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Improvement of an instrument to evaluate the impact of postgraduate training in the Chair of Quality, Metrology and Standardization

Perfeccionamiento de un instrumento para evaluar el impacto de la formación de posgrado en la Cátedra de Calidad, Metrología y Normalización

Aperfeiçoamento de instrumento para avaliação do impacto da formação pós-graduada na Cátedra de Qualidade, Metrologia e Normalização

Abstract

Introduction: evaluating the impact of training is a scientific and academic challenge due to the need for continuous improvement of program quality in terms of relevance and academic excellence. **Objective:** to analyze the results of the refinement of an instrument for evaluating the impact of postgraduate academic training. **Method:** the instrument for evaluating the impact of training, refined and implemented in the 10th Edition of the Master's Program in Quality and Environmental Management, is a modification of the Kirkpatrick Model to include the program's societal impacts. **Results:** the refinement of the instrument focuses on specifying the strategic sectors where the impact occurs, as well as the levels of introduction and potential generalization of the achieved results. Its application demonstrates the positive effects of the program on the performance of graduates and their organizations, as well as the incorporation of research results in seven strategic sectors for the country's economic and social development. **Conclusion:** the developed instrument for evaluating the impact of academic training allows for understanding the positive effects of the evaluated program in personal, organizational, and social domains.

Keywords: impact, evaluation, training, postgraduate

Resumen

Introducción: la evaluación del impacto de la formación es un reto científico y académico ante la necesidad de mejorar continuamente la calidad de los programas desde su pertinencia y excelencia académica. **Objetivo:** analizar los resultados del perfeccionamiento de un instrumento para la evaluación del impacto de la formación académica de posgrado.

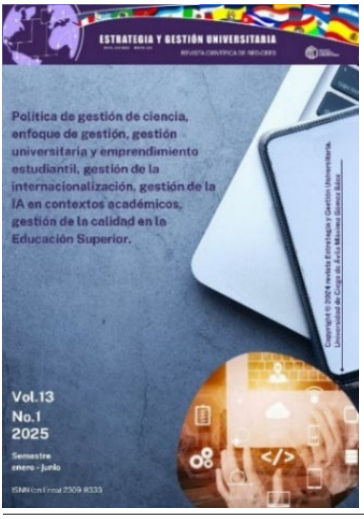
Método: el instrumento para la evaluación del impacto de la formación, perfeccionado e implementado en la Edición 10 del Programa de Maestría en Gestión de la Calidad y Ambiental, es una modificación del Modelo de Kirkpatrick para incluir los impactos del programa en la sociedad. **Resultados:** el perfeccionamiento del instrumento radica en especificar los sectores estratégicos en los que se produce el impacto, así como los niveles de introducción y potencial generalización del resultado obtenido. En su aplicación se evidencian los efectos positivos del programa en el desempeño de los egresados y sus organizaciones, así como la introducción de los resultados de las investigaciones realizadas en siete sectores estratégicos para el desarrollo económico y social del país. **Conclusión:** el instrumento desarrollado para la evaluación del impacto de la formación académica, permite conocer los efectos positivos del programa evaluado en los ámbitos personal, organizacional y social.

Palabras clave: impacto, evaluación, formación, posgrado

Resumo

Introdução: a avaliação do impacto da formação é um desafio científico e acadêmico devido à necessidade de melhoria contínua da qualidade dos programas em termos de relevância e excelência acadêmica. **Objetivo:** analisar os resultados do aperfeiçoamento de um instrumento para a avaliação do impacto da formação acadêmica de pós-graduação. **Método:** o instrumento para avaliação do impacto da formação, aperfeiçoado e implementado na 10ª Edição do Programa de Mestrado em Gestão da Qualidade e Ambiental, é uma modificação do Modelo de Kirkpatrick para incluir os impactos do programa na sociedade. **Resultados:** o aperfeiçoamento do instrumento concentra-se na especificação dos setores estratégicos onde o impacto ocorre, bem como nos níveis de introdução e potencial generalização dos resultados alcançados. Sua aplicação evidencia os efeitos positivos do programa no desempenho dos egressos e de suas organizações, assim como a incorporação dos resultados das pesquisas realizadas em sete setores estratégicos para o desenvolvimento econômico e social do país. **Conclusão:** O instrumento desenvolvido para a avaliação do impacto da formação acadêmica permite compreender os efeitos positivos do programa avaliado nos âmbitos pessoal, organizacional e social.

Palavras-chave: impacto, avaliação, formação, pós-graduação



Introduction

The training impact evaluation allows for understanding the effects attributable to a training program in relation to objectives concerning the development of individuals, institutions, and society (Díaz Leyva & Marrero Fornaris, 2021; Guerra Castillo, 2021; Parra Robledo & Ruiz Bueno, 2020). It also contributes to improving the training process and ultimately identifying the qualitative and quantitative benefits that training generates. Thus, impact evaluation is one of the activities that help assess the quality of the training provided, both in terms of its relevance and from the perspective of academic excellence. In Cuba, the Evaluation and Accreditation System for Master's Programs has included social relevance among the characteristics of program quality since its early versions, necessitating the systematic application of a tool capable of evaluating training impact.

An evaluation is a systematic process that involves the collection, processing, analysis, and interpretation of data. "It is based on specific criteria designed to determine the level of achievement of objectives and to provide feedback on the successes and failures of the training process" (Ramos Azcuy & Guerra Bretaña, 2023, p. 11). The training impact evaluation is considered to have two fundamental moments: the evaluation of learning and the transformation that occurs when the learned material is applied in the workplace, that is, when knowledge is incorporated into organizational practices (Stable Rodríguez & Núñez García, 2021; Gómez Miranda; 2023; Jiménez-Pitre et al., 2023). In evaluating training impact, factors that influence the transfer of acquired knowledge to the workplace and the role performed by program graduates must also be considered. The characteristics of the work environment and the participants themselves influence the achievement of the expected impacts of the training program (Guerra Bretaña et al., 2017).

The Kirkpatrick model, initially published in 1959, has gained the most popularity for evaluating training impact in organizations and for managerial training (Nawaz et al., 2022). In this model, effects are evaluated at four levels: Reaction, Learning, Transfer, and Results. The Phillips model, initially published in 1997, is inspired by Kirkpatrick's postulates but takes a more quantitative approach, including a fifth level based on calculating return on investment (Guerra Castillo, 2021). Another adaptation of the Kirkpatrick model was made by Watkins in 1998, contributing a fifth stage for evaluating social impact (Ramos Azcuy et al., 2016).

Cahapay (2021) has identified some limitations in how evaluators apply the Kirkpatrick model in higher education, such as primarily using only its lower levels, failing to consider all the contextual characteristics of the evaluated program, and the scarcity of evidence regarding causal interconnections between the model's levels. This author also noted that evaluating impact solely through participants' perceptions can be subjective and diminish the reliability of results. Direct observation of changes in behavior, collection of verifiable data on results attributable to training, and surveys of employers can contribute to a better evaluation of impact.

Despite the aforementioned considerations, the Kirkpatrick model can be adapted and enriched to understand the effects generated by provided training as a means to improve the quality of programs in educational organizations (Alsalamah &

Callinan, 2021). The limitations raised in applying the model in higher education should be viewed not as obstacles but as opportunities and challenges for evaluators. The effects of training on graduates in terms of performance improvement, prestige, and professional development are relatively easy to measure. However, measuring impacts on organizations and society presents a significant research challenge. Evaluating the profitability of training is particularly difficult, requiring quantitative data on incurred expenses and the gains obtained as a result of the training provided. For this reason, most training impact evaluations are confined to the first three levels of the Kirkpatrick model (Reaction, Learning, and Transfer), without considering organizational performance indicators or economic benefits.

Shewchuk et al. (2023) conducted a systematic review on how training programs focused on knowledge application have been evaluated. They found that, to gauge participants' reactions, evaluators employed both quantitative methods (surveys) and qualitative methods (interviews and focus groups), investigating satisfaction levels with the program and its specific components, the organization of the curriculum, the competencies of instructors, and the utility and relevance of the training for participants' job performance.

Bahl et al. (2024) studied the relationships among the levels of the Kirkpatrick model, finding that positive participant reactions significantly influence learning and that behavior, as measured through job performance, has a positive impact on outcomes. These relationships were particularly strong in managerial training. Other authors have also successfully utilized the Kirkpatrick model to evaluate the effectiveness of training programs in healthcare (Firooznia et al., 2020) and pharmaceutical services (Yi et al., 2020).

Stable Rodríguez & Núñez García (2021) established a methodology to evaluate the impact of training in scientific and technological information organizations, consisting of three phases: evaluation preparation, evaluation implementation, and results analysis. The impact evaluation (the second phase) was conducted at all four levels of the Kirkpatrick method.

In a similar approach, Guerra Castillo (2021) proposed a methodology for evaluating the training impact in the companies of the Business Group of the Steel Mechanical Industry in Cuba. The methodology was structured in two stages. The first, prior to training, involved planning the evaluation process, its levels, indicators, and instruments, as well as exploring participants' expectations and motivations. The second stage, following training, focused on conducting the impact evaluation across five levels similar to the Phillips method. Finally, he suggested assessing training effectiveness by systematizing the results obtained regarding its efficacy and efficiency.

García González et al. (2021) reflected on the importance of evaluating the impact of training for managers in Cuba but did not propose a specific instrument for its implementation. Carrera Morales et al. (2022) suggested a methodology for evaluating the impact of graduate education consisting of four stages: planning, organization, impact measurement, and information analysis. For the evaluation of the graduate program's impact, they established three variables, primarily in the personal domain and focused on knowledge management:

- Students – dimensions of intellectual and professional growth and satisfaction level.
- Graduates – dimensions of professional performance and intellectual output.
- Instructors – dimensions of scientific production and professional prestige.

Fernández Medina and Ruiz Arnaud (2023) recognized that tracking graduates is a fundamental method in evaluating the impacts of training programs, especially at the graduate level. These authors established four variables with a total of 51 indicators to assess the impact of graduate programs. The variables are:

- Impact Evaluation (9 indicators).
- Training Outcomes (17 indicators).
- Satisfaction (15 indicators).
- Graduate Recognition (10 indicators).

Paredes-Dávila et al. (2022) emphasized the importance of understanding the impact of the program on performance, not only from the graduates' perspective but also from the employers' perspective. Other authors applied various measurement instruments to evaluate the results and impacts of graduate programs without establishing a general theoretical model (Nieto Acosta et al., 2022).

At the Chair of Quality, Metrology, and Standardization at the University of Havana, an instrument was developed to assess student satisfaction with the courses offered since the first edition of the Master's Program in Quality and Environmental Management (2006-2009). Another survey was administered to graduates and their employers to evaluate the program's impact. This instrument has undergone modifications over time for continuous improvement (Ramos Azcuy et al., 2016) and has been applied, with necessary adaptations, to the other two academic programs offered by the Chair (Master's in Metrology and Postgraduate Specialization in Standardization).

A significant modification occurred when the programs transitioned to a blended format, which included a new satisfaction survey for courses delivered in the Virtual Teaching-Learning Environment (EVEA) of the University of Havana. Additionally, to guide instructors in developing virtual courses, a procedure was established that outlines the quality criteria to be considered for designing virtual courses in graduate programs. These criteria include: objectives, instructional design, interactivity, effective communication, evaluation and feedback on results, accessibility, and course evaluation by students. Currently, the Chair has the technical instruction IT 45 on the Evaluation of the Impact of Graduate Training, which is part of the documented information of the Quality Management System of the Center for Biomaterials, certified according to the NC-ISO 9001:2015 standard.

The objective of this study is to analyze the results of refining an instrument designed to evaluate the impact of graduate academic training at the Chair of Quality, Metrology, and Standardization at the University of Havana, aiming to demonstrate its effects on individuals, organizations, and Cuban society.

Methods and materials

The instrument for impact evaluation, once the program editions were completed, was theoretically grounded in the Kirkpatrick Model, with adaptations to include the social impacts of training. In its current refinement, the instrument was structured as shown in Table 1. In addition to the aspects reflected in the table, the instrument included two general questions:

- About the student's retention in the organization during the program and after its completion (Question 1).
- Suggestions for program improvement.

Table 1

Dimensions of the Impact Evaluation of Graduate Academic Training (Survey for Graduates)

Level	Dimension	Question	Number of Items
Satisfaction	Quality attributes of the program	Question 7	9
		Question 8	2
	Overall satisfaction level	Question 9	1
	Fulfillment of expectations	Question 10	1
	Would you recommend?	Question 11	1
Learning	Evaluations conducted in all program curriculum activities.		
Results	Objectives	Question 2. Fulfillment of program objectives	4
Impacts	Personal domain	Question 3. Contribution to knowledge management and professional and research competencies	5
		Question 4. Impact on personal performance	5
	Organizational domain	Question 5	5
	Social domain	Question 6	1

Source: Own elaboration.

The questions were designed in both closed and open formats, with some using a five-point Likert scale for responses. An instrument was also applied to the employers of the graduates to gather their perceptions about the program and its impacts, which included the dimensions of satisfaction, results, and impacts (in the organization), similar to what is presented in Table 1.

For the application of the instrument, a mixed-methods research approach was

conducted, consisting of both qualitative and quantitative elements, of an exploratory cross-sectional type, as it investigated the perceptions of graduates from the 10th Edition (10/2021-11/2024) of the Master's Program in Quality and Environmental Management. The responses were processed using SPSS v.27, obtaining the median as a measure of central tendency and frequency distributions. Bar charts were produced using Excel. Additionally, the non-parametric Spearman's Rho test was employed to ascertain potential relationships between the perceptions of graduates and their employers, as well as between the Learning and Satisfaction levels.

Results and discussion

The impact evaluation focused on how students have transferred the acquired knowledge and skills to their work within the organization, how they have utilized these skills, and how the training received has influenced their professional performance, the organization, and society.

Student satisfaction with the courses was evaluated through two types of surveys: one for in-person courses and another for those delivered in the Virtual Teaching-Learning Environment. Learning evaluation was conducted directly by the instructors through questions in classes, seminars, extracurricular assignments, and exams, following the assessment methods planned for each course, seminar, workshop, and final project defense, in accordance with the procedures established in the document IT 43 Evaluations and Certifications in Graduate Programs (Center for Biomaterials, 2023).

While academic training is a strategic investment, and immediate results are often not achievable, the impact is evaluated in the Master's programs in Quality and Environmental Management, Metrology, and the Postgraduate Specialization in Standardization during the self-evaluation process at the end of each edition. Graduates are expected to acquire the necessary knowledge and skills to enhance their performance and conduct research aimed at promoting improvements or innovations that impact their organizations (Sosa Vera et al., 2024).

Upon completing the 10th Edition in November 2024, the satisfaction of students with the program and its impact was assessed using questionnaires distributed to graduates and their direct supervisors, as they are considered beneficiaries of the academic training service provided.

In refining the instrument, new elements were included, such as:

- Strategic sectors in which the impact occurs (Ministry of Economy and Planning, 2020).
- Levels of introduction and potential for generalization of the results obtained.
- Levels of satisfaction with the competencies and experiences of instructors and advisors, as well as with program management.

Table 2 presents the statistical results from the application of the instrument

to 12 graduates (92.3%) of the 10th Edition of the Master's Program in Quality and Environmental Management. Additionally, five employers (71.4%) of the seven contacts provided by the graduates responded to the impact evaluation instrument (Table 3).

Table 2

Quantitative Results of the Instrument Application (Graduates)

Items	Median	Frequencies (%) 5	4	3
Question 2. Fulfillment of Objectives (4: Satisfactorily; 5: Fully)				
2.1 Contribute to the Improvement of Organizational Performance.	4	41,7	58,3	
2.2 Argue and Disseminate the Importance of Management Systems.	5	83,3	16,7	
2.3 Conduct Research Related to Management Systems.	4	41,7	58,3	
2.4 Interpret the Legal, Regulatory, and Normative Basis of Management Systems.	5	66,7	33,3	
Question 3. Contribution of Developed Activities to (4: Satisfactorily; 5: Significantly)				
3.1 Update and Deepen Knowledge	5	83,3	16,7	
3.2 Obtain New Knowledge	5	75,0	25,0	
3.3 Produce Knowledge	5	75,0	25,0	
3.4 Develop Specific Professional Skills	5	58,3	41,7	
3.5 Acquire the Methodology Required for Scientific Research	5	66,7	33,3	
Question 4. Effect on Graduates' Social Functions (3: Sufficient; 4: Significant; 5: Very significant)				
4.1 Effect on Professional Performance	5	58,3	33,3	8,3
4.2 Effect on Intellectual Production	4,5	50,0	41,7	8,3
4.3 Effect on Professional Prestige	5	58,3	41,7	
Question 5. Effect on Organizational Performance		Yes (1)	Partial	No
5.1 The academic training received has influenced your organization's performance	1	83,3	16,7	
5.2 There are conditions in your organization for change	1	83,3	16,7	
5.3 From your position, you can implement changes in the organization	1	75,0	25,0	
Question 6. The results of your research have the potential to be implemented	1	100		
Question 7. Evaluate (3- Good; 4- Very good; 5- Excellent.)				
7.1 Pedagogical Competence of Instructors and Advisors	5	75,0	25,0	
7.2 Scientific Competence of	5	83,3	16,7	

Items	Median	Frequencies (%) 5	4	3
Instructors and Advisors				
7.3 Experience of Instructors and Advisors in the Knowledge Area	5	75,0	25,0	
7.4 Availability of Updated Bibliography	5	66,7	33,3	
7.5 Access to Networks and ICT	5	58,3	41,7	
7.6 Equipment and Facilities	4	25,0	50,0	25,0
7.7 Access to Computing Resources	4	41,7	41,7	16,7
7.8 Organization, Execution, and Control of the Program	4,5	50,0	41,7	8,3
7.9 Attention to Students' Academic Needs	5	66,7	25,0	8,3
Question 8. Evaluate (3- Good; 4- Very good; 5- Excellent.)				
8.1 Requirement for Independent Study	5	75,0	25,0	
8.2 Requirement for Research Work	5	83,3	16,7	
Question 9. General Impression of the Course	5	83,3	8,3	
Question 10. Fulfillment of Expectations	5	58,3	41,7	
Question 11. Would you recommend? (1: Yes)	1	100		

Source: Own elaboration.

Table 3

Quantitative Results of the Instrument Application (Employers)

Items	Median	Frequencies (%) 5	4
Question 2. Fulfillment of Objectives (4: Satisfactorily; 5: Fully)			
2.1 Contribute to the Improvement of Organizational Performance.	5	60	40
2.2 Argue and Disseminate the Importance of Management Systems.	5	60	40
2.3 Conduct Research Related to Management Systems.	4	40	60
2.4 Interpret the Legal, Regulatory, and Normative Basis of Management Systems.	5	60	40
Question 4. Effect on Professional Performance: Yes (1)	1	100	
Question 5. Effect on Organizational Performance:		Yes (1)	Partial
5.1 The academic training received has influenced your organization's performance	1	100	
5.2 There are conditions in your organization for change	1	100	
5.3 From your position, you can implement	1	100	

Items	Median	Frequencies (%) 5	4
changes in the organization			
Question 6. The results of your research have the potential to be implemented	1	100	
Question 9. General Impression of the Course (5: Very satisfied; 4: Satisfied)	5	100	
Question 10. Fulfillment of Expectations (5: 100%; 4: 90%)	5	100	
Question 11. Would you recommend? (1: Yes)	1	100	

Source: Own elaboration.

Note. The question numbers in this table do not follow the consecutive order of the survey but correspond to the dimensions defined in Table 1.

Regarding the first question about the retention of graduates in the organizations they belonged to at the start of the master's program, 67% (8) remained in their positions. Of the four graduates who changed jobs during the program, one was promoted to work in the OSDE, two moved to the non-state sector, and another left teaching to work in the tourism sector. The student who did not respond to the survey broke her employment link immediately after completing her master's studies. These results reflect the labor mobility manifesting in the national context.

Overall, the responses from the surveyed employers ranged from 4 to 5 as a measure of central tendency (median). The objectives that received the highest percentage of responses regarding their total fulfillment were related to:

- Being able to argue and disseminate the importance of quality and environmental management for the sustainability of organizations.
- Interpreting the legal, regulatory, and normative basis for the implementation of quality management systems, environmental systems, and others.

All respondents indicated that the program generated positive effects on the graduates and their organizations. The aspects of personal performance most influenced by the master's program, according to the perceptions of respondents (Figure 1), included:

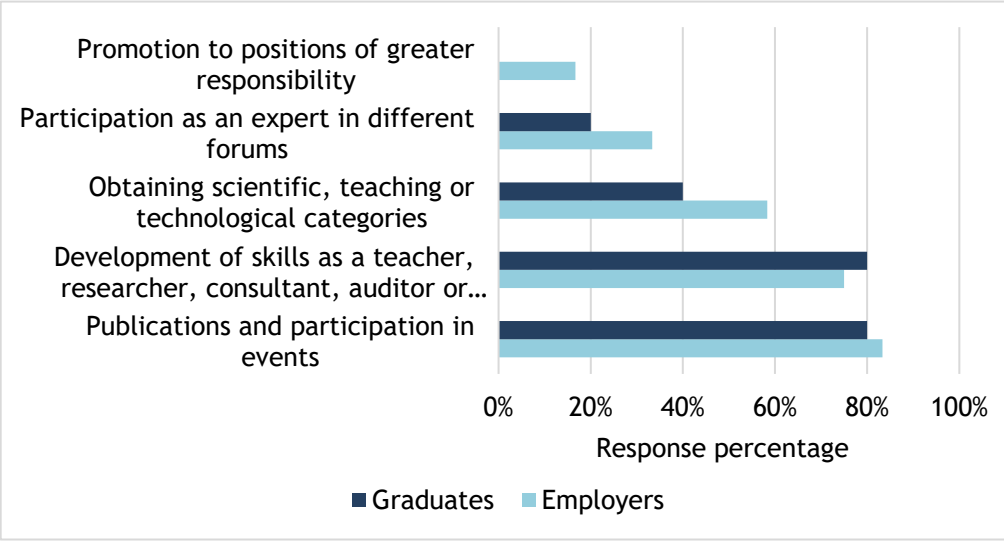
- Publications made and participation in events.
- Development of capacities as a teacher, researcher, consultant, auditor, or other functions exercised by the graduate.

There is a correlation of 0.975 (Spearman's Rho, p=0.005) between the opinions of graduates and their employers regarding the perceived effects on personal performance. These opinions are objectively supported by the scientific production of the students from the 10th Edition during the program, which includes 19 publications and 30 presentations at events, as well as other activities related to their scientific, technical, and professional work (teaching, consulting, and

auditing).

Figure 1

Responses on the Aspects of Personal Performance of Graduates Most Influenced by the Master's Program



Source: Own elaboration.

100% of the graduates considered that the program has a significant or satisfactory contribution to knowledge management and professional and research competencies in relation to the following elements:

- Updating and deepening knowledge.
- Obtaining new knowledge.
- Producing knowledge.
- Developing specific professional skills.
- Acquiring the methodology required for scientific research.

Additionally, both graduates and their employers noted that positive impacts have been achieved in organizational performance, contingent upon the existence of conditions for change within these organizations, and that graduates have the ability to influence these changes from their positions.

Table 4 outlines the theses completed by graduates of the 10th Edition. Regarding the strategic sectors of the National Economic and Social Development Plan until 2030 to which the results of the conducted research contribute, these include:

- Integrated Transport Logistics: 3
- Professional Technical Services: 3

- Electrical Energy: 2
- Integrated Logistics of Hydraulic and Sanitary Networks and Installations: 2
- Tourism: 1
- Pharmaceutical, Biotechnological, and Biomedical Productions: 1
- Food Production Sector: 1

Table 4

Theses Defended in the 10th Edition by Organizations and Strategic Sectors

No	Theses Defended	Organization	Sector
1.	Implementation of the Integrated Management System at the Technological Management Information Center of Cienfuegos	CIGET/ CITMA	Professional Technical Services
2.	Digital Transformation of Documented Information in MYCRON Laboratories	MINFAR	Professional Technical Services
3.	Procedure for Environmental Performance Evaluation at the Cuban Air Navigation Company	ECNA	Integrated Transport Logistics
4.	Implementation of Knowledge Management at the Base Business Unit: "Service to Airlines"	ECASA	Integrated Transport Logistics
5.	Proposal of Actions to Enhance Customer Satisfaction with Photovoltaic Systems Connected to the National Electric Grid	UNE	Electrical Energy
6.	Procedure for Identifying Customer Needs and Expectations at Pagary Company	SNE	Integrated Transport Logistics
7.	Improvements to the Production Process of Pre-Cooked Tostone in a Food Processing Mini-industry	SNE	Food Production
8.	Implementation of NC-ISO 9001:2015 at the National Drilling and Construction Company	INRH	Hydraulic Networks and Installations
9.	Procedure for Implementing Organizational Surveillance and Intelligence at the Geominsal Business Group	GEOMINSAL	Professional Technical Services
10.	Implementation of Documentation Management Procedures at the Base Enterprise for the Production of Semi-solids	BioCubaFarma	Pharmaceutical, Biotechnological

No	Theses Defended	Organization	Sector
11.	Procedure for Identifying Environmental Aspects and Impacts at the Maintenance and Repair Company for Hydraulic Works	INRH	Hydraulic Networks and Installations
12.	Integral Risk and Opportunity Management at the Santiago de Cuba Electric Company	UNE	Electrical Energy
13.	Implementation of an Action Plan to Enhance Customer Satisfaction among Yachters at the MARLIN Nautical Branch, Marina Hemingway	OSDE Ecosol	Tourism

Source: Own elaboration.

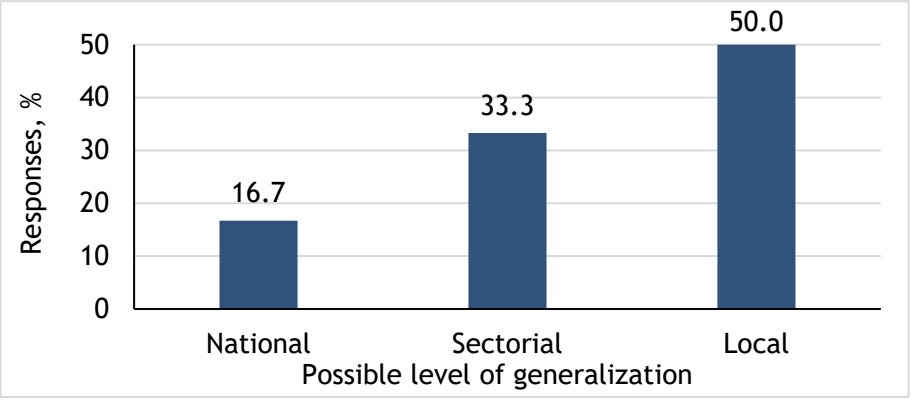
Graduates considered that their research has led to organizational improvements or innovations in the following aspects:

- Organizational improvements/innovations.
- Implementation of management systems.
- Process optimization.
- Enhancements in environmental performance evaluation.
- Digital transformation in laboratory management.
- Improvements in documentation management.
- Comprehensive management of risks and opportunities.
- Improvements in customer satisfaction.

All results obtained by the graduates have been fully or partially implemented, which is a requirement established in the program for the defense of final projects, ensuring they do not remain as mere proposals for solutions. Graduates believed that their results could be generalized to different levels (Figure 2).

Figure 2

Potential Level of Generalization of Solutions Provided by Graduates



Source: Own elaboration.

The conditions that favor the implementation of the proposed improvements or innovations in the graduates' organizations include:

- The existence of a formalized management system.
- The academic preparation and training of personnel.
- An organizational culture that fosters an environment valuing and promoting innovation and creativity, encouraging workers to propose new ideas and solutions.
- Cloud-based work and the allocation of computing resources.
- The willingness and leadership of management.

When planned changes are only partially achieved, it is often because managers remain reluctant to change and are comfortable with their current practices. Furthermore, for the organizational changes proposed by graduates to be fully implemented, leadership and commitment from the organization's management are required. In this regard, it is important to highlight that good human resource management contributes to employee commitment to achieving strategic objectives and improving organizational performance (Mohamed Ali et al., 2024). Training is a key factor influencing employee motivation and the development of competencies, which ultimately enhances their organizational commitment (Tumi et al., 2022).

Regarding the social needs (current and prospective) addressed by the program, graduates identified the following:

- The program promotes teamwork, information searching, and the exchange of updated knowledge at a global level to find the best solutions, based on compliance with current norms and regulations, and the use of new technologies, which leads to resource savings and environmental protection.
- Cuban society requires a significant change in the state business sector; any activity that directly or indirectly supports this goal should be prioritized. This training provides knowledge that positively impacts the implementation of organizational innovations in these entities.
- The master's program has provided key tools to help organizations comply with current environmental regulations, both locally and globally. This is crucial in a context where environmental regulations are becoming increasingly stringent, and communities require effective solutions to mitigate the effects of pollution and promote sustainable development.
- It improves professional performance, fosters critical thinking, problem-solving, and research skills. In the future, it may contribute to access to better-paying and more responsible jobs.
- It contributes to technological change and increases customer satisfaction.

- It provides the necessary knowledge and tools for innovation and management that lead to the sustained and sustainable success of organizations.
- It addresses needs in the fields of quality and environmental management and other management systems, as well as the integrated management of these systems, along with research methodology.
- It enhances professional competencies in management, primarily in quality management.
- It influences the improvement of environmental management in organizations.
- It allows for a comprehensive understanding of the use of legislation, current norms, and the interconnection of quality, occupational health and safety, and environmental systems within an organization, which would reduce information duplication. It provides a broader perspective on processes.

In analyzing satisfaction regarding the quality attributes of the program (Table 2), 100% of graduates expressed high satisfaction (levels 4 - Very Good and 5 - Excellent) with the following attributes:

- Pedagogical competence of instructors and advisors.
- Scientific competence of instructors and advisors.
- Experience of instructors and advisors in the knowledge area.
- Availability of updated bibliographic resources.
- Access to networks and other information and communication technologies.

It is important to highlight that, as the program is currently offered in a blended format with all courses in the Virtual Teaching-Learning Environment (EVEA), students are required to have internet access as a condition for enrollment. Additionally, a preparatory course titled “Use of Information and Communication Technologies for Training and Research” is provided. Another preparatory course, “Introduction to Statistical Methods,” essential for the subsequent application of statistical tools for management and research, is also taught in the EVEA. This should contribute to students being familiar with the virtual environment by the time they begin the academic activities of the curriculum.

The seminars and thesis defenses are conducted at the Biomaterials Center of the University of Havana, which has a meeting room used for these purposes. Although students are informed that, if necessary, they can access the internet or the information available at the institution in both printed and digital formats, they rarely express this need. However, the percentage of students with high satisfaction was lower regarding:

- Equipment and facilities (75%).
- Access to computing resources (83%).

When responding about their overall satisfaction with the program, there

was a high response to expectations, high satisfaction, and an intention to recommend the program to other students.

Regarding student learning, this was evaluated through curriculum activities (courses, seminars, and thesis defenses). Out of an initial enrollment of 16 students, three did not complete all activities preceding the thesis defense, resulting in an 81% retention rate. Of the 13 students who accumulated all prerequisite credits, 11 defended their theses within the timeframe of the edition, representing 84.6% of the final enrollment, while the other two defended two months later, achieving a 100% effectiveness rate. The thesis defenses were conducted with quality and were evaluated rigorously, with nine rated as Excellent (69%), three as Good (23%), and one as Approved.

The calculation of the medians of the graduates' grades yielded the results shown in Table 5. A total of 61.5% had a median evaluation of Excellent (5). This indicates that the courses offered in the EVEA facilitate effective student learning. Additionally, it is interesting to note that students with better learning outcomes also demonstrate higher satisfaction with the program. This positive correlation is significant, with a Spearman's Rho coefficient of 0.672 (p=0.017).

Table 5

Distribution of the Medians of Graduates' Grades

Value	Simple Frequencies		Cumulative Frequencies	
	Absolute	Relative	Absolute	Relative
3,5	1	7,7 %	1	7,7 %
4,0	2	15,4 %	3	23,1 %
4,5	2	15,4 %	5	38,5 %
5,0	8	61,5 %	13	100,0 %
Total	13	100,0 %		

Source: Own elaboration.

Students provided suggestions for the master's program, primarily related to the lack of in-person meetings for clarifying doubts in courses and insufficient connectivity. Both aspects present significant challenges for the development of blended programs, especially if transitioning to full virtuality is desired, considering the technological and energy situation in the country, where synchronous online interactions are quite limited.

In empirical studies, other authors (DiLoreto et al., 2022) have identified that the presence of the academic advisor is the best predictor of both student satisfaction and perceived learning in virtual training environments. Self-regulated learning processes and student-academic advisor dialogue/interaction processes have also been identified as mediating factors for the learning and satisfaction perceived by students (Eom & Ashill, 2023).

On their part, Arslankara et al. (2024) have suggested that factors such as computer literacy and students' self-efficacy in using technology play an important role in the effectiveness of virtual training implementation. Additionally, the quality of the course's instructional design and the technology environment, as well as the

assurance of student-to-student and teacher-to-student interactions, contribute to student satisfaction, engagement, and motivation. Given the importance attributed to interaction in the technology-mediated teaching and learning process, Hamtini (2008) proposed this designation for the first level of evaluating the effectiveness of virtual training as a replacement for the term "reaction."

Similar findings were evidenced through the observations made in this study, indicating that when students do not dedicate sufficient time or exhibit a lack of autonomous learning capacity, or when there are gaps in student-academic advisor interaction, perceived satisfaction is lower, and learning outcomes are negatively affected.

Conclusions

The instrument developed for evaluating the impact of academic training allows for an understanding of the positive effects of the evaluated program in personal, organizational, and social spheres. The assessment of the effects of the Master's program in Quality and Environmental Management across four levels (Satisfaction, Learning, Results, and Impacts) demonstrates the relevance and quality of the program, as well as identifies opportunities for improvement. The study identifies the contextual conditions of organizations that contribute to the positive impact of student outcomes, aimed at enhancing personal performance and organizational innovation, based on the research developed in a master's program in quality and environmental management. Factors such as students' self-study and learning capabilities, as well as the necessary interaction with their academic advisors, influence their perceptions of satisfaction and the results of their academic training.

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Karen Pupo Méndez 2: Research, Methodology, Validation/Verification, Visualization, Writing/original draft, and Writing, review and editing.
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