Seminars in Medical Writing and Education. 2025; 4:38
doi: 10.56294/mw202538

REVIEW

Level of satisfaction with the results of science and technology processes in the context of medical education

Nivel de satisfacción con los resultados de los procesos de ciencia y tecnología en el contexto de la educación médica

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Cite as: Herrera Masó JR, Lardoeyt Ferrer R. Level of satisfaction with the results of science and technology processes in the context of medical education. Seminars in Medical Writing and Education. 2025; 4:38. https://doi.org/10.56294/mw202538

Submitted: 20-03-2024 **Revised:** 12-06-2024 **Accepted:** 01-10-2024 **Published:** 01-01-2025

Editor: PhD. Prof. Estela Morales Peralta

ABSTRACT

Introduction: the Science, Technology and Innovation System constitutes the organizational form to implement the scientific and technological policy in the health sector in accordance with the economic and social development strategy of Cuba.
Objective: to evaluate the level of satisfaction regarding the results of the science and technology processes, as part of one of the prioritized lines of research of the Vice-Rectorate of Teaching and Research of the University of Medical Sciences of Havana, Cuba.
Method: descriptive, cross-sectional, and instrumental observational study with a quantitative approach. The study involved 31 research managers who were given a questionnaire consisting of three closed questions and two open questions following the guidelines of the Iadov technique; the analysis of the answers allowed obtaining indirect information on the level of individual and group satisfaction of the participants.
Results: the overall group satisfaction index is 0,645 (acceptable), although it is higher in the Science and Technology Entities (IG=0,710) than in the Medical Sciences Faculties (0,625).
Conclusions: the results of the research indicate an acceptable but insufficient level of individual and group satisfaction, although higher in the Science, Technology and Innovation Entities than in the faculties. The projects, categorization and scientific publications of the university's medical potential are the main concerns of the managers.

Keywords: Satisfaction; Ladov; Processes; Results; Science and Technology; Group Satisfaction Index.

RESUMEN

Introducción: el Sistema de Ciencia, Tecnología e Innovación constituye la forma organizativa para implementar la política científica y tecnológica en el sector de la salud en correspondencia con la estrategia de desarrollo económico y social de Cuba.
Objetivo: evaluar el nivel de satisfacción sobre los resultados de los procesos de ciencia y tecnología, como parte de una de las líneas de investigación priorizadas de la Vicerrectoría de Docencia e Investigación de la Universidad de Ciencias Médicas de La Habana, Cuba.
Método: estudio observacional descriptivo trasversal e instrumental de abordaje cuantitativo. En el estudio participaron 31 gestores de investigación a los que se le aplicó un cuestionario conformado por tres preguntas cerradas y dos abiertas siguiendo las pautas de la técnica de Iadov; el análisis de las respuestas permitió obtener información indirecta sobre el nivel de satisfacción individual y grupal de los participantes.
Resultados: el índice general de satisfacción grupal es 0,645 (aceptable) aunque es más elevado en las Entidades de Ciencia y Tecnología (IG=0,710) que en las Facultades de Ciencias Médicas (0,625).

Conclusiones: los resultados de la investigación apuntan a un nivel de satisfacción individual y grupal aceptable pero insuficiente, aunque superior en las Entidades de Ciencia, Tecnología e Innovación con respecto a las facultades. Los proyectos, la categorización y publicaciones científicas del potencial médico de la universidad concentran las mayores preocupaciones de los gestores.

Palabras clave: Satisfacción; Ladov; Procesos; Resultados; Ciencia y Tecnología; Índice de Satisfacción Grupal.

INTRODUCTION

In Cuba, Decree Law # 07/2020[1] defines the foundations, components, principles, and objectives of the Science, Technology, and Innovation System (SCTI) made up of the State and Government Bodies, which include the Ministry of Science, Technology and Environment (CITMA) in its role of rector, the bodies of the central administration of the State (OACE) and the National Entities, the Higher Business Management Organizations, the Local Bodies of People's Power, the Cuban Academy of Sciences as a consultative body, and the legal and natural persons directly involved in the execution of science, technology and innovation activities, in particular the Science, Technology and Innovation Entities (ECTI) and the universities. According to their mission, the ECTI is classified as a Research Center (CI). Scientific and Technological Services Centers (CST) and Development and Innovation Units (UDI).

According to Decree # 40/2021, "Regulation of Decree-Law #7 of the Science, Technology and Innovation System"[1] in its Article 5, the SCTIs objectives include promoting the generation, assimilation, and application of knowledge and technologies; increasing research and innovation in the field of social sciences; contributing to the formation of values and the strengthening of national awareness; increasing the contribution of STI and the gross domestic product (GDP), the internal and external financial balance, the improvement of the quality of life and the welfare of the population.

The Cuban health management model is premised on the triad of assistance-teaching-research, both in its conception and organization, where the integrating element is research to develop basic competencies in medical science professionals to address the main health problems from a biopsychosocial conception.[3] The SCTIs constitute the organizational form to implement scientific and technological policy in the health sector in correspondence with the country's economic and social development strategy.

During the COVID-19 confrontation, the Cuban health management model was conceived based on three components: epidemiology, organization of services, and science, which facilitated and favored scientifically based and timely decision-making. This model's design, implementation, and subsequent validation constituted the first scientific result in the country, the result of the integration between science and health in confronting the pandemic.[4]

The University of Medical Sciences of Havana (UCMH) is an institution of the Ministry of Public Health (MINSAP), whose mission is the comprehensive training of health professionals, producing knowledge, technology, and innovations, developing university extension, and exercising the methodological leadership of study programs of careers and postgraduate modalities. To this end, it is based on the clinical-epidemiological-social paradigm and an environmentalist and humanist projection in the search for solutions to the health problems of Cuban society.

This institution, in addition to training students, professors, researchers, specialists, and other professionals in the sector, has the social task of generating new knowledge through scientific research, whose results are reverted in teaching and care management, so one of its important substantive processes is the management of science, technology, and innovation (STI), which is carried out by one or more specialists in each of the 44 entities subordinated or attached to the UCMH: 14 faculties, 9 Centers for Graduate Studies (CEPG) and 21 Science, Technology and Innovation Entities (ECTI), of which: 12 CI, 9 UDI and one CST.

The STI managers provide methodological advice to the faculties and affiliated entities and specialized attention to the science and technology processes developed in these scenarios.

The study's objective is to evaluate the level of satisfaction with the results of the science and technology processes as part of one of the prioritized lines of research of the Vice Rector's Office for Teaching and Research of the UCMH.

METHOD

An observational, descriptive, cross-sectional study with a quantitative approach was carried out on an intentional sample (non-probabilistic) made up of 31 CTI managers participating in a methodological session; of these, 12 came from the faculties and 19 from the ECTI to whom a questionnaire was applied with three

closed questions and two open questions, whose analysis reveals relationships unknown to the participants and constructed following the Iadov Technique[5] to measure individual and group satisfaction in the academic area.

Structure of the questionnaire

Personal data

Sex - Age - Origin - Teaching / Scientific Category - Master's Degree - PhD

Questions

To what degree are you satisfied with the results achieved in the scientific and technological activity in your field of competence?

a) Very Satisfied
b) More satisfied than dissatisfied
c) Indifferent (neutral)
d) More dissatisfied than satisfied
e) Very dissatisfied
f) Don't know

Do you believe that scientific and technological activity has had a decisive impact on the development of your entity?

a) Yes
b) Don't know
c) No

Do you consider that the development of science, technology and innovation processes have the required effectiveness in your area of competence?

a) Yes
b) I don't know
c) No

What unfavorable aspects limit the development of scientific-technological activity in your area of competence?

What favorable aspects can be highlighted about the development of scientific-technological activity in your area of competence?

The database and statistical processing were performed with the SPSS.V-25 program (2017). Descriptive statistical techniques (frequency distribution tables and measures of central tendency) were used for each variable. Contingency tables were prepared for qualitative variables (nominal and ordinal) and Pearson's x2 nonparametric test to determine whether there were significant statistical relationships (at the α=0,05 level) between the variables sex, age, and origin (faculties or ECTI) categories (teachers and scientists).

Kendall's Coefficient of Concordance (W) was used to determine the degree of agreement (consensus) among the managers consulted, and the Chi-square (Chi)2 hypothesis test to test the level of significance of W using the null hypothesis (HO. There is no agreement among managers) and the alternative (H1: Yes there is agreement). Test that: W≠0 and (Chi)2 calculated > (Chi)2 (tabulated) for $p < \alpha$.

To obtain the Group Satisfaction Index (GSI), the different levels were expressed on a numerical scale between +1 and -1 where Maximum satisfaction (MS)= +1; More satisfaction than dissatisfaction (MSQI)=+0,5; Not defined and contradictory (NDC)=0; More dissatisfaction than satisfaction (MIQS= -0,5; Maximum dissatisfaction (MI)= -1.[6] And calculated with the formula:

$$ISG = [A (+1) + B (+0,5) + (C + F) (0) + D (-0,5) + E (-1)] / N$$

where A, B, C, D, E, F: number of participants for the personal satisfaction categories and N: total number of participants.

-1 -0,5	0	0,5	+ 1
Dissatisfaction	Not defined or contradictory		Satisfaction

https://doi.org/10.56294/mw202538

Interpretation of the meaning of the ISG value

The cross-checking of the 3 closed questions allowed the construction of the Iadov Logic Chart.

Table 1. Iadov Logic Chart

P1	P2								
	Yes			No I don't know			No		
	P3								
	Yes	NI	No	Yes	NI	No	Yes	NI	No
Very satisfied									
More satisfied than dissatisfied									
I am indifferent (neutral)									
More dissatisfied than satisfied									
Very dissatisfied									
I do not know what to say									

For the selection of the sample and the application of the questionnaire, the required ethical standards were respected, based on informed consent, the principle of voluntariness and the confidentiality of the information provided by the participants according to the Declaration of Helsinki.[7]

RESULTS

More than 70 % were women and were between 34 and 60 years of age (mean=55,6 years); all had teaching status, mainly as assistants or tenured; more than half had senior scientists and 9 were classified. 51,6 % (16) have a master's degree and 48,4 % (15) have a doctorate in science.

Table 2. Characterization of the sample (n=31)

Variable	Category	Frequency	%	Variable	Category	Frequency	%
Sex	Female Male	23	74,2	Teaching	Assistant	5	16,2
		8	25,8	category	Assistant	13	41,9
					Titular	13	41,9
Age (years)	34-50	11	35,4	Scientific	Attaché	6	19,4
	51-60	12	38,7	category	Assistant	10	32,3
	61-74	8	25,8		Titular	6	19,4

The Individual Satisfaction Index (ISI) and the impact and effectiveness of STI activity outcomes were explored.

The data for question 1 indicate that 97 % of the managers surveyed are "MS" or "MSQI" concerning the results of the STI processes in their respective intuitions, and one manager is "MIQS." In question 2, only one manager answered that "Does not Know" if the scientific-technological activity has a decisive impact on their faculty. Regarding question 3, it is observed that six managers consider that the S&T processes do not have the required effectiveness in their area of competence (2 full professors of faculties and four researchers of the ECTI: 1 aggregate, two assistants, and one tenured); one full professor of faculty answered that he "does not know".

Table 3. Satisfaction with the results of scientific and technological activity according to origin

Source		Total	P1 (Satisfaction)			P2 (Impact)			P3 (Effectiveness)		
			MS	MSQI	MIQS	Yes	NI	No	Yes	NI	No
Faculty	Frequency	12	4	7	1	11	1	0	9	1	2
	% →	100	33,3	58,3	8,3	91,7	8,3	0	75,0	8,3	16,7
ECTI	Frequency	19	8	11	0	19	0	0	15	0	4
	% →	100	42,1	57,9	0	100	0	0	78,9	0	21,1
Total	Frequency	31	12	18	1	30	1	0	24	1	6
	% →	100	38,7	58,1	3,2	96,8	3,2	0	77,4	3,2	19,4

Symbology: MS (Very satisfactory), MSQI (More satisfactory than unsatisfactory), MIQS (More unsatisfactory than satisfactory, NS (Don't know).

https://doi.org/10.56294/mw202538

As can be seen in the table above, the greatest proportion of "MS" managers are from the ECTI and "MSQI" from the faculties.

Table 4 shows the Iadov Logical Table, where it can be seen that 24/31 managers who express satisfaction consider that the scientific-technological activity has had an impact and feel satisfied in their area of competence.

Table 4. Iadov's Logic Table (n=31)

1. To what degree are you satisfied with the results of the scientific and technological activity in your area of competence? (Q1.)	2. Do you consider that the scientific and technological activity has had a decisive impact on the development of your entity? (Q2)									Σ
	Yes			NI			No			
	3. Do you consider that the science and technology processes have been fulfilled with the required effectiveness in your area of competence? (Q3)									
	Yes	NI	No	Yes	NI	No	Yes	NI	No	
Very satisfied	11		1							12
More satisfied than dissatisfied	13		4		1					18
More dissatisfied than satisfied						1				1
Σ	24		5		1	1				31

The calculation of the Group Satisfaction Index (ISG) was 0,645

ISG= [A (+1) +B (0,5) +C (0) +D (-0,5) + E (-1)]/N= [12*1+18*0,5+ 1(-1)]/31= =20/31) = 0,645

As can be seen, the group index indicates that, as a tendency, there is satisfaction with the results of scientific-technological activity at UCMH, although with a discrete value well below the existing potential. Nevertheless, it was considered pertinent to carry out the ISG analysis in a differentiated manner since the faculty professors dedicate most of their time to teaching and academic work. In contrast, in the ECTI, the researchers prioritize scientific activity.

The values of the W coefficient, the (Chi)2 test, and the asymptotic significance are robust enough to reject the Ho hypothesis and accept the H1 hypothesis with 99 % confidence, which shows the degree of consensus in the judgments issued by the managers (W=163,58; p= 0,000 <0,05).

Satisfaction Index of the Faculty Managers (ISF)

Table 5 shows that 9/12 faculty managers express satisfaction with the activity due to its impact and repercussions in their area of competence.

Table 5. Logical Table of Iadov→Faculties (n=12)

P1	**P2**									**Σ**
	Yes			**No I do not know**			**No**			
	P3									
	YES	**No I do not know**	**No**	**Yes**	**No I do not know**	**No**	**Yes**	**No I do not know**	**No**	
I am very satisfied	4									4
More satisfied than dissatisfied	5	1	1							7
More dissatisfied than satisfied						1				1
Σ	9	1	1			1				12

The calculation of the Group Satisfaction Index (ISG-F) was 0,625

ISF= [*4 + 7*0,5+ 1*(-1)] /12= 4+3,5/12=7,5/12=0,625

The ISG-F ranks within the satisfaction interval, although its value is not high and is close to the limit of indefiniteness.

ECTI Managers' Satisfaction Index (ISE)

15/19 ECTI managers feel satisfied due to the affirmative answer to questions 2 and 3 (table 6).

ISE= 8*1 + 11*0,5+ 0*0+ 0* (-0,5) /19= 8+5,5/19= 13,5/19= 0,710

https://doi.org/10.56294/mw202538

Both the ISG (0,645), the ISF (0,625) and the ISE (0,710) are in the satisfaction zone, but are still far from the needs and possibilities for the development of STI processes at the university to achieve excellence in the academic training required of future health professionals.

Table 6. Iadov Logic Table- ECTI (n=19)

P1	P2									
	Yes			No I do not know			No			Σ
	P3									
	YES	No I do not know	No	YES	No I do not know	No	YES	No I do not know	No	
I am very satisfied	7		1							8
More satisfied than dissatisfied	8		3							11
Σ	15		4							19

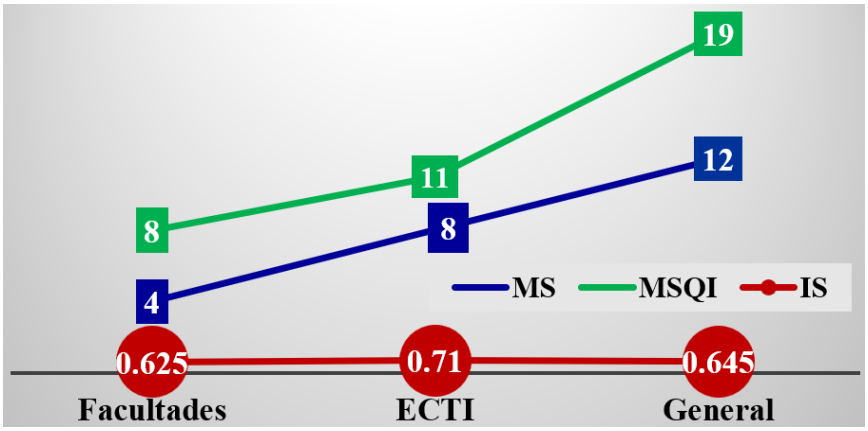

Figure 1. Degree of satisfaction according to origin

The statistical technique of Discriminant Analysis was applied to establish whether or not the variables measured belong to their respective groups of origin. The main objective of this technique is to find a combination of variables that maximizes the separation between groups. In this case, it was used to classify research managers into their respective groups of belonging: Faculties and ECTI.

The variables measured are P1 (degree of satisfaction with the results of the scientific-technological activity), P2 (impact of the scientific-technological activity on the development of their entity), P3 (effectiveness of the scientific-technological activity in their field of competence), sex, age, category (teaching or scientific) and teaching or scientific degree (master's or doctoral). The results indicate that 80,5 % of the research managers were correctly classified in their groups of origin, which means that the model has high precision in the general classification of the cases in the groups to which they belong 2nd the research managers belonging to ECTI have a higher percentage of correctly classified cases (84,2 %) than those of the Faculties (75 %). This suggests that the model is more effective in classifying ECTI cases than faculty cases. It is possible that the characteristics of cases in ECTI are more distinctive or that there is less overlap between ECTI groups.

Discriminant Analysis was used to classify cases into two predefined groups (Faculties and ECTI) based on the selected variables. The model has a good overall classification rate (80,5 %) and better accuracy in classifying ECTI cases than Faculties. This indicates that the variables used effectively differentiate these two groups, although there could be room for improvement in the classification of faculty cases.

The triangulation of the answers to questions P4 (unfavorable aspects that limit the scientific-technological activity) and P5 (favorable aspects that boost the scientific-technological activity) of the questionnaire, the interviews with the managers and the documentary analysis (annual balance sheets of CTI-UCMH 2021 and 2022), made it possible to systematize the main weaknesses, achievements and projections of the science, technology and innovation activities in the faculties and Science and Technology Entities (ECTI) studied. In this sense, it is possible to highlight that the processes most profusely referred to by the managers deal with research projects, scientific categories, and publications, about which they referred to 22 weaknesses, eight achievements, and 15 work projections. Due to their strategic importance, the prevailing criterion was that these processes are far from the capacities and possibilities of the human scientific and technological potential formed by the university in five decades of existence and the results achieved by Cuban medicine at the national and international level.

https://doi.org/10.56294/mw202538

Results of the triangulation and systematization carried out
In relation to research projects:

Weaknesses:

- Low number of projects that contribute to the completion of specialties, master's and doctoral degrees.
- Limited incorporation of students, both undergraduate and graduate, to research projects and science and technology processes.
- Deficient dissemination of calls for proposals for national and sectoral projects.
- Reduced submission of projects to the calls for proposals of the National Programs.
- Insufficient number of projects in Primary Health Care (PHC) and Natural and Traditional Medicine (NTM).
- Insufficient management of projects with international collaboration. o Insufficient number of projects with international collaboration.

Achievements:

- There are projects on current topics of national and international relevance and impact.
- A Sector Program on "Social Determinants of Health and Risk Prevention in Vulnerable Groups" is being managed.
- Execution of international projects with external financing.
- Implementation of the process of reorganization and renewal of research projects. o Increase in the number of research projects.
- Increased the number of research projects with a doctoral program
- Prioritization of research projects related to the training of human resources.

Projections:

- Disseminate among researchers, professors and students, the calls for priority health programs, national programs and the problem bank.
- Conduct methodological workshops to update science managers about research projects, their management and control.
- Improve the control and execution of research projects.
- Strengthen the leadership of the project leader as well as the science manager. Design work strategies to increase the effectiveness of the project.
- Design work strategies to increase the number of projects in PHC.
- Develop actions to increase the participation of students in projects. o Develop actions to increase the participation of students in projects. o Develop actions to increase the participation of students in projects.

In relation to scientific categorization:

Weaknesses:

- Scarce number of professors with scientific categories in PHC.
- Increase in the number of departures due to retirement, departure from the country and death.
- Insufficient preparation to obtain research categories. o Insufficient preparation to obtain research categories. o Insufficient preparation to obtain research categories.

Achievements:

- Development of workshops and courses for the implementation of the new resolution 208/21 of the SCTI in the different entities of the University.
- Increase in the level of motivation of young professors to opt for scientific categories. o Increase in the level of motivation of young professors to opt for scientific categories.

Projections:

- Train managers on the scientific categorization process.
- Increase the scientific categorization of researchers, particularly in PHC.
- Motivate Ph.D. and M.Sc. graduates to obtain higher scientific categories.
- Insert the youngest professors to reach scientific categories.
- Determine the pool of professors with the potential to reach scientific categories and individualize their counseling.

https://doi.org/10.56294/mw202538

In relation to scientific publications:

Weaknesses:

- Irregularity in the management and control of publications.
- Low rate of publications by professors
- Methodological deficiencies in the elaboration of scientific articles.
- Lack of motivation of physicians, nurses, technologists and health professionals to publish. o Low number of publications from PHC.
- Scarce publications coming from PHC
- Insufficient participation of students and residents in publications. o Deficiencies in PHC libraries.
- Deficiencies in the libraries of the entities for the control and registration of publications.

Achievements:

The ranking of a university is measured based on six indicators that evaluate them in four areas: research, teaching, employability and internationalization. In the ranking of Latin American universities in the last 5 years, the UCMH is in fourth place among 50 Cuban universities. In 2022 more than 50 % of the periodical publications are in journals indexed in prestigious databases.

Projections:

- Organize virtual courses on the writing of scientific articles.
- Broaden the dissemination of the publication possibilities of teachers and researchers.
- Stimulate the publication of scientific articles and recognize outstanding authors.
- Develop an institutional strategy to increase the quantity and quality of scientific publications o Develop an institutional strategy to increase the quantity and quality of scientific publications.

Scientific publications constitute a relevant result that provides added value and quality guarantees to the research processes in most areas of scientific knowledge and the main form of communication, dissemination, and evaluation in correspondence with the rigor of external arbitration, being also sources of exchange and scientific debate and indispensable reference base for other researchers.[8] The UCMH has researchers with recognized research experience and national and international prestige.

Scientific publications in health and disseminating knowledge make it possible to evaluate the quality of research results to improve the training of students and teachers and, therefore, provide excellent medical services to the population. Unquestionably, indexed publications are an indispensable requirement for universities to accredit their quality and contribute to financing national and international projects.

Other inadequacies addressed by the interviewees are the "problems of information discipline on the processes of STI activity; 'lack of financial resources to execute the tasks that are planned, as well as to remunerate researchers even when they are budgeted'; 'failures in the functioning of the Scientific Councils'; 'insufficient implementation and generalization of the scientific results of research due to economic limitations and organizational problems' and 'little mastery of the new law 7 of the Science, Technology and Innovation System'.

DISCUSSION

Several authors have used Iadov's method for different purposes, but mainly in academic research to evaluate the ISG about methodologies, systems, strategies, models, plans, and programs or processes; however, few results have been found directly related to its application in the processes of science, technology, and innovation, although those consulted do not differ from those most related to our object of research.

Some of the topics investigated by Cuban universities evidenced the validity and usefulness of Iadov's method from different scientific perspectives. They are Academic training in scientific research methodology of masters and doctoral students of a medical institution in Cuba;[9] Evaluation of the level of satisfaction of university law students with the Criminology Program;[10] System of indicators for the forecasting, design, and measurement of impact of research projects in the agricultural sector. Agrarian University of Havana, Mayabeque province;[11] Procedure for introducing knowledge management for STI activities in Pinar del Rio;[12] Support system for the remote diagnosis of genetic diseases based on fuzzy cognitive maps. University of Informatics Sciences.[13] Development of informatics skills for knowledge management associated with medical sciences. University of Medical Sciences of Matanzas;[14] Methodology for training in Good Pharmacovigilance Practices of the human capital of the Base Business Unit. Laboratorios Liorad de la Empresa Laboratorios AICA, Havana, Cuba;[15] Implementation of workshops as a way for the training of professionals of the Pharmaceutical Services of Havana in the framework of Knowledge Management;[16] Methodological instrument for the management of the performance of the Science and Innovation System, focused on academic processes in Health. University of

Matanzas;[17] Evaluation of the nursing professional with a care intervention as a way for knowledge management in the municipal intensive areas of emergency polyclinics in Primary Health Care in Mayabeque province.[18]

In other countries, Iadov's method has also been used in the university setting with excellent results; some are scientific research strategies and technological innovation. Faculty of Educational Sciences, Humanities, and Technologies of the National University of Chimborazo, Ecuador;[19] Development of organizational competencies linked to the organizational behavior of dairy product marketing companies in the province of Manabí, Ecuador;[20] Impact of the university-community relationship through research work on taxes for micro-enterprises. Universidad Regional Autónoma de Los Andes, Ecuador;[21] Incidence of ICT in learning statistics of fourth cycle students of the Faculty of Sciences of the Universidad Nacional de Educación (UNE), Peru.[22]

CONCLUSIONS

Iadov's method is applicable and can be generalized to other research on STI processes since it provides important elements about the perception of satisfaction levels achieved in different areas to reorient actions to achieve better results.

The results of the research point to an acceptable but insufficient level of individual and group satisfaction, although higher in the ECTI than in the faculties.

Projects, categorization, and scientific publications of the university's medical potential are the main concerns of managers, which requires strategic actions in the short, medium, and long-term.

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FINANCING

No funding sources were available.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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https://doi.org/10.56294/mw202538