

Training in Science, Technology and Society: Diagnosis from the postgraduate level

Formación en Ciencia, Tecnología y Sociedad: Diagnóstico desde el posgrado

Formação em Ciência, Tecnologia e Sociedade: Diagnóstico a partir da pós-graduação

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Abstract

The present work shows the theoretical-methodological framework of the research, and the evaluation that characterizes the current state of Postgraduate Studies in Science, Technology and Society (ECTS) at the University of Holguín. Likewise, the diagnosis of the postgraduate course for training in Science, Technology and Society (CTS). In addition, for the collection of information, was carried out through surveys and in-depth interviews with experts who teach and teachers who receive these contents as part of their professional improvement. Similarly, the objective is to: Evaluate the training in Science-Technology-Society in context and according to the educational demands in higher level institutions.

The university should train a professional with the capacity to face the challenge of contemporary times, with suitable scientific and technological knowledge, with values for optimal performance, as a member of society,

Key words: training; postgraduate; science; technology; society

Resumen

El presente trabajo muestra el marco teórico-metodológico de la investigación, y la evaluación que caracteriza el estado actual de los Estudios de Posgrado en Ciencia, Tecnología y Sociedad (ECTS) en la Universidad de Holguín. Asimismo, el diagnóstico del curso de posgrado para la formación en ciencia, tecnología y sociedad (CTS), además la recogida de información se realizó mediante encuestas y entrevistas en profundidad a expertos que imparten y docentes que reciben estos contenidos como parte de su superación profesional. De igual forma, el objetivo radica en: Evaluar la formación en Ciencia-Tecnología-Sociedad en contexto y acorde a las demandas educativas en las instituciones de nivel superior.

La universidad debe formar un profesional con capacidad para enfrentar el reto de la época contemporánea, con conocimientos científicos y tecnológicos idóneos, portador de valores propios para un óptimo desempeño, como miembro de la sociedad.

Palabras clave: formación; posgrado; ciencia; tecnología; sociedad

Resumo

Este trabalho mostra o arcabouço teórico-metodológico da pesquisa e a avaliação que caracteriza o estado atual da Pós-Graduação em Ciência, Tecnologia e Sociedade (ECTS) da Universidade de Holguín. Da mesma forma, o diagnóstico do curso de pós-graduação de formação em ciência, tecnologia e sociedade (CTS), além da coleta de informações, foi realizado por meio de pesquisas e entrevistas em profundidade com especialistas que ensinam e professores que recebem esses conteúdos como parte de suas aulas. melhoria. profissional. Da mesma forma, o objetivo consiste em: Avaliar a formação em Ciência-Tecnologia-Sociedade no contexto e de acordo com as demandas educacionais nas instituições de nível superior. A universidade deve formar um profissional com capacidade para enfrentar o desafio da contemporaneidade, com conhecimentos científicos e tecnológicos adequados, portador de valores para um ótimo desempenho como membro da sociedade.

Palavras-chave: treinamento; pós-graduação; Ciência; tecnologia; sociedade

Introduction

The accelerated development of science and technology nowadays has generated economic, political and social transformations for humanity; these changes have created in man a way of thinking and proceeding according to the scientific-technological activity that is developed. Cuba is a signatory state of Resolution 70/1 of the United Nations General Assembly entitled "Transforming our world: the 2030 Agenda for Sustainable Development" which includes goal 4 "Quality education", which postulates that the achievement of quality education "is the basis for improving people's lives and sustainable development" (United Nations General Assembly, 2015, p.8).

In accordance with the provisions of that objective, the member countries of the Community of Latin American and Caribbean States recognize the need for education to be a backbone element for the sustainable development of countries, which must be inclusive, equitable and of quality. To achieve this, the states are committed to promoting public policies and regional programs that guarantee it, with the highest technology (CELAC, 2021). In line with the above, the search for quality education has, among other implications, in the case of universities, that of increasing their relevance to social demands, in terms of solving the most pressing problems, in addition to those generated by the Covid-19 pandemic that impose a radical change in the forms of organization of their substantive processes.

As a result, the training of professionals does not end at the end of the university major and continues in a new stage according to the needs for the job that is performed or for which it is prepared, the needs of the development of science, technology and art, and the needs of the professional as a social being, so that professionals are in a constant intellectual and cognitive development, which is achieved in part in the academic postgraduate (Hernández & Bernaza, 2018). Similarly, Núñez & Alcázar (2018), raise three conceptual references that underpin the role of universities in economic and social development, related to changes in development styles, related to all representations on science, technology and innovation and their connection with territorial, community and local development and finally the current debates on how the models of the new university should be.

In this order of ideas, Núñez & Alcázar (2018) emphasize that universities have important and persistent commitments to the social, environmental and economic development of countries, they are direct actors of local development, capable of producing, disseminating, transforming and promoting the use of knowledge and technologies of economic, social, environmental, political and cultural importance, according to the most pressing needs. In that sense, the epistemic study determined (Álvarez et al., 2021;

Fernández et al., 2018, 2021; Karışan & Zeidler, 2017; Núñez, 2010, 2019; Ortega et al., 2023; Solbes, 2019) that the performance of the professional takes place in the midst of contradictions of practice, scientific knowledge and the introduction of its scientific results in the also contradictory contemporary society, so that the development of conceptions and attitudes in the proper management of science, technology and innovation; and the corresponding reflective processes become essential objectives of professional performance.

Consequently, the existence of two major traditions: the European and the North American for the understanding of Science Technology and Society Studies (STS) at the level of education, differences were found in terms of: style and content, these two STS traditions, due to the diversity of their perspectives and fields of work (academic research, on the one hand; politics and education, on the other), can be said to constitute elements of a common understanding of science, technology and society. Similarly, according to Núñez (2010), at the educational level STS seeks to put into practice two important objectives of academic STS research: the social contextualization of expert's approach (demystification of science, problematization of technology) and the consequent advancement of public participation in decision-making related to science and technology.

From this perspective, education, science, technology and the arts, as stipulated in the Regional Conference on Higher Education for Latin America and the Caribbean, of the UNESCO International Institute for Latin America and the Caribbean UNESCO (2018) should thus be a means for freedom and equality, guaranteeing them without social distinction, gender, ethnicity, religion or age. Thinking that technologies and sciences will solve the pressing problems of humanity it is important but it is not enough. In order to be universal, the dialogue of knowledge must be plural and egalitarian, to enable the dialogue of cultures.

In other words, in Cuba education in Science-Technology-Society (STS) formally began in 1997 with the opening of the master's degree of the same name at the University of Havana and the University of Cienfuegos, respectively. Previously, STS-oriented knowledge was taught in Marxism-Leninism lessons and closer to Science-Technology-Society Studies. Subsequently, the subject Social Problems of Science and Technology (PSCT) was introduced in 1994, in several university majors, especially those with an engineering profile. In 1994, the Social Problems of Science and Technology exercise was introduced among the requirements for the processes of obtaining teaching and research categories and scientific degrees in the Higher Education system in Cuba.

The above, according to Núñez et al. (2019), favored the incorporation of graduate studies and offered the possibility of a space to influence the development of the approach to Science-Technology-Society relations; however, at present, the presence of STS courses in Higher Education institutions and the demands in the teaching category processes show insufficiencies in the understanding of the STS approach. Nowadays, universities are undergoing significant transformations, which have to do with all their fundamental functions, from the academic to the organizational context. For the University of Holguín to face these challenges, it is necessary to execute innovative processes that have an impact on the postgraduate activity in such a way that it answers back with the most current science and technology to the prevailing social needs.

Therefore, as the need to train and develop professionals attentive to the reflection on science and technology increases, it is contradictory that there are insufficiencies in the formative practice in STS from the graduate level related to the understanding of knowledge in context, and according to social demands. As well as the use of content for the interpretation and use of science and technology in society as part of the general culture of the teacher and researcher.

It is clear that STS education contributes to the student acting with the most effective ways of analyzing the role of the scientist both within the scientific community and within society in general and in the implications of scientific thought and practice, the understanding of the role of the scientist and of science. This educational activity to transform both subjectively and objectively of the current professionals and researchers will show relevance in future generations. Indeed, the objective of the research focuses on assessing the level of knowledge regarding the STS approach achieved by professors who teach and receive the postgraduate course to determine the needs of knowledge in continuous improvement

Materials and methods

In order to develop the research, the methods of analysis-synthesis and induction-deduction were used, which allowed the critical analysis and the taking of theoretical positions in relation to the objective previously exposed and in the context of the formation of the professional and particularly of the postgraduate. Another method used was the questionnaire and the interview for the collection of opinions on Science, Technology and Society, which allow us to verify the variables related to the knowledge that the professors involved in the training course have about science, technology and their relationship with society.

For this purpose, there are on the provisions issued by the Ministry of Higher Education (MES), referring to the indications for the management of the secondary forms of postgraduate professional development in the context of professional training, and particularly in the postgraduate course. Instruction 1 Graduate Management Manual, Resolution No. 140/19 of the MES, (MES, 2019). This endorses the idea that the Cuban University has the mission of perfecting the work begun at the undergraduate level through the postgraduate level.

Results and discussion

The main results obtained in the diagnosis were that the professors taking this postgraduate course have between 6 and 10 years of experience in higher education (56%), most of them are graduates (48%), and 44% have a scientific degree or master's degree. At the beginning of the course, the professionals involved consider that they have a low level of knowledge of the STS approach. According to those surveyed, the experience of improvement on university campuses was validated as important and necessary for their training and improvement, appropriating new knowledge in STS, since science and technology are social processes. In the application of the survey, and regarding the question, if they know how to identify in which field of their activity as higher education professionals they can develop this approach, 65% present limited knowledge about STS.

Consequently, a cognitive contradiction could be identified in the data tabulation, since they identify with the importance of this STS approach, but they are unable to interweave the science they develop with this field of study. It is sometimes difficult for them to focus their research and base it on this approach. The relevance and authenticity of training in science, technology and society for the professionals was marked in 100%, where they expressed the need to work on the STS approach in the various areas of knowledge and consider that it can contribute to their improvement and better understanding of the practical contribution that each science makes to society.

In this sense, for the professionals, relevance was recognized as very adequate in 88% and adequate in 12%, despite their theoretical ignorance of this term; they understand that it is at the postgraduate level where the encounter of the professional with the problems of practice, teaching and research is favored, for which it is significant to have the topics provided by the STS field of study, which serve for sustainable social development based on knowledge, and the interaction of the various social actors that emerge from research-action.

Similarly, the different specialties that participated in the course are between the social sciences and technical sciences. It was detected that several professors of technical sciences have an artifactual vision

of technology; they do not identify it as a social process, with socio-cultural and environmental conditioning factors in a given socioeconomic context. This vision is worrying, since there are many scientific-technological activities that these professionals carry out in order to make great contributions to society, and showing the absence of an STS knowledge system can lead to a dispersion of the social contribution that their science would make.

On the other hand, for the social, pedagogical and humanistic sciences it constitutes a new experience in a field of knowledge unexplored by some professionals of these branches. As a result, these sciences do not identify their technological and technological transfer contribution in question. This relationship of their research with the field of STS studies can lead to an exercise that is difficult to carry out in professional practice. In the preparation received during the postgraduate course, the need to be well oriented in this STS field of study was manifested, which favors the didactic, epistemological, axiological and techno-scientific development of the teacher and researcher.

In line with the above, the assessment of the experience once the STS postgraduate course was completed for the professionals who received the course was very positive, since it offers them materials that facilitate the understanding of social issues with a certain degree of complexity, as well as visualizing the social impact of the scientific-technological results obtained in their research.

- Fragmented conceptions are manifested, accentuated by conceptual and methodological deficiencies for the analysis of the relationships between science, technology and society in professional development.
- The link between the field of science in question and the postulates offered by the STS field of study is not established; they only concentrate on their object of research.
- The absence of a research topic prior to the professional development process limits training in science, technology and society at the postgraduate level.
- There is no STS postgraduate training process organized along lines of research prior to the course or diploma course for the improvement of professional training.
- Inadequate management of STS training by university professors when they have not yet mastered both the design of research and the main aspects of its theoretical framework and the contribution expected to achieve better results in the process of graduate training.

Therefore, higher education should achieve through postgraduate education that students, professors and society in general, know how to establish the essential links between science and technology; interpret

the advantages and disadvantages of the accelerated scientific and technological development that currently occurs in the world, in order to decipher and produce authentic scientific knowledge.

When evaluating the results, for the postgraduate studies in science, technology and society in the University of Holguin from the formative scenarios and taking as reference the diagnosis made, it is necessary the training on these topics for the performance of professionals and researchers of the diverse sciences and the collaboration and exchange with the productive business sectors and territorial community projects.

Consequently, this training in STS is based on essential relationships and starts from theoretical, normative and organizational bases, with a strategic, systemic, process and continuous improvement approach, to fulfill its principles of integration, through its conceptions of knowledge management, information management, human talent management, technological, social and technological transfer to achieve the objective of the postgraduate course. Likewise, during the research, the need to form in the professionals of the University of Holguin an integral conception of the field of knowledge of Science, Technology and Society was verified. The existence of deformed visions of STS is evident; the idea of science as a scientific product predominates, that is, as a set of concepts, laws and principles, which are defined through the application of the scientific method aimed at the search for truth.

Conception for the postgraduate degree in Science-Technology-Society

Nowadays, Cuba demands a more competent professional every day, aware of the constant changes that arise related to their specialty in contemporary society; therefore, the Cuban University has the mission to improve the work started at the undergraduate level through the postgraduate program. This is a teaching-educational process whose purpose is to update professionals on the scientific and technological advances that have taken place in recent times worldwide. It is a more systemic, profound and creative process than the undergraduate training.

In graduate education, one or more formative and developmental processes are together, not only in teaching-learning, but also in research, innovation, artistic education and others, harmoniously articulated in an educational proposal relevant to this level. From another perspective, STS studies emphasize that the educational models of interest must be capable of promoting collective learning, interactions, autonomy, self-management of knowledge; they must also be capable of developing students' capacities for research, management, application and decision making; of personalizing learning; in short, they must develop training processes that allow learning to learn and learning to undertake.

In this line of ideas, learning to learn means developing in the student autonomy and creativity in study, which allows him/her to achieve an effective and efficient self-management of learning. On the other hand, learning to undertake means developing the capacity to start and execute processes and projects successfully, for example, research, creation, innovation, professionalization, social transformation and others that society requires to satisfy its material and spiritual needs (Núñez, 2010).

Thus, an educational model that considers the above is a conception that consolidates a developmental teaching-learning method that promotes independent activity and collaboration with others. The following graph contextualizes the cognitive pyramid proposed to identify the theoretical-practical assimilation processes with respect to the science-technology-society (STS) approach.

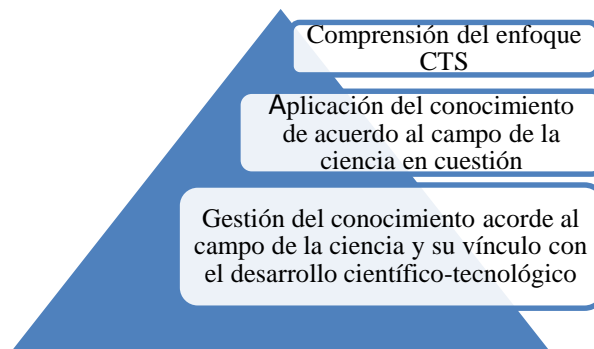


Figure 1. Educational process for the STS postgraduate course

Comprensión del enfoque CTS: Understanding the CTS approach

Aplicación del conocimiento de acuerdo al campo de la ciencia en cuestión: Application of knowledge according to the field of science in question.

Gestión del conocimiento acorde al campo de la ciencia y su vínculo con el desarrollo científico-tecnológico: Knowledge management according to the field of sciences and its link to the scientific-technological development.

It is adopted that, the understanding of the STS approach is given in first order by the level of prior knowledge that the student demonstrates about the content to be worked on in the course, the critical systematization of the theoretical content, the collective debate, the elaboration by teams of a cognitive map, the diagnosis of learning and the elaboration of a work schedule based on the diagnosis made, focuses students and teachers on the cognitive line to be followed in the Science-technology-Society postgraduate course.

Undoubtedly, the application of knowledge at a second level is characterized by the assimilation capacity of the contents received in combination with the tasks performed in the inter, trans and multidisciplinary groups during the course. In addition to designing learning situations that demand a certain cognitive effort to visualize the interaction of STS contents with the science in which students develop, which can favor the applicability of these contents in the research.

It is clear that knowledge management is established at a third level, given the possibilities offered by the content received during the Science-Technology-Society course to develop materials that provide students, according to their activity in the area of science being developed, with the capacity to produce, transfer and apply knowledge in practice. Conjugating this cognitive process for the assimilation of STS contents marks the way to know and know-how, since interposing a system of knowledge with the spheres of action of professionals and their possible applicability in practice, links the subject with the object to be transformed.

The dialectic of this relationship enables the understanding, application and management of the contents to be known, which gradually develop a set of skills that determine the scientific activity in question. This activity is imbued with social values that strengthen the scientific-technical work of society. Thus, a crucial aspect to keep in mind in the educational field is to learn from science and the implications of this with science and technology, and another, to educate in science, technology and society to promote a technological culture.

The Social Studies of Science and Technology as an academic field, committed to the production of theories or explanations, in general, offers a more classical understanding and orientation of the demands of knowledge and the controversies that are generated around this approach. In this sense, it is necessary to think not only of an academic orientation, but also of an activist one that faces new social demands with a creative and innovative character in the face of new public policies that may emerge in a given context. The didactic conception is based on results obtained from the empirical methods used in STS postgraduate courses, such as: surveys, interviews, participant observation and analysis-synthesis of documents related to this training system.

Among the results obtained to be considered are:

- a) Teaching experience in the scientific activity in question.
- b) Research capacity to transform the object of interest.
- c) Ability to reflect on the theoretical-practical problem of science.

d) Ability to apply scientific-technological results for social benefit.

The absence of some of these elements makes the subjective action of understanding science and technology as social processes impossible; not visualizing science and its contribution to society hinders the cognitive development of the teaching-learning process, which is of crucial importance for STS education.

The latter reflects the critique and dialectics of the links between Science, Technology and Society, since every contemporary social relationship is strongly marked by their presence. Therefore, the insistence on the explicit inclusion of these contents in the continuing education of university professors contributes to the achievement of research with a marked social relevance. This theoretical and activist conception can favor the dialectics of the teaching and learning processes in the postgraduate program, especially reflecting the complexity of the STS approach in the creative practice; it is linked to the understanding of the scientific activity to be carried out by the subject to transform society.

In this order, Núñez (2010) states that relevance at this educational level always means the establishment of multiple relationships between University and environment, links in which one and the other undergo mutations, which serve the purposes of a sustainable social development based on knowledge. According to Núñez (2010), the processes of training professionals must foster an understanding of technology that visualizes it and consequently transforms it as a social process and overcomes the "crude determinism in use and the common acceptance of its axiological neutrality" (p. 110). Likewise, reflecting on science and its contribution to social processes from its specific object of study, and accepting the trans, inter- and multidisciplinary that characterizes this approach will achieve an effective STS vision for the educational processes in question. That is to say, the visualization of technology should be framed to give it a social purpose that satisfies the needs and subjective values of individuals in society.

In the opinion of the authors of the research, the Higher Education Institutions and the different social actors linked to techno-scientific development, which are directly and indirectly related to it, have the mission to develop teaching, research and extension in correspondence with the science-technology-society interrelations. This core approach should not be absent in university graduate education, nor should it be outside the territorial and therefore local and community reality. Contemporary society requires professionals to handle scientific and technical knowledge that allows them to respond to everyday needs, whether personal, professional, cultural, material, or spiritual (Ortega et al., 2023). This situates the perspective of STS education from different practical angles, where the professional and research interact with everyday practice.

Therefore, the STS approach from the educational point of view lays the theoretical foundations for the understanding of practical events related to science and technology, an STS education in context, projects the need to rapidly raise the level of scientific culture of all citizens, develops important attitudes and values, as well as motivates the learning of science and technology as social processes on the rise.

According to Núñez (2019), universities should promote interactive learning processes for innovation, to which they will contribute from the knowledge and skills they already possess or will create, through research and teaching, based on the needs that arise so that innovations are technologically and socially satisfactory (p. 95). The interrelation of STS contents in the learning process strengthens the appropriation and management of new scientific knowledge for its subsequent application in the scientific field in which the professional involved in this mode of study works. In order to learn to know and know how to do, to produce and innovate in each of the modes of action and to know how to implement knowledge in the face of the territorial demands that emerge in the different contexts.

Conclusions

Finally, training in science, technology and society in universities allows the improvement of postgraduate studies, and favors the management and appropriation of knowledge from the formative and institutional scenarios. During the research, and the application of surveys and interviews in postgraduate studies, the need to train professionals in an integral conception of the approach to science, technology and society to achieve an articulation between the demands of knowledge in context, strategic sectors of the economy, sustainable development objectives and the guiding documents of Cuba's economic and social development was confirmed.

The application and management of knowledge in science and technology in the postgraduate activity contributes to professionals being carriers of skills and having the necessary capacities to make decisions and assume social responsibilities. The applied diagnosis confirmed the need to form in the University professionals a systemic conception of Science, Technology and Society from the postgraduate activity in all areas of knowledge, in order to achieve an articulation between undergraduate and postgraduate and mitigate the approaches that limit this field of knowledge in the university community and also contribute to the organizational culture of the institution.

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Conflicts of Interest

The authors declare no conflict of interest.

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Yamilka Pino Sera: Conceptualization, methodology, writing—original draft preparation, writing—review and editing, supervision