



QUALITATIVE ORIGINAL ARTICLE

PRINCIPLES OF SCIENCE MANAGEMENT AND TECHNOLOGICAL INNOVATION IN HEALTH TECHNOLOGY

PRINCIPIOS DE LA GESTIÓN DE CIENCIA E INNOVACIÓN TECNOLÓGICA EN TECNOLOGÍA DE LA SALUD

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ABSTRACT

Introduction: accomplish with norms and principles contributes substantially to the improvement of the substantive processes of the university in a cooperative and harmonious manner, by acting as a whole interrelated. The purpose of the research was to identify the principles of science management and technological innovation in Health Technology. *Development:* six principles were identified, to be precise: University education in Health Technology, Education at work, Research ethics, Permanent and continuing education, Development of sciences and Health Technologies to meet with quality the needs of health of the population, Integrated and intersectoral management of science and technological innovation. *Conclusion:* the principles of science management and technological innovation in Health Technology were identified, which contribute to the understanding of the need for the systematic evaluation of the process, in order to achieve its improvement.

Keywords: Health Technology, management, principles, science, innovation

RESUMEN

Introducción: el cumplimiento de normas y principios contribuye de forma sustancial al mejoramiento de los procesos sustantivos de la universidad de manera cooperada y armónica, al obrar como un todo interrelacionado. El propósito de la investigación fue identificar los principios de la gestión de ciencia e innovación tecnológica en Tecnología de la Salud. *Desarrollo:* fueron identificados seis principios, a saber: Educación universitaria en Tecnología de la Salud, Educación en el trabajo, Ética de la investigación, Educación permanente y continuada, Desarrollo de las ciencias y las Tecnologías de la Salud para satisfacer con calidad las necesidades de salud de



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la población, Gestión integrada e intersectorial de ciencia e innovación tecnológica. *Conclusión:* se identificaron los principios de la gestión de ciencia e innovación tecnológica en Tecnología de la Salud, los cuales contribuyen a la comprensión de la necesidad de la evaluación sistemática de dicho proceso, para lograr su mejoramiento.

Palabras clave: Tecnología de la Salud, gestión, principios, ciencia, innovación

INTRODUCTION

The process of science and technological innovation (STI) must respond to the needs of the training process in Health Technology. This must be done based on the Governing Documents of Science and Technological Innovation, until now the only legal document of the Ministry of Science, Technology and Environment (MSTE) related to the subject, dating from 2001, ⁽¹⁾ however the School of Health Technology (SHT), as the national methodological guiding center, suffers from an Institutional System of science and technological innovation (STI), an Institutional Policy of IP and an Institutional Strategy of IS.

In the opinion of the authors, in the (SHT), the compliance of resolutions of the (MSTE) as: the number 10/2015 related to the regulation for the granting of the additional payment for participation in programs and projects, ⁽²⁾ the number 44/2012 referred to is insufficient. to the regulation for the process of elaboration, approval, planning, execution and control of the programs, projects of science, technology and innovation; ⁽³⁾ the methodological indications for the activity of programs and projects of science, technology and innovation of 2014. ⁽⁴⁾

The fulfillment of these norms and principles contributes substantially to the improvement of the substantive processes of the university in a cooperative and harmonious way, by acting as an interrelated whole: teachers, bosses, the rest of the staff and students, in favor of resolving, from science, all welfare, teaching, managerial, extensionist and research problems that merit it.

The integration is expressed in the aggregate activity of the institution's management and its professors, which in the medium term includes students and the rest of the workers, professionals; since the development in teaching, based on advances in scientific technology, in the constant generation of new knowledge as results of scientific research and make good use of them, is a guarantee of a better development of the teaching-learning process.

When the management of any of the processes is sustained in new techniques and styles of leadership and direction, whose updating comes from scientific research, a better management of the directed process is obtained and therefore of its results. When the university extension works not only to improve processes within the university, but also in the community, all this through science, the contents are also integrated.

When the teaching process is well directed, the extension, the research, the organization of a university institution like this one; when the problems arising in these areas are solved from science; when in each of these scenarios good forms of teaching and learning are used; when you interact with society to solve your problems, then you see the integration of the substantive processes of the university.

With the purpose of contributing to the epistemic bases of Health Technology within the Sciences of Medical Education, this study identifies the principles of science management and technological innovation in Health Technology.

DEVELOPMENT

The five principles that enrich the epistemological foundations of Medical Education Sciences are described in chapter one of the book Epistemology of Medical Education, published in 2015 and are the autonomy, not doing harm, professional ethics, charity and education in the work. ⁽⁵⁾ From the vision of the process of science and technological innovation in Health Technology (STI in HT) should be viewed as follows.



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The principle of autonomy responds to the need to inform the patient about everything that happens with their health, the diagnostic means with their advantages and disadvantages, as well as the therapeutic and rehabilitative modalities; he chooses, or failing that, the accompanying person or relatives. During the STI process this principle is applied, giving the people who will be studied, the possibility of entering or not, once explained its importance and objectives, as well as the advantages and disadvantages; It also applies to not reacting with those who decide not to participate or leave before concluding the study. This is autonomy and informed consent; research is not conceived without its strict compliance and is linked to the ethics of scientific research.

Not doing harm is an old principle related to the voluntary practice of not wanting to do wrong. This is the slogan to meet patient safety during the health care process and also applies to the phases of scientific research. In no technological procedure or investigative result, the integrity of the patient must be put at risk. To this end, the Health Technology professional must be well prepared academically and scientifically, to show an adequate performance, given by the skill, capacity and acceptable conditions in its exercise, because it is what is expected of him. When the student is prepared (undergraduate and postgraduate) as a future researcher, the humanist conception should be inculcated in his actions, in the act of contributing to diagnosis, treatment, rehabilitation, saving life and raising quality of life.

As for professional ethics, this is particularized in a deferential and respectful attitude, which has to be real and adapt to the investigative circumstances of the case in question at all times. This principle is linked to the previous ones. When individuals are units of analysis of a scientific research, it is necessary to comply with the principle of data confidentiality, when presenting the information collectively and not individually, when using them only for research purposes and by researchers, in addition, they should inform about the results of the research.

In Health Technology, during the process of science and technological innovation, it is necessary to manifest ethics in the education of values, from their professional performance to their role as teachers, tutors and researchers. The adequate interpersonal relationships between all the actors and factors involved in the research process, teaching, care, management and extension, is another way of acting, essential to achieve the integration of the process of science and technological innovation. In the same way, the author considers it important to place more emphasis on the protection of the intellectual property of Health Technology professionals.

The beneficence is a principle focused on the distribution of resources is available equally, likewise happens with the completion of technological procedures, they are human beings, regardless of their nationality, religion, creed, culture, political affiliation, among other personal characteristics. Experimentation in humans, as a way for the development of science, whenever it is used for the benefit of man, is welcome.

Education at work, considered the guiding principle of this science, should be developed in an organized manner and with teaching, care, extension, managerial and research integration, that ennobles more and more the work in group and with the tutors; that strengthens the development of creativity and individual and collective resolute capacity of students of different levels and teachers, in interaction with the health problem, in the real context where it is manifested, in a multiprofessional and interdisciplinary way in the care services, in such a way that allows the development of new modes of action during the science and technological innovation management process, improves interpersonal relationships and promotes ethical-moral values in intimate relationship with the community. This allows the future professional of Health Technology to be trained in the area where they will practice their profession, with developed research skills and scientific thinking incorporated.

It is important to take into consideration the need to learn to manage research, teaching, extension and assistance, from the undergraduate level and complement it in postgraduate studies, always from science. The university has to manage all the processes and its teaching starts from undergraduate. Evaluating this management leads to the improvement of the processes evaluated and guarantees, in the end, the improvement of the services provided to the population.



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In the context of the new innovative university in which it is intended to convert Health Technology, this was defined by Columbié Pileta in 2018 "as a branch of Medical Education Sciences that contributes in a decisive way to the solution of the health problem -disease of the Medical Sciences and Health, from a system of knowledge and technological procedures of health, for the application and transfer of scientific and practical knowledge, integrated in processes and services, that link this professional with the biomedical technologies and the patient, adjusted to quality requirements that guarantee safe care, with an epidemiological-clinical-social and ecological approach." ⁽⁶⁾

After the analysis of the literature systematized by the authors, it is considered important to show the principles of science management and technological innovation in Health Technology. They are based on the principles of Medical Education identified by Salas Perea and Salas Mainegra in 2012, ⁽⁷⁾ the statements in the book of epistemology of Medical Education in 2015, ⁽⁵⁾ the basic principles of Medical Education, taken from the Declaration of the World Medical Association on Medical Education in 2017; ⁽⁸⁾ as well as the seven existing ones to implement the Quality Management System, established by the ISO 9001 Standards of 2015. ^(9, 10)

Salas Perea and Salas Mainegra discuss the importance of the principles of contemporary medical education and health management. They also refer that the processes of training and improvement of health personnel are designed to ensure the development of four essential functions for professional work in the National Health System: care, teaching, research and health management. ⁽⁷⁾

In their opinion, these processes are structured on the basis of the following principles: satisfying with quality the health needs of the population, development of sciences and technologies, combination of study and work, linking theory with practice, as well as, Education at Work in institutions and health units. ⁽⁷⁾ The authors consider that the last three are interrelated, therefore they consider them as Education at Work.

It is known that the epistemic foundations of the Medical Education Sciences are under construction. Morales Villavicencio and collaborators in 2015, in their book related to the subject, expose as principles of this science the following: education at work as a guiding principle, autonomy, not doing harm, professional ethics and charity. ⁽⁵⁾ The last four included within the principles of Bioethics.

The Declaration of the World Medical Association on Medical Education in 2017 identifies four basic principles, to be precise: university medical education; selection of students that includes the curriculum and evaluation, support to the student, the faculty and institutional resources, in addition, the financing of the Medical Education; Postgraduate Medical Education and continuous professional development. ⁽⁸⁾ Within the framework of research, the author includes the second within the first and the last two in continuing and continuing education.

For the development of the evaluation model of the management of STI in HT, in the context of the new innovative university that is intended to be achieved for SHT, it is considered pertinent to enunciate the principles of the Quality Management System, established by ISO 9001 Standards of 2015 and which are: customer focus, leadership, commitment of people, approach to processes, improvement, decision making taken in the evidence and management of relationships. ⁽¹⁰⁾

Supported in this analysis, the main author identified the following six basic principles of Health Technology or Technological Education in Health, in its constitution as Science, and in the context of the new innovative university, for which it is essential that it be support in the management of science and technological innovation in HT. They are: university education in HT, education at work, research ethics, permanent and continuing education, development of sciences and Health Technologies to meet with quality the health needs of the population, and integrated and intersectorial management of STI. Below is explained what each of them consists of.

➤ *University Education in Health Technology:* part of the selection of the students of the of HT careers , according to their intellectual capacity, motivation, pertinent previous formation that can be through the "open



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doors" carried out in the institution, where It guides you on each profession. The process must not be discriminatory and may reflect admission requirements.

The curriculum must be content of a clear description of the knowledge, attitudes and investigative skills necessary to conduct the STI process, in such a way that the problems originated in any of the basic areas are investigated: research management, extension, assistance and teaching. For them, students should be introduced with more thoroughness in the Research Methodology, with well-prepared teachers in the subject, how to introduce the results in to practice and publish them. This is achieved when the HT student has the opportunity to participate in research projects.

Therefore, for a good professional performance as a researcher, in any of the levels where it is developed, the solution through the STI process, problems related to technological health procedures and the evaluation of technologies should be included in the sanitary curriculum, among others.

Students who are assistants must be given special support in the development of research skills through tutoring and guidance, which are reflected in Education at Work; ensuring an institutional environment in which they are sensitized for learning and investigative demands. For the afore mentioned, the availability of STI is essential.

The purpose of the university Medical Education is that students upon graduation have acquired knowledge, experience and professional conduct that prepares them to perform in assistance, teaching, research and management, in such a way that they respond to the health needs of the population.

➤ *Education at Work:* Considered the guiding principle of Medical Education, it must be developed in an organized manner and with the integration of teaching, care, extension, management and research, which ennobles the work in groups and with the tutors; that strengthens the development of creativity and individual and collective resolute capacity of students and teachers, in interaction with the health problem, in the real context where it manifests itself, in such a way as to allow the development of new ways of acting during the process of STI management, perfect interpersonal relationships and promote ethical-moral values in intimate relationship with the community. This allows that the future professional of HT is formed in the own area where will practice the profession, with developed investigative abilities and incorporated scientific thought.

It is important to take into consideration the need to learn to manage research, teaching, extension and assistance, from the undergraduate level and complement it in postgraduate studies, always from science. The university has to manage all the processes and its teaching starts from undergraduate. Evaluating this management leads to the improvement of the processes evaluated and guarantees, in the end, the optimization of the services provided to the population.

➤ *Research Ethics:* this refers to thoroughness, honesty and integrity, through constant updating, compliance with good practice guidelines; respect for life, the law and the public good, ⁽¹¹⁾ by minimizing the risks during the performance of any technological health procedure and during the stages of scientific research; as well as the responsibility for the communication of the results, whether oral or written, previous honesty in the interpretation of the data and review of the scientific evidence, in addition to the feedback to the patient that was the object of study.

Ethics in the publication of results is guaranteed by avoiding scientific fraud ⁽¹²⁾ that can be expressed in different ways such as: invention, falsification and manipulation of data, plagiarism and self-plagiarism, fictitious authorship, repeated publication (duplicated, fragmented or inflated), incorrect bibliographic citations, publication biases, publicity of research results, as well as authors' rights.

➤ *Permanent and continuous education:* emphasize the improvement related to the STI process, useful for the solution of problems originated in the variety of contexts and different levels of attention where the HT



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professional works. Master's and doctorate training programs that help the development of the desired research skills in this professional.

Continuous professional development must respond to the vertiginous advance of science and technology, which leads to a rapid obsolescence of knowledge and must be renewed, if possible, at the same speed in which it ages. It must begin in the undergraduate, when the student is admitted to the university, and continue in the academic postgraduate training and professional improvement throughout life.

➤ *The development of sciences and HT to meet with quality the health needs of the population:* during the STI process, a solution to a research problem that may arise in the social practice where HT professionals work or can be solved. of the environment that surrounds him, which leads to the updating and generation of new knowledge that enrich the epistemic foundations of the sciences, in particular to the Sciences of Medical Education, with special contribution to the theory in HT, as a young branch within this science. This results in the consequent improvement of the quality of the technological health procedures, which lead, as an end, to progress in the quality of the services provided by this professional, which includes patient safety during the performance of these procedures.

Health professionals have emerged since ancient times, to respond to the ever-increasing social demands of the health-disease problems that affect the population. They are due to patients, hence the importance of working with compliance with the principles of professional ethics and bioethics, constantly updated to meet the quality of health needs of the population. Requirements that TS professionals do not escape.

➤ *Integrated and Intersectoral Management of STI:* to achieve an innovative university, the integration of university processes is vital. The STI process should be seen as a way to solve the problems that arise in any of the areas: investigative, extension, teaching, care and managerial, in which the HT professional develops. It is interesting to recognize the interrelation of the processes, because each one must be managed with quality, relying on new and constant scientific knowledge that helps in the best performance of teaching, leadership, health services with quality, as well as, to the solution of problems within the university community and the population where the HT School is located.

The integrated management of the STI process must be assumed as a determining condition in the innovative university that scientific and technological innovation requires today. These institutions must be renewed so that they become centers that increase the formation of research communities, which, in their actions, conceive the STI as determining factors of a sustainable society. Under this integration the frontiers between basic and applied research are dissolved, its interdisciplinary approach is strengthened, where the evaluation of the results of the STI is based on its social impact, in which many sectors of society are involved. All this leads to a transformative action where the quality of Cuban Public Health services benefits.

That is why integration must be assumed as a revolutionary institutional culture of what is understood by STI, where an atmosphere of knowledge, attitudes and practices in favor of scientific research is breathed, where it is seen as a routine part of daily and professional work not as an additional task, where scientific, innovative and technological research is understood as the essential integrating core, where alternative solutions are sought for the improvement of institutional processes from science positions: flexible, participatory, dynamic and contextualized, with an interdisciplinary approach.

The evaluation process of STI in HT must be supported in its management, which facilitates institutional unity and exchange with the different disciplines that make up Health Technology, without losing sight of the necessary integration of teaching, care, research areas, management and extension, where from the Education at Work as a guiding principle of Medical Education, it is possible to bring the academy to the sectors of society, but also allows the transforming action of the activity, achieve the essential social impact.



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That's why it is necessary that the institution from all its edges achieve a STI management, integrating from becoming a faculty able to transform itself permanently and systematically, in correspondence with the advances of science and especially in this branch where the avalanche of advanced biomedical technologies is continuous; it is precise that the same one, from its management of STI is suitable to take care of the great technological challenges and of the surroundings; where the expectations of its executives mobilize their human resources in function of permanent reforms, enriching the management model of STI to fulfill its social function, through an adequate balance of the activities of permanent and continuous training, in which the research is agreed as core integrator of the processes in close relation with society.

The results that emerge from this STI management process in Health Technology are appreciated when viewing the outputs of a project: from where training courses, professional improvement, academic training, production and intellectual property, methodological documents, teaching literature emerge, the socialization and generalization of results; all this with an unquestionable improvement of undergraduate and postgraduate training in the areas of teaching, care, research, management and extension, which is a sign of an adequate and integrated management of STI in Health Technology.

That's why, the author considers that the management of STI should be focused on the solution of the problems of the users, whether they are intra or extra-university, and all the participants during the process are equally responsible and important in driving and obtaining results of the process. To achieve the proposed goal, a good leadership exercise is vital. It is a leader who establishes good communication with his subordinates and they all go in the same direction.

During the STI management process in HT and in its evaluation for improvement purposes, it is important to achieve the commitment of all those involved through recognition for the work that each one does, teamwork, preparation for the sake of professional improvement and communication with the immediate boss. You should also have an organization and procedures manual that is a guide to improve each time, in each of the stages of the management, about: planning, organization, integration, direction and control.

The improvement is achieved, with the systematic evaluation in the planning stages of the improvement actions, once the problems and their causes have been identified, by measuring the 30 indicators of the management stages; with the implementation of the measures; verification of the results obtained with the measures implemented, compared with the initial results; verification of the causes of the unfulfilled recommendations and those that succeed in the expected achievements; and action through decision-making based on the scientific evidence that appears, to draw new objectives, emerging needs for training or improvement, new improvement plan. This gives rise to endless cycles of systematic evaluation that are the ones that guarantee the improvement of the STI management process in HT, since everything that can be measured is improved.

It is interesting the scope of an adequate management of STI in HT, based on intersectorial relationships of the interested parties (users), who can be providers of resources for the development of the process, or beneficiaries of the results found; which should be present at all stages, so that a relationship of interconnection and interdependence can be established.

CONCLUSIONS

The principles of science management and technological innovation in Health Technology were identified, which contribute to the understanding of the need for the systematic evaluation of the process, for the sake of its improvement.

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