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An instrument for evaluating the economic and social impacts of professional training in master's programs

Un instrumento para la evaluación de impactos económicos y sociales en la formación profesional en maestrías

Um instrumento para avaliar os impactos económicos e sociais da formação profissional nos programas de mestrado

Abstract

Introduction: assessing the impact of higher education is one of the most complex and relevant challenges in contemporary educational research for measuring the economic and social returns of master's programs. **Objective:** to design an instrument for assessing the economic and social impacts of the academic master's program in Computer-Aided Design and Manufacturing (CAD/CAM), affiliated with the CAD/CAM Study Center at the University of Holguín, Cuba, contributing to the continuous improvement of the program with effects on territorial development through the contributions of its graduates. **Method:** an explanatory sequential mixed-methods design was used, together with longitudinal studies, supported by other groups of theoretical and empirical research methods in a process of reviewing experiences in this field of knowledge to serve as the basis for constructing the proposed instrument. **Results:** the concept of knowledge valorization as a whole was adopted and operationalized into an instrument for evaluating the economic and social impacts of academic master's programs. **Conclusion:** the instrument also aids the empirical demonstration of the added value of the master's training in CAD/CAM through its implications for R&D+i programs in promoting and advancing territorial development.

Keywords: instrument, economic and social impacts, professional training, master's programs

Resumen

Introducción: la evaluación del impacto de la educación superior constituye uno de los desafíos más complejos y relevantes de la investigación educativa contemporánea para medir los retornos económicos y sociales de los programas de máster.

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Objetivo: diseñar un instrumento para la evaluación de impactos económicos y sociales del programa académico del máster en Diseño y Fabricación Asistidos por Computadoras (CAD/CAM) adscrita al Centro de Estudios CAD/CAM en la Universidad de Holguín, Cuba, en contribución a la mejora continua del programa con efectos en el desarrollo territorial desde las aportaciones de sus egresados. **Método:** diseño metodológico mixto secuencial explicativo, junto a estudios longitudinales, apoyados en otros grupos de métodos teóricos y empíricos de la investigación científica en un proceso de revisión de las experiencias en este campo del conocimiento que permitiera tomar de base para la construcción del instrumento propuesto. **Resultados:** el concepto de valorización del conocimiento como totalidad, ha sido apropiado para derivarlo en un instrumento de evaluación de impactos económicos y sociales para programas académicos de maestrías. **Conclusión:** ayuda además a la demostración empírica del valor añadido de la formación del máster en CAD/CAM por las implicaciones en los programas de I+D+i en la promoción y progreso del desarrollo territorial.

Palabras clave: instrumento, impactos económicos y sociales, formación profesional, maestrías

Resumo

Introdução: a avaliação do impacto do ensino superior constitui um dos desafios mais complexos e relevantes da pesquisa educacional contemporânea para mensurar os retornos econômicos e sociais dos programas de mestrado. **Objetivo:** elaborar um instrumento para a avaliação dos impactos econômicos e sociais do programa acadêmico de mestrado em Projeto e Fabricação Assistidos por Computador (CAD/CAM), vinculado ao Centro de Estudos CAD/CAM da Universidade de Holguín, Cuba, em contribuição à melhoria contínua do programa com efeitos no desenvolvimento territorial a partir das contribuições de seus egressos. **Método:** utilizou-se um desenho metodológico misto sequencial explicativo, juntamente com estudos longitudinais, apoiado por outros conjuntos de métodos teóricos e empíricos da investigação científica, em um processo de revisão das experiências nesse campo do conhecimento que permitiu servir de base para a construção do instrumento proposto. **Resultados:** o conceito de valorização do conhecimento como totalidade foi apropriado e derivado em um instrumento de avaliação dos impactos econômicos e sociais para programas acadêmicos de mestrado. **Conclusão:** além disso, contribui para a demonstração empírica do valor agregado da formação de mestrado em CAD/CAM pelas implicações nos programas de P&D&I na promoção e no progresso do desenvolvimento territorial.

Palavras-chave: instrumento, impactos econômicos e sociais, formação profissional, mestrados

Introduction

Assessing the impact of graduate education offered by higher education institutions (HEIs) worldwide is among the most difficult and consequential challenges facing contemporary educational research. With growing demands for institutional accountability, the need for rigorous, validated instruments capable of measuring the economic and social returns of master's programs from the standpoint of change and transformation experienced by program participants, has taken on strategic importance (Ma et al., 2019; Psacharopoulos & Patrinos, 2018; Bermúdez Morris & Pérez Martín, 2022).

Graduate professional training, referred to in Cuba as academic postgraduate education, positions master's programs at the intersection of academic specialization and workforce qualification. At this academic level, contributions to knowledge emerge through thesis work, including the integration of tools, models, strategies, and methods, among other outputs. As Tight (2019) and Teichler (2020) have observed, the transition toward knowledge economies demands not only expanded access to this level of training but also empirical evidence of its added value. Thus, firms increasingly favor such academic preparation for their professionals, viewing it as a pathway to greater autonomy, effectiveness, and competitiveness. Several researchers (Ma et al., 2019; Psacharopoulos & Patrinos, 2018; Bermúdez Morris & Pérez Martín, 2022) concur that human capital constitutes the primary competitive advantage and a key determinant of organizational survival.

In Cuba, academic postgraduate education encompasses all training activities undertaken by workers after completing their initial university-level studies. These activities may include further training, master's programs, specializations, and doctoral studies. Such pursuits generate mutual benefits for both graduates and their employers, influencing productivity gains, salary improvements, innovation capacity, and motivation (Álvarez Velázquez et al., 2022; Burbano et al., 2023; De la Cruz, 2025). Rather than constituting a discrete stage, this represents a formative process that, according to Alonso Betancourt et al. (2021):

> ...is developed consciously, in a planned and organized manner, within educational institutions and workplaces in close coordination, through a dynamic that integrates teaching with work and research activities (...) through socio-professional interaction among the actors involved, with the aim of achieving the worker's professional growth (p.22).

This perspective clarifies that the process encompasses not only the preparation of graduates, whether master's degree holders or specialists, for professional problem-solving within their organizations, but also their development as individuals and professionals in society, with performance aligned to the needs of their social and enterprise contexts. Although master's programs and specializations pursue different objectives in terms of job functions, research in the former and technological expertise in the latter, the professional performance of both ultimately converges on problem-solving within social practice. In this regard, Alonso Betancourt et al. (2021) defines professional performance as:

> The manner in which workers engaged in continuing education demonstrate the development of professional knowledge, skills, and values through the execution of tasks and projects, thereby qualifying and distinguishing their fulfillment of the socio-labor demands of the positions where they carry out activities, tasks, or roles inherent to their profession (p.24).

The concept of impact, meanwhile, is understood as the operation and outcome of a collision, impression, or intense effect produced by an action or event. From another perspective, impact is examined as the manner in which a result is evidenced or estimates realities, whether general or specific, in society, the environment, the economy, technology, or other fields of knowledge. Such evidence or effects may be tangible or intangible, beneficial or detrimental (Blundo Canto et al., 2020; Organización para la Cooperación y el Desarrollo Económico [OECD], 2023; Ministerio de Ciencia, Tecnología y Medio Ambiente [CITMA], 2025).

The theoretical foundation of this article rests on three major research traditions: human capital theory, approaches to valuing postgraduate curricular processes, and the sociology of higher education. In the development of human capital theory, Schultz (1961) and Becker (1964) established that costly educational processes generate sustained increases in individual and collective productivity. Psacharopoulos and Patrinos (2018) subsequently updated these theses with global evidence on personal and social rates of return. In this vein, master's-level academic training reveals underexplored potentialities from the standpoint of the socioeconomic impacts generated through graduates' professional performance and its interdependence with territorial development, a dimension requiring further study.

Regarding educational program evaluation, the model proposed by Kirkpatrick (1994) and its contemporary adaptations provide a four-level framework (reaction, learning, behavior, and results) that has been extensively applied in higher education contexts (Phillips, 2011). This contributes a process-oriented methodological perspective for impact evaluation that spans from inception to conclusion, enabling program feedback and improvement at any level, phase, or step. As for the social impact of education, Bourdieu (1986) and Coleman (1988) contributed complementary perspectives on cultural and social capital as non-economic dimensions of educational value, essential for understanding benefits that extend beyond the labor market. This dimension has received limited attention within the technical sciences, where the focus tends to fall on benefits, which are complementary to effects but require differentiation when effects generate benefits.

Impact studies, as a general practice, form an integral part of any analysis because they help generate possible responses regarding the effects (in the short term) and consequences (in the medium and long term) produced by specific activities or actions. They contribute to the assessment, monitoring, and control of decisions, with the aim of correcting negative effects (mitigation) and enhancing positive ones (enhancement). In this sense, the effect is a key component of impact because it can reveal and interpret the interdependencies and interconnections that

occur within the process under analysis over a short timeframe. Hence the importance of evaluating impacts to help clarify or estimate potential effects and to derive consequences over time.

Impact evaluation in education generally, and specifically in master's-level academic training offered by universities and authorized institutions, is conducted to determine and verify the extent and manner in which expected change has occurred among master's graduates, particularly regarding their social and economic contributions to their environment (Blundo Canto et al., 2020; Díaz-Leyva & Marrero, 2021; Carrera et al., 2022; OECD, 2023; González-Díaz et al., 2023; Boffill et al., 2024; CITMA, 2025). However, the specialized literature reveals a notable lack of standardized tools capable of capturing in an integrated manner the economic and social dimensions of impact generated at this level of professional training. The present article therefore aims to design an instrument for evaluating the economic and social impacts of the Master's program in CAD/CAM, offered by the CAD/CAM Studies Center at the University of Holguín (UHo), Cuba, contributing to the program's continuous improvement and its effects on territorial development through the contributions of its graduates.

Methods and materials

Given the complexity of the topic, characterized by dispersed, limited, and insufficiently treated literature, and with the assistance of the artificial intelligence (AI) tool Jenny, an exploration was conducted into the experience of impact evaluation, specifically economic and social effects, in master's-level academic training, drawing on case studies from Europe. Validated instruments adapted to the Spanish university context (CIE-Máster and EIS-Máster, available under Creative Commons licenses) were employed; these are publicly accessible databases with standardized tools used by universities worldwide, accreditation agencies, and educational policymakers to systematically evaluate the impact of their postgraduate programs. Similar instruments exist in English-speaking countries (Phillips, 2011), and the Spanish-language originals were selected due to shared linguistic and cultural characteristics that facilitate potential social contributions.

These instruments facilitated analysis through longitudinal studies, contributing to a culture of evaluation and continuous improvement in postgraduate higher education, and specifically regarding the CAD/CAM master's program in the management of indicators, patterns, and potential variables. Through exploration assisted by the aforementioned AI, in the discrimination of the information provided, a sequential explanatory mixed-methods design was adopted. In this design, an initial quantitative phase provided baseline data, while a second qualitative phase allowed for deeper exploration of the mechanisms underlying the impacts identified between 2021 and 2023 at three public Spanish universities in Madrid, Catalonia, and Andalusia, serving as a starting point for achieving the present research objective. The study was conducted in four phases:

Phase I: Instrument Design. Three differentiated instruments were constructed:

- Economic Impact Questionnaire (CIE-Máster): 42 items on a 5-point Likert scale, focused on labor market insertion, salary progression, and employability.
- Social Impact Scale (EIS-Máster): 38 items oriented toward civic competencies, community participation, and social capital.
- Semi-Structured Interview Guide (GES Employers): 18 open-ended questions for employers and human resource managers.

Phase II: Validation

Content validity was established using the Delphi method with a panel of 15 experts, including educational evaluation researchers, economists of education, and academic administrators. The Content Validity Index (CVI) was computed for each item, with items scoring below 0.78 being eliminated (Lynn, 1986). Reliability was assessed using Cronbach's alpha coefficient and McDonald's omega index.

Phase III: Application

The instruments were administered to a stratified sample of 342 participants: 218 master's graduates (cohorts 2018–2022), 89 employers, and 35 academic administrators, ensuring disciplinary and gender representativeness (databases available for working with master's programs under open science principles for impact evaluation under Creative Commons licenses, assisted by the AI tool Jenny, and with data reliability following Phillips (2011), with the sample representing 87% of the accessible public information).

Phase IV: Quantitative analysis was performed using SPSS v.26 and R v.4.2, employing descriptive statistics, exploratory and confirmatory factor analysis (CFA) with the Lavaan package, as well as multiple linear regression to examine how master's programs influence economic outcome variables. Qualitative analysis of interviews was conducted using Atlas.ti v.9, applying an inductive-deductive thematic coding system (Braun & Clarke, 2006).

Research ethics were ensured through informed consent, data anonymization, and approval from the relevant institutional ethics committee for the public databases. The results of this process, viewed from a structural-systemic perspective, allowed for the identification of variables, including:

- Economic benefits exceed individual investment in most disciplines (Ma et al., 2019).
- Positive social impact, cohesion and community participation, is consistent with the postulates of Coleman (1988) on social capital.
- The validity and reliability of the instruments replicate standards of analogous tools in Anglo-Saxon contexts (Phillips, 2011).
- Disciplinary differences in economic returns were more pronounced than anticipated, particularly between medical specialties (first and second degree) and humanities, including arts-related sciences.

- Social impact proved more difficult to quantify, confirming the warnings of Tight (2019) regarding the limits of objective measurement of social capital.

These elements laid the groundwork for delineating the instrument for evaluating the economic and social effects generated by the CAD/CAM master's program, as promoted by graduates through their professional performance in their respective organizations. Furthermore, through a historical-logical analysis, this master's program has been developed at the CAD/CAM Studies Center over 28 years of dedicated work toward scientific development across engineering disciplines: civil, geomatics, mechanical, computer science, hydraulic, agronomy, addressing the challenges of the country's strategic programs.

The program's research lines are closely aligned with the needs of socioeconomic development and play a leading role at the national level, in line with the priorities of the Ministry of Higher Education (MES) and the UHo. These lines include Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), Computer Aided Engineering (CAE), Computer Aided Process Planning (CAPP), and Building Information Modelling (BIM), also recognized as CAx. However, the program encompasses a more complex and comprehensive vision that includes Engineering Systems as a framework and Artificial Intelligence for intelligent Big Data management and decision-making. Based on these trends and needs, the master's program provides broad scientific culture and advanced knowledge, facilitating its contextualization toward the transition to Industry 4.0.

Cuban higher education deploys a quality framework for postgraduate activity that includes the development of a program-specific instrument for measuring impacts. For the CAD/CAM Master's program, this is a crucial aspect, as the program has already completed 11 editions with an excellence quality rating from the National Accreditation Board (JAN).

The program is characterized by continuous improvement in theoretical, methodological, and practical aspects, reflected in the proper organization of teaching and research activities, the currency and relevance of content addressed and investigated, and its relationship with the development of science and technology in its field of knowledge in recent years. These elements have served as the starting point for developing the economic and social impact evaluation instrument for this academic program, as a renewal of the instrument used to date, guided by a conception aimed at territorial development, its effects, and socioeconomic consequences. Validating this perspective based on other experiences that help optimize the quality of the CAD/CAM master's program is a pressing need.

From another angle, the application of scientific research methods such as inductive-deductive analysis enabled the examination and determination that, from this diversity of possible impacts in master's programs, the conception associated with knowledge valorization is feasible. Its purpose is the systematization and valorization of knowledge based on the effects and consequences that the academic program produces in graduates over time from both economic and social standpoints.

In this regard, knowledge valorization is recognized as the process of creating induced amounts, obtained at social and economic levels, resulting from products (transformation of data, technical know-how, and other outputs associated

with research into goods and services) of knowledge for the benefit of society (European Union, 2022; CITMA, 2025). Therefore, the contributions of the master's academic program from an economic and social perspective, as realized by its graduates, were framed within the following particularity:

- The program implements a closed curriculum based on Project-Based Learning (PBL) methodologies (Mújica, 2011; Alonso Betancourt et al., 2020; Almeida Gomes et al., 2024; Zúñiga-Igarza et al., 2021b), integrated with the project system established by CITMA through the CAD/CAM Studies Center to which the master's program belongs.

  In this sense, PBL, according to Zúñiga-Igarza et al. (2021a),

  > ...links the mode of learning with project development, where both converge in their procedural nature, gradual development to build new qualities, products, or knowledge, with a defined purpose and participatory character (...) this convergence is valid because project-based learning can be leveraged as a methodological option in a creative act through action research (p. 1).

This potential of PBL in the academic training of the master's program means that, on the one hand, students learn to conduct research within a research project, responding to the socioeconomic demands of the territory; and on the other, they develop professional competencies and professional growth, contributing to the transition toward Industry 4.0. Consequently, the expected impacts of the master's program are aligned with and evaluated from the standpoint of knowledge valorization as declared in the management of Research, Development, and Innovation (R&D&I) projects, from economic and social perspectives, based on:

- The complementarity and interconnection between the mandatory academic curriculum and the research academic curriculum, grounded in the programs and projects established by CITMA (CITMA, 2025) and the Technology Readiness Levels (TRL) achieved through the research conceived within the Studies Center to which the master's program belongs.
- The interdisciplinary nature of the faculty, underpinned by university-enterprise-community relations addressing the territory's socio-technological challenges in shaping the general academic program.
- The faculty's competencies in the knowledge value chain regarding the how-to of the academic program in its 12th edition, responding to the dynamics of strategic sectors committed to the Studies Center's research projects and employers, who are in turn involved in the master's academic training.

Results and discussion

In designing the instrument for evaluating the economic and social impacts of the CAD/CAM Master's academic program, the following qualities were considered:

Recognition by program participants (faculty, graduates, and employers) of

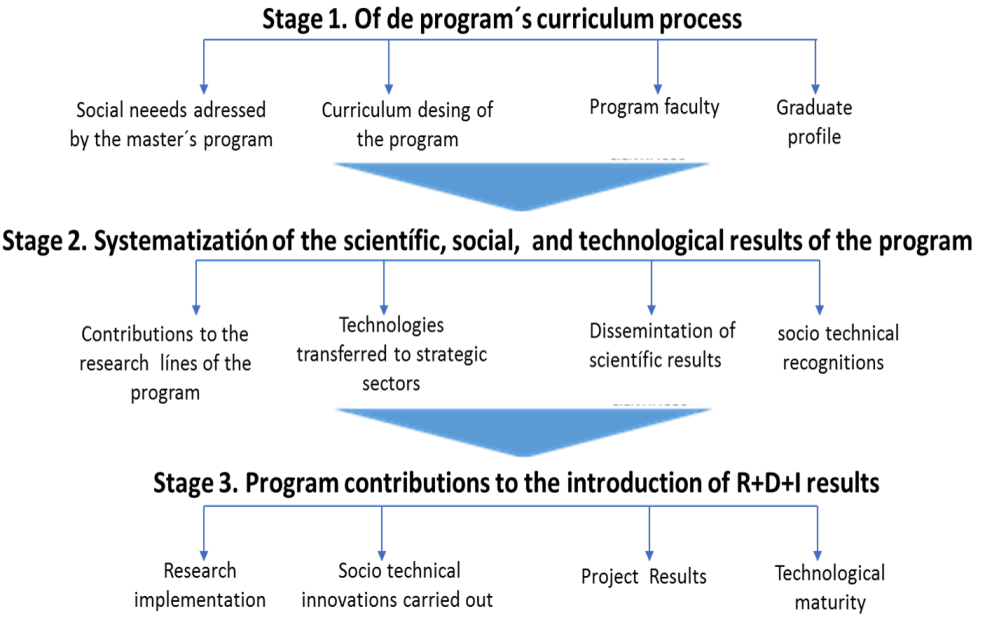
the need to enhance the program's positive effects in contribution to the desired national development model, grounded in the following bases:

- Optimization of technological processes with economic and social implications.
- Digital transformation processes linked to industry as long-term consequences or benefits.
- Technically and socially trained human capital responsive to strategic sectors, contributing to the country's scientific heritage.

The faculty's demonstrated willingness and commitment to identifying areas for improvement that contribute to program sustainability in CAx systems, Engineering Systems, and Artificial Intelligence, through contextualization toward the Industry 4.0 transition via the research projects implemented by the CAD/CAM Studies Center and upon which the master's program bases knowledge valorization through PBL. This perspective emphasizes the analysis from the standpoint of knowledge valorization of the master's program and its primary effects, which lead to socioeconomic consequences that support territorial development. Therefore, the tool created for the particularity of this master's program follows the process shown in Figure 1.

Figure 1

Tool for evaluating economic and social impacts of the CAD/CAM master's program



Source: Authors' own elaboration.

The tool for evaluating program impacts is described below:

Stage 1. Curricular process of the program. Objective: To review the effects occurring within the curricular process based on the following variables: social needs addressed by the master's program; curricular design of the program; program faculty; and graduate profile, as essential components of students' professional growth for achieving scientific and technological results.

Stage 2. Systematization of the program's scientific, social, and technological results. Objective: To demonstrate the effects of the development achieved by program participants (Faculty, Graduates, and Employers) based on the following variables: contributions to the program's research lines; technologies transferred to strategic sectors; dissemination of scientific results; and socio-technical recognitions, as responses to the cohesive work of the students' professional growth process, their visibility in the academic context, and their role as agents of change in the territory's socioeconomic development.

Stage 3. Program contributions to the introduction of R&D&I results. Objective: To analyze the program's socioeconomic consequences through contributions to the introduction of R&D&I results by graduates based on the following variables: implementation of research; socio-technical innovations carried out; project results; and technological maturity achieved through program implementation, along with the role of master's professional training and demonstrated professional growth in research, progress, and creation within the economic sectors involved.

Among the tools employed are: document review related to each variable, structured surveys, unstructured interviews with participants, and statistical processing of results using descriptive statistics. Subsequently, in each stage, a satisfaction index is constructed using the Logical Frame Method (Ladov's Quadrant), which ranges between minus one (-1) and one (1), where the closer the index approaches one, the higher the program's impact satisfaction on territorial socioeconomic development.

Once the stage-specific indices are determined, the economic and social effects and consequences of the academic program are described over specified timeframes. This perspective empirically demonstrates its added value in the short term (upon completion of the edition), implying that socioeconomic outcomes are produced and evidenced based on the impact endorsement of each defended thesis and its credits in the research component, as a totality of the tool, viewed from the consequences reported to each involved party (graduate, faculty, employer).

The tool is applied again starting from stage three, monitoring results in the medium term (three years after program completion) and long term (five years after program completion) to analyze the consequences of the CAD/CAM master's academic training process through interviews with graduates and employers. The economic and social impacts resulting from each timeframe are presented in a results report addressing:

Direct social consequences:

- for graduates: improved professional competencies, leading to better technical or managerial positions related to their specialization and consequent improvements in quality of life.
- for employers (strategic sectors) to which research contributes: given the current state, relevance, and results achieved, transformation toward a desired state has been possible, through improvement, innovation, or technological transformation, a problem evidenced in the social practice inherent to the organization concerned.
- for faculty: increased scientific potential with quality on the path toward the knowledge economy transition to which Cuba is committed.

Direct economic consequences:

- for faculty: contribution to the recovery of costs incurred in postgraduate programs (the set of quantifiable and non-quantifiable benefits that individuals and society obtain from postgraduate training, Ma et al., 2019) in the design, development, improvement, and optimization of processes, systems, and technological activities as an effect of academic research.
- for employers: development of R&D&I projects in the technology field, utilizing continuous professional training as an added value of modest cost in obtaining high-quality scientific results that drive organizational development.
- for graduates: salary improvements resulting from efficiency in their results, whether technical or managerial in nature within the organization.

The report requires an analysis of the academic program's alignment and objectives regarding their economic and social implications as a final outcome, with evidence in the following relevant aspects:

- Optimization of technological processes carried out.
- Trained human capital responsive to strategic sectors.
- Digital transformation processes linked to industry.

The platform for constructing the economic and social impact evaluation instrument was based on the following researched deductions:

- Psychometric analyses conducted using the AI tool Jenny confirmed satisfactory technical properties of the developed instruments: the CIE-Máster achieved a Cronbach's alpha of $\alpha = 0.91$ and McDonald's omega of $\omega = 0.93$, while the EIS-Máster reached values of $\alpha = 0{,}88$ and $\omega = 0.90$. CFA revealed adequate fit indices for both scales (CFI > 0.95; RMSEA < 0.06), confirming the proposed factor structures. These findings corroborated that these programs developed in Europe generate significant returns at both personal and social levels, although the magnitude of these returns varies depending on the specialty, the student's field of knowledge, and the institutional context, demonstrating that economic and social impact

evaluation in master's training is feasible.

In this regard, and based on the quality framework stipulated by JAN, an instrument for social and economic impact evaluation of the CAD/CAM master's program has been constructed. However, conducting longitudinal studies remains a necessary commitment to help track the evolution of impact over time, as produced by graduates in their organizations, given that the short term provides limited results.

- The master's program, attached to a studies center, succeeded in establishing an academic program under PBL precepts, derived from the processes and regulations developed in association with scientific research through projects guided by CITMA. In this regard, PBL played an essential role because it is:

> ...a method that develops a contextualized and interdisciplinary process that occurs between students and teachers from professionalized perspectives through group work with the school, family, workplace, and community, based on a problem situation that is investigated, produces a result, and is evaluated within an established timeframe and with specific resources, helping students plan, design, and evaluate their learning through commitment, decision-making, and research in a given context (Zúñiga-Igarza et al., 2021b, p. 1187).

This has conferred the strength of a tangible socioeconomic impact evaluation in the short term, particularly through graduate results, given by the endorsement of result introduction and the research curriculum; in articulation with the requirements of Programs and Projects (CITMA, 2025), because through incorporation into specific R&D&I projects, research results that enterprises needed were obtained from applied research with favorable economic and social balances for territorial development.

The concept of knowledge valorization has been appropriated to derive an economic and social impact evaluation instrument for master's academic programs when they are subject to the PBL method, because its purpose is the development of research into knowledge-based products, services, solutions, and policies that contribute to both individual and collective economies, as well as to territorial development.

Similar studies in postgraduate programs conducted at the University of Holguín, such as master's programs in Social Sciences and Axiology, University Mathematics Education, Applied Mathematics to Informatics for Administration, and Professional Pedagogy, recognize responses to social needs at micro, meso, and macro levels (current and prospective) toward contextualized transformations; student performance in their training; and effects from social, technological, economic, and environmental perspectives in a generic sense.

Other analyses conducted in the area of medical specialties, such as those referred to by Fernández Domínguez et al. (2026), indicate that the most important aspect is the relationship produced between medical teaching and graduate

performance in the health institutions where they practice their profession, from the social repercussion of their actions.

A different perspective addresses the impact on capacity-building projects, Boffill et al. (2024), and on municipal development strategies, Álvarez Velázquez et al. (2021), which recognize the instrument's potential for social improvements, relevance, and contribution to territorial development.

In general terms, all the instruments analyzed coincide in their process-oriented perspective, with a configuration of phases, stages, steps, or activities; the inclusion of long-term consequences as a culmination in these instruments is recognized as an aspect that receives little visibility, as does the follow-up of graduate performance in their social function. Indicators, parameters, or variables are also established as the core of analysis and behavior of students, graduates, employers, and faculty.

Limitations are also observed regarding integration with scientific research tools and project management from HEIs. There is little evidence of the economic effect in the graduate-employer relationship.

In the specificity of the CAD/CAM master's program in its 12th ongoing edition, the application of its first and second phases already stands out, with contributions from 50% of the defended students to the following projects:

- PS211LH005-027, Increasing structural and energy resilience of lightweight-roof housing against extreme wind impacts. Program: Integrated Disaster Risk Reduction in Cuba (RRD).
- PN305LH013-072. Mathematical models and biomarkers based on Artificial Intelligence in neurodegenerative diseases sharing common mechanisms. Program PN305LH013: Neurosciences and Neurotechnology.
- PS126LH003-014-26. Digital transformation for the implementation of the BIM methodology in the Holguín territory. Program PS126LH003: Development of systems and technologies for optimizing investments and organizational management.
- PT211HO0006-008. Agroecological adaptation of Robusta coffee in the Holguín plains, Cuba: Case study, El Cafetal III Farm. Program PT211HO0006: Climate change impacts in Holguín.

From these projects have emanated: articles, international events, CENDA registrations; instruments that optimize processes such as models, procedures, methodologies; employer impact endorsements. The economic and social impacts are currently being recorded and processed; an aspect that will constitute a second publication based on the experiences of the process.

Conclusions

The design of an instrument for evaluating the economic and social impacts of the CAD/CAM Master's academic program, attached to the CAD/CAM Studies Center at UHo, has been made possible through the retrospective analysis of studied

experiences and the articulation of tools such as the MES Master's Program Evaluation and Accreditation Subsystem and the CITMA Program and Project Management System. Its purpose is to contribute to the continuous improvement of the academic program and postgraduate higher education more broadly. It also aids in the empirical demonstration of the added value of CAD/CAM master's training through its implications for R&D&I programs in promoting and advancing territorial development through the contributions of its graduates.

Limitations encountered in the research relate to the information collection and processing process, in response to which a database is being created and modeled to enable procedure automation as a future research line for greater ease, speed, and result acquisition, with the assistance of the AI tool Jenny.

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Declaration of author responsibility

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