater interest in these tools for practical and collaborative teaching.

On the other hand, the decrease in more structured technologies, such as online educational platforms and open educational resources, could indicate a shift in students' technological preferences. There is evidence of an evolution in preferences for technological tools used in the agricultural sector, with a growing emphasis on mobile applications and social networks.

Table 2

To what extent do the pedagogical strategies used in your classes help you understand the principles of sustainable development in agriculture?

Options	Pre-Test	Post-Test	Difference
Very little	10%	5%	-5%
Somewhat	20%	10%	-10%
Average	40%	30%	-10%
A lot	20%	40%	+20%
Quite a lot	10%	15%	+5%

Source: survey conducted among students of the U.E.F.S.I. agricultural technical high school.

There was a 5% increase in the "Quite a lot" category, which reinforces the trend of a positive perception in the effectiveness of pedagogical strategies after the educational intervention.

The overall trend is positive, with a move toward higher perceptions of effectiveness. This could be due to the implementation of methodologies more aligned with the goals of sustainable development in agriculture, or to students' better understanding of these principles. This analysis shows an evolution in the perception of teaching toward greater effectiveness in understanding key topics in sustainable agriculture.

Table 3

To what extent do the pedagogical strategies used in your classes motivate you to implement sustainable agricultural practices in your future projects?

Options	Pre-Test	Post-Test	Difference
Very little	10%	5%	-5%
Somewhat	20%	10%	-10%
Average	40%	30%	-10%
A lot	20%	40%	+20%
Quite a lot	10%	15%	+5%

Source: survey conducted among students of the U.E.F.S.I. agricultural technical high school.

The percentage of students who felt that the pedagogical strategies motivated them "a lot" increased significantly, by 20%. This is the highest increase in the table, indicating that the pedagogical strategies were much more motivating after the educational interven-

tion. There was also a slight increase of 5% in the "Quite Somewhat" category, reinforcing the idea of greater motivation among students to apply what they learned in sustainable agricultural practices.

The lowest categories ("Very little" and "Somewhat") decreased. In contrast, the highest categories ("A lot" and "Quite a lot") increased, indicating an overall improvement in students' perceptions of the ability of pedagogical strategies to motivate them to implement sustainable agricultural practices.

Table 4

What types of pedagogical strategies would you like to see used more in your classes to learn about sustainable agricultural practices?

Options	Pre-Test	Post-Test	Difference
Experiential learning (projects, farm visits, etc.)	50%	45%	-5%
Use of digital technologies	40%	40%	0%
Collaborative work	30%	35%	+5%
Problem-based learning	20%	25%	+5%
Others (specify)	10%	5%	-5%

Source: survey conducted among students of the U.E.F.S.I. agricultural technical high school.

In general, the table shows a tendency towards practical and collaborative methods for learning about sustainable agricultural practices, with a stability in the use of technology, and a positive assessment of teamwork and problem-based learning.

Despite a slight decline in popularity, experiential learning remains the most valued strategy, reflecting the importance of hands-on projects and farm visits in the context of agricultural education.

Students continue to rate digital technologies in the same way as in the pre-test, suggesting that they were already familiar with these tools and consider their use appropriate in the classroom.

The increase in preference for collaborative work (+5%) and problem-based learning (+5%) reflects a trend toward methodologies that encourage critical thinking and cooperation, which is essential for addressing complex issues such as sustainability in agriculture. The decrease in this category suggests that the options presented are sufficient to meet students' expectations, and they do not feel the need to propose additional alternatives.

Table 5

What do you think about the importance of pedagogical innovation in the training of agricultural technical graduates?

Options	Pre-Test	Post-Test	Difference
It is very important	80%	85%	+5%
It is important	15%	10%	-5%
It's average	3%	3%	0%
It's not important	2%	2%	0%
I'm not sure	0%	0%	0%

Source: survey conducted among students of the U.E.F.S.I. agricultural technical high school

The majority of students already considered pedagogical innovation to be "Very important" in the pre-test, but in the post-test, that percentage increased by 5%. This increase suggests that, after the intervention period, students value innovation in pedagogical methodologies even more as a crucial part of their technical training.

The 5% increase in the "It is very important" category shows a positive trend in the perception of pedagogical innovation after the intervention, suggesting that students are more aware of the value of new methodologies to improve their technical training, while the absence of responses in the "I am not sure" category reinforces that students have a clear and well-defined position on the role of innovation in their education.

In this context, and in relation to students, the study found a heterogeneous panorama regarding the use of educational technologies by students. Online educational platforms and open educational resources showed a decrease in the frequency of use of these tools, with a decline of 10% and 20% respectively. Exploring the causes behind this trend, it was observed that the following factors could be involved:

- lack of familiarity with the platforms or resources because, although their use was proposed, they are still new and difficult to understand fully;
- Internet access or access to electronic devices, given that the San Isidro canton is rural, where service is poor or nonexistent, even within the school. Furthermore, the majority of the population has low purchasing power;
- Inadequate curricular integration of digital tools, as several teachers were unfamiliar with them. This is in contrast to mobile applications, where a 20% increase in the use of mobile applications for agriculture was observed. This growth can be attributed to the greater accessibility and ease of use offered by the applications, as well as their specific focus on agricultural tasks, given that the number of mobile devices far exceeds that of computers and network connectivity.

Furthermore, this increase was also evident in the use of social media to share information and experiences related to agriculture, with a 10% increase. This trend reflects the growing role social media plays as platforms for learning and knowledge sharing, especially among younger generations. It is worth highlighting this understanding of sustainable development, an area where a positive result was obtained, with a significant increase in students' perception of the help pedagogical strategies have in understanding sustainable development applied in practice, with a 20% increase. This achievement highlights the potential of innovative strategies to facilitate the assimilation of key concepts in the training of future agricultural professionals.

Another relevant aspect is the motivation to use sustainable agricultural practices, which, like the previous point, increased in students' thinking. The information provided by pedagogical strategies for implementing sustainable agricultural practices impacts their morale, and we found a 20% increase in this aspect. This result is crucial, as it demonstrates a positive impact on the development of values and responsible attitudes toward the environment.

In addition, the students' preferred teaching strategies were investigated. 45% preferred experiential learning (projects, farm visits), followed by the use of digital technolo-

gies (40%) and collaborative work (35%). This inclination toward active and participatory strategies highlights the need to adapt teaching to the changing needs and learning styles of today's generations.

Parents' perceptions of the use of innovative practices

Table 6

Learning about sustainable agricultural practices

Options	Pre-Test	Post-Test	Difference
Very little	10	5	5% decrease
Somewhat	20	15	5% decrease
Average	30	25	5% decrease
A lot	35	45	10% decrease
Quite a lot	5	10	5% decrease

Source: Surveys and interviews with parents of agricultural technical high school students at U.E.F.S.I.

The three categories indicating less favorable perceptions ("Very Little," "Somewhat," and "Average") decreased, reflecting a clear trend toward a more positive view among parents regarding the learning of sustainable agricultural practices. The most significant increase in "A Lot" (+10%) suggests that the strategies implemented between the pre-test and post-test have been effective in improving student learning, as perceived by parents.

In summary, Table 6 shows a positive trend, with a clear improvement in parents' perceptions of learning sustainable agricultural practices, highlighting that more and more parents believe their children are acquiring deeper and more meaningful knowledge in this field.

Table 7

Satisfaction with pedagogical strategies

Options	Pre-Test	Post-Test	Difference
Very satisfied	15	25	10% increase
Satisfied	35	40	5% increase
Average	30	20	10% decrease
Dissatisfied	15	10	5% decrease
Very dissatisfied	5	0	5% decrease

Source: Surveys and interviews with parents of agricultural technical high school students at U.E.F.S.I.

The "Very Satisfied" and "Satisfied" categories experienced increases, with the most notable increase in "Very Satisfied" (+10%). This suggests an overall improvement in parents' perceptions of the teaching strategies, indicating that they have been more effective and satisfactory after the intervention.

The categories reflecting dissatisfaction ("Dissatisfied" and "Very Dissatisfied") decreased, indicating that fewer parents are dissatisfied with the teaching strategies. This reflects a more positive perception.

Table 7 shows a trend toward greater satisfaction with pedagogical strategies, with a decrease in dissatisfaction and neutrality, and significant growth in the highest satisfaction categories. All of this indicates a positive impact of pedagogical improvements on parents' perceptions.

Table 8

Estrategias pedagógicas más efectivas (puede elegir varias)

Opciones	Pre-Test	Post-Test	Diferencia
Experiential learning	60	70	10% increase
Use of digital technologies	30	40	10% increase
Collaborative work	40	50	10% increase
Problem-based learning	25	30	5% increase
Others	5	5	Equal

Source: Surveys and interviews with parents of agricultural technical high school students at U.E.F.S.I

All the main strategies evaluated in Table 8 (except "Others") showed an increase in their perceived effectiveness, suggesting an improvement in their implementation and adaptation in the educational process.

The higher score and increase in the post-test demonstrate that parents continue to view hands-on learning as the most effective approach, which is logical in an agricultural context, where direct experience and application of knowledge are essential.

The 10% increase reflects that parents are increasingly recognizing the value of technology in education, especially in a field like agriculture, where digital tools are revolutionizing traditional practices.

Teamwork and collaboration among students also gained more support, reinforcing the importance of interpersonal skills and cooperation in the agricultural sector.

Although the 5% increase is positive, parents still consider other strategies more valuable, although they recognize the value of confronting students with real problems to solve.

In summary, Table 8 reveals a positive trend towards the appreciation of more dynamic and practical pedagogical strategies, with experiential learning and the use of digital technologies as fundamental pillars in parents' perception of the effectiveness of teaching in the agricultural technical baccalaureate.

Table 9

Importancia de la innovación pedagógica

Options	Pre-Test	Post-Test	Difference
It is very important	70	80	10% increase
It is important	25	20	5% decrease
It's average	5	0	5% decrease
It's not important	0	0	Equal
I'm not sure	0	0	Equal

Source: Surveys and interviews with parents of agricultural technical high school students at U.E.F.S.I.

The 10% increase in the "Very important" category reflects a shift toward greater appreciation for pedagogical innovation. Parents are increasingly recognizing the need for innovation in educational methods to ensure quality education in the agricultural technical baccalaureate.

The disappearance of responses in the "It is average" category suggests that parents have stopped being neutral regarding the importance of innovation, leaning towards a more positive assessment.

The absence of responses in the "Not important" and "Not sure" categories shows absolute consensus among parents that pedagogical innovation is relevant to their children's education, with differences only in the intensity of this perception. Not only do they recognize the importance of pedagogical innovation, but they increasingly consider it a critical factor in education. Improvements in the innovative strategies implemented seem to have consolidated this positive opinion.

Regarding what parents reported throughout the research, it was found that satisfaction with the pedagogical strategies increased. In general, parents were very satisfied with the pedagogical strategies used. This positive indicator reflects parents' confidence in the education their children receive. Regarding the pedagogical strategies they consider most effective, parents agreed that these are experiential learning (70%), the use of digital technologies (40%), collaborative work (50%), and project-based learning (30%). Perception largely coincides with the preferences of their children, which highlights the importance of parental involvement in the teaching-learning process.

Finally, when analyzing teachers, an increase was evident in the frequency of use of all innovative pedagogical strategies, especially experiential learning (5%), the use of digital technologies (15%), and collaborative work (10%). This positive change indicates a greater openness of teachers to innovation and the adoption of new classroom practices. Teachers also considered that pedagogical innovation and its strategies are very useful for understanding sustainable development (60%) and for fostering motivation to implement sustainable agricultural practices (50%) on the part of students.

Despite this, teachers expressed challenges to efficiently implementing these innovative practices, including a lack of teacher training (60%), a lack of resources and time (70%), resistance to change (40%), and a lack of support from the educational institution (30%). These results indicate that work with teachers must be focused if optimal results are desired. They also expressed the need for teacher training (85%), access to educational and technological resources (80%), time for planning and developing materials (70%), and support from the educational institution (60%). This is a call to provide these resources and support if good results are desired.

DISCUSSION

Within the framework of the findings of this research, a convergence was found with what was stated by Ávila (2017), who criticizes the lack of attention on the part of governments towards rural education. This coincides with the need for resources expressed by

teachers and students in this work. Regarding pedagogical strategies, Ávila agrees on the importance of implementing innovative methods such as experiential learning and digital technologies to improve the quality of education in rural areas. However, she highlights a greater resistance to change among teachers than that found here.

The moments of the study on the implementation of Information and Communication Technologies in Rural Schools in Colombia by Soto Arango and Molina Pacheco (2018) highlights the importance of addressing access barriers and teacher training to achieve effective integration of ICTs in rural environments, being a point in common with what was found in the technical agricultural baccalaureate of the UEFSI. A decrease in the use of online educational platforms is also observed due to the lack of familiarity of students with these tools, difficulties in accessing the internet and electronic devices, and insufficient curricular integration by teachers, showing that the results presented tend to be consistent with other studies.

Within this discussion, Vanwildemeersch et al. (2017) express the need to adapt pedagogical strategies to the specific context of technical baccalaureate, which aligns with the Bonn Declaration suggestion to advance this type of education to promote sustainability. Likewise, the importance of training teachers in methodologies focused on the development of competencies and on teaching practice as a facilitator aligns with the need to change teaching methods towards alternatives based on work and practice, as evident in the results of this research, which is an aspect on which there is agreement.

Research on the implementation of innovative pedagogical strategies in the Technical Agricultural Baccalaureate of the UEFSI to promote sustainable development yielded results that converged in several aspects with other research. Commonalities were found with previous studies on rural education, information and communication technologies (ICTs), and sustainable development. However, no research could be found that differs from or refutes the findings, except for the difference mentioned above. There is a need for further research on the topic.

These results were obtained from a content analysis of the interviews and observations to identify relevant themes and patterns. This analysis provided a better understanding of the experiences and perceptions of students, parents, and teachers regarding the pedagogical innovation and its impact on student development.

In addition to the fact that this was a study involving human participants, ethical considerations were taken into account, and informed consent was obtained from all research participants. The confidentiality of the information provided by participants was guaranteed, and the diversity of opinions and perspectives was respected.

The research had limitations since it was conducted with a small sample, chosen according to the institution's agricultural technical high school population, so the results cannot be generalized to other populations. Furthermore, the research was carried out in a particular educational context, which represents 20% of the establishments in the parish, so the results may not be replicable in other contexts, depending on the topic. Despite these limitations, the research provided valuable information on the potential for pedagogical innovation, which reports a difference of over 10% after the post-test in almost all

questions. This indicates that a significant proportion of students and parents believe that integrating digital media into pedagogy is essential for enhancing the training of agricultural technical high school graduates in sustainable practices.

CONCLUSIONS

Pedagogical innovation involves the implementation of new strategies, tools, and approaches in teaching and learning in order to improve educational quality and respond to the changing demands of the environment. In the context of the training of agricultural technical bachelors, pedagogical innovation focuses on integrating methodologies that not only improve theoretical understanding, but also facilitate the practical application of knowledge.

Surveys show an increase in satisfaction with pedagogical strategies, especially in areas such as experiential learning, the use of digital technologies, and collaborative work. These approaches have proven effective in improving student learning, promoting deeper learning that applies to sustainable agricultural practices.

By engaging students in projects and activities that have a tangible impact, a greater commitment to sustainable practices is fostered, and a long-term vision of their importance in the agricultural sector is promoted.

First, it highlights the importance of adapting teaching strategies to the specific needs and contexts of students and the rural environment in general. The data reveal that digital tools face significant challenges, such as students' lack of familiarity, difficulties accessing the internet and electronic devices, and insufficient curricular integration by teachers. This underscores the need to develop teaching strategies that are not only innovative but also accessible and relevant to rural communities, which requires greater investment in infrastructure and teacher training.

The positive impact of innovative pedagogical strategies on students' understanding of sustainable development and motivation to implement sustainable agricultural practices and their real-life environment is highlighted. The significant increase in students' perceptions of the usefulness of these strategies for understanding and applying key concepts in the agricultural field highlights the transformative potential of education in fostering responsible attitudes toward the environment. However, attention should be paid to the challenges identified by teachers, such as a lack of training, resources, and institutional support, which could hinder the effectiveness of these strategies.

Finally, pedagogical innovation has great potential to improve the training of agricultural technical baccalaureate graduates in sustainable practices. Innovative methodologies not only facilitate a better understanding and application of sustainability principles but also increase student motivation and parental satisfaction. To maximize this potential, it is crucial to continue implementing and adjusting pedagogical strategies that integrate theory and practice, technology, and collaboration. This will prepare students to address the challenges of the agricultural sector more effectively.

RECOMMENDATIONS

Foster collaborative research among academics, educators, and local communities to delve deeper into the impact and effectiveness of innovative pedagogical strategies in rural settings. This could include longitudinal studies to assess the development of students' skills and attitudes over time, as well as qualitative research exploring the experiences and perspectives of teachers, students, and community members. The findings of this research can inform more effective and sustainable educational policies and practices.

AUTHORS' CONTRIBUTION

Celso Gustavo Dueñas Basurto: Project management; Conceptualization; Writing - original draft; Research; Resources; Software; Validation; Visualization.

Eura María Zambrano Vera: Formal analysis; Data curation; Writing - review and editing; Research; Methodology; Resources; Supervision; Validation; Visualization.

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