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## CTS IN TIMES OF PANDEMIC: FOR SOCIOPOLITICAL ACTION IN THE TRAINING OF DIGITAL SKILLS AND IN THE TRAINING OF TEACHERS TO FACE THE FUTURE

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**Abstract:** The article collects the experiences presented by three researchers from Panama, Colombia and Spain, who present from their perspectives the impact that CTS training has shown in times of pandemic. They raise different perspectives on the STS training that has manifested itself, in the way in which the teaching-learning processes were faced in the higher education centers of their countries. The sociopolitical perspective from the training of teachers with a Colombian experience and the training of digital skills of citizens prior to the emergency, helped to face the exchange and communication between people: students and citizens during the pandemic. The approach leads us to reflect on whether all the years invested in CTS training had their moment, when applied to this global event that subjected the world to innovating and adapting to move forward.

**Keywords:** CTS-training-digital skills-pandemic-curricular practices-higher education approach

## INTRODUCTION

The pandemic confronted the world with an unprecedented situation in the contemporary era in which we live; except for the similarity with the plagues of the past, in which thousands of people died as in the recent one. This fact marked a milestone in the appropriation and linking of science and technology with society.

This reality close to loss, allowed many people to understand the role of science and technology, to improve the quality of life of human beings. Thus understanding how these elements are linked to each inhabitant of this planet. Despite this, the current pandemic was framed in a context of growing mistrust in science, sometimes deliberately promoted for political or economic purposes, as is the case with climate change denialism or “anti-vaccine” denialism. We live in times of

regression with regard to democracy, human rights, social justice and the well-being of people, societies and the environment and when this happens, many people do not feel empowered to make decisions about the social and environmental problems that affect them (Reis, 2021).

We are at a crucial moment in which, on the one hand, we have impressive scientific and technical advances that have changed our ways of life in recent decades and, on the other, we are suffering the consequences of a serious deterioration of the planet and human well-being caused by our own action. Despite the rapid development of vaccines against COVID-19, people in situations of socioeconomic vulnerability had higher risks of contagion and death from COVID-19. Inequalities are related both to the ability to protect against contagion, as well as to a greater severity of the disease and a higher incidence of death (Cruz Castanheira and Monteiro da Silva, 2021).

On the other hand, the development that digital media and, in particular, social networks have achieved in the last decade exposes people to a worrying risk of an overabundance of information (infodemic) that is often based on scientific-technical aspects wrong, misunderstood, or that are misinterpreted on purpose and make it difficult for people to find reliable sources and guidance when they need it.

The lesson that we have left from the entire emergency is that it must be fundamental that the STS approach is transversal in all education scenarios and that the use of IT is an implicit component in human knowledge and learning. This will facilitate in the future, facing new challenges for humanity, perhaps with greater consequences or impacts like the one just past.

## **FROM THE CTS PERSPECTIVE TOWARDS SOCIOPOLITICAL ACTION**

What to do from the CTS perspective? It has become evident that to solve current social and environmental problems we need a generation of critical people with scientific and political knowledge who take action and not just limit themselves to expressing opinions and discussing these problems (Hodson, 2003). For Hodson (2011) it is necessary to broaden the objectives and practices of CTS and CTSA to give a higher priority to the promotion of critical thinking and sociopolitical activism. This way, it would go further, giving rise to a critical scientific literacy that becomes the engine of sociopolitical action. Action-oriented critical thinking also incorporates the ability to question inequalities and the ideas that justify them and to implement responsible actions aimed at greater social justice (Puig and Jiménez-Aleixandre (2022).

Sibel Erduran (2020) proposes to make these uncertain and distressing times useful and productive for research and learning communities committed to improving science education, engaging in constructive discussions about how it can contribute to understanding and solving the science crisis. COVID-19 and provide citizens with scientific skills to understand and deal with the pandemic. Given the situation we are experiencing due to the COVID-19 pandemic, the science education community must rethink the complex systems and sociopolitical contexts in which people learn and practice science to reconceptualize these processes through a prism of social justice (Dillon and Avraamidou, 2020).

From the QSV-ENCIC project (Spain et al, 2021) that the ENCIC research group of ``Universidad de Malaga`` is developing, we are working on tools and resources that help citizens to critically analyze controversies

about socially live issues (Legardez & Simonneaux, 2006) and offers them the opportunity to participate in debates about them, with the idea of favoring the assumption of both personal and social responsibilities, as well as decision-making for action. For this, we use the cartography of controversies (Latour 2007) as a tool that makes it possible to make visible the participants in socio-scientific controversies, as well as the complex relationships that are established between them, with different interests at stake, in a first step to address and analyze the controversies about socially live issues.

In order to develop these objectives as a channel for dissemination and citizen participation and as a tool to promote the didactic and information exchange to deal with this problem also from formal education and, specifically, from scientific education, the web page was created: <https://qsv.encic.es>. Until now we are addressing controversies related to the dominant model of production and consumption of meat and dairy” (Cabello-Garrido et al, 2022), “how to face the COVID-19 pandemic” (Cabello-Garrido et al, 2021) and “the spaces for care in the city”. In formal education we have developed training activities and programs in secondary and university educational stages, including initial teacher training.

### **HOW DID THE CTS APPROACH DEVELOP BEFORE THE PANDEMIC IN TRAINING?**

As stated by López Cerezo, the STS approach arose at the end of the sixties in Scotland and the United States, as an academic reflection that sought to understand the social context of post-war science and technology and its socio-environmental impacts. And as he identifies it, it is at the ``Universidad de Edinburgh``, where a program began “whose fundamental interest

was the study of the genesis, elaboration and acceptance of scientific beliefs; its articulation and evolution” (1998). This approach, from its beginning, emphasizes the links of Science and Technology with Society, where the role of that Technology is more subsidiary than protagonist, from an integrating perspective. Thus, the teaching of science focuses on the contextualization of social problems that allow science to be humanized for those who learn from the philosophical contributions of (Aikenhead, 2003; Lawrence et al., 2001).

In similar periods, North American universities focused their gaze more on the effects of developments in science and technology on economic production and consequently on social progress. That movement known as STEM puts its strength more in the relationships that exist between the disciplines that make up its acronym (science, technology, engineering, mathematics). Many researchers consider it as an evolution of the CTS, although it is debated about it. I do not want to enter into that controversy today, I just want to mention it because from both perspectives, they tried to formulate science and technology policies as a way of promoting scientific and technological research that would allow the Latin American region to raise its level of economic development. This was supported by international organizations such as OAS, UNESCO and ECLAC, among others.

In Latin America, therefore, since the end of the last century, a strong movement arose for the development of science and technology policies, which would allow a greater number of scientific vocations in our nations. It could be said that he started the work within the academic community to intervene, in the different fields of knowledge, in the origin and nature of that knowledge and the linking of the products of science with society; who benefits, directly or indirectly. The STS

approach permeated the different levels of the educational systems of our countries and began a movement for research within universities, which echoed these ideas.

The STS movement, like STEM later, began as the need to improve curricula to explore the possibilities of science and technology in an interdisciplinary way and understand how they affect culture, values and modern institutions on the one hand and, on the other, another, how values and culture influence Science and Technology. As Mansour (2009) points out, a limitation for this development were the beliefs and practices of science and technology teachers; A whole topic that we could talk about but it is not the focus of today, but to comment on it, because they did something or not to see the results in a pandemic.

### **CTS FOR TEACHER TRAINING?**

Uncertain times demand other mentalities, not only to assume the present conditions but also to generate alternatives for the search for innovative solutions that allow finding ways of transformation, in this sense, since the WHO in March 2020 declared the COVID-19 Pandemic. 19, the educational institutions of the countries quickly had to make decisions in accordance with fundamental rights and give continuity to training at all levels and educational processes. This time not only revealed huge social, technological, political and human gaps, but also offered opportunities to build other ways of seeing and assuming reality, especially in terms of teacher training.

From Unesco (2020), it is stated that “around 63 million primary and secondary teachers worldwide are affected by the closure of schools in 165 countries due to the Covid-19 pandemic” (p.1) However, given the impacts, they were also opportunities for teachers who were not familiar with information and communication technologies to open up a

world of possibilities to approach the new generations and make transformations and adaptations to their classes in their day to day. day both in the curricular, the pedagogical and the evaluation.

In terms of the curricular, it became necessary to “promote disruptive innovation of curricular structures and practices” Díaz-Barriga and Argón Tirado (2020), in terms of whether the important thing was to continue with the established contents, distancing students from their most immediate realities.

This way, the opportunity was given in terms of CTSA education to dialogue with various disciplines and create interdisciplinary projects that gave meaning to participation with other students and teachers in various places in favor of meaningful learning.

In such a way that the projects of the academic space “Training of teachers in education CTSA”, of the Physics Department of ` ` Universidad Pedagógica Nacional de Colombia` `, focused on achieving transformations in the ways of proceeding of the human being on nature in times of pandemic, in terms of not seeing himself as an intervening subject but as someone who must make a turn from instrumental rationality and position himself in an ecological rationality integrating the Sustainable Development Goals and the 2030 Goals.

Table 1 presents a summary of the projects, their intentions and scope that made it possible to make sense of the curricular in times of the pandemic.

This experience provided opportunities for teachers not only to make reflective processes about their pedagogical practices, but also to modify the linear view of the subject contents and open spaces for dialogue and support and social participation among colleagues and even communities.

The evaluation also took on another meaning, since it allowed it to be extended to

community work where the practical aspects and the integration of knowledge take on another meaning “since it makes it possible to rethink the way in which the knowledge of the students is developed and appropriated, when shared not only with the classmates but with other members of the educational community that has normally been unrelated to the development of the curriculum” expresses one of the teachers.

## **DEVELOPMENT IN DIGITAL SKILLS SHOWN WITH THE PANDEMIC**

What is related to didactics proved to be the limitation of all the initiatives that were developed on STS education in Latin America, and that mobilized both educational, political and economic interests.

After those reflections on what was sought to teach and learn, let's see what the pandemic showed us. He confronted the universities to implement “distance” teaching-learning processes, using ICT as fundamental tools to achieve it.

Many Ibero-American universities had developed platforms that already had their online courses; just as the teachers were prepared to face the challenge of virtuality. However, many others had not developed these mechanisms in their academic structures. Or his faculty was not prepared to face such a condition.

In the Colombian experience, for teachers it was significant for making changes and it gave them relevance given that the difficulties and tensions derived from the pandemic are evident in the documents that circulate. However, the bets for change are also evident when integrating views are evident, where the teaching of science and technology find meaning when they dialogue with the needs and interests of the entire educational community. It is clear that collective and

Project	Goal	Ranges
Student Environmental Memory for Climate Action	Consolidate a space for the dissemination and enrichment of educational environmental experiences with a view to contributing to the materialization of the sustainable development goals - climate action in three educational institutions. Consolidate a space for the dissemination and enrichment of educational environmental experiences with a view to contributing to the materialization of the sustainable development goals - climate action in three educational institutions.	Contrast the importance of technologies and their influence in today's society, which allows us to understand that the role of this project is coherent with the current context, and more so in times of pandemic, because although sometimes we cannot go hiking in some wetland, we will be able to resort to images and contexts of our city, taken first-hand by other fellow teachers, which will enrich the experience of our students in one way or another. So this space cannot be seen from the perspective of being a place where information is agglomerated, rather it is a space where interaction between institutions is possible, which favors the transformation of environmental projects.
Transgenic corn in Colombia. Myths or Realities of food in times of pandemic?	Carry out a descriptive analysis on the use of transgenic corn seeds in order for students to reflect on sustainable development in Colombia, facilitating critical thinking in times of confinement.	<p>The impact of science on the daily life of children in times of pandemic leads to awareness and understanding of the problems faced by communities with the use of transgenic corn associated with techno-scientific developments. Therefore, it is necessary to promote and generate spaces for reflection, analysis and communication about what is thought and how to act against these problems.</p> <p>In addition, presenting problems close to the reality of the students allows interest to be generated and learning to be applicable in understanding the world and the different ways in which we behave within a society around identifying the developments that have taken place. given with the use of transgenic corn seeds and its implications at the community level.</p>
Design of an ecological trail as a pedagogical strategy for the recognition and conservation of the natural heritage of a wetland from a comprehensive perspective in times of confinement	<p>Propose the design of an environmental interpretative ecological trail as a pedagogical tool for the recognition and conservation of the natural heritage of a wetland.</p> <p>Using the school farm is a space for the convergence of experiences, which makes possible the divergence of knowledge.</p>	<p>It is necessary to approach from different perspectives, including digital technologies, axes of recovery of cultural and historical heritage, as a didactic and interdisciplinary resource to promote environmental education and recreation in the natural environment, to awaken sensations and perceptions of students and visitors. based on knowledge of the territory.</p> <p>Promote the principles of solidarity, integration, economic and above all sustainability, where it is intended to benefit the educational community directly, students and their families and connected from ICT for the exchange of knowledge.</p>

Table 1

interdisciplinary work helps to close gaps and promote changes in educational dynamics, turning the views from the deficiencies that have characterized the reports and reports in these times of pandemic.

From `` universidad de las islas baleares ``, Vásquez and Manassero (2021) tell us that “in the Spanish university system and throughout the European Higher Education Area, the study plans are based on their approved reports and from them They prepare the teaching guides that are a contract that teachers and students must comply with. The most problematic aspect has not been the adaptation of teaching, but the adaptation of the evaluation of student learning. In the case of teachers, the first challenge was to modify the teaching guides of the subjects to online teaching.” What is relevant now will be to change educational paradigms and train professionals with a more practical education aimed at understanding our world with the aim of providing solutions to the problems and needs of social, political, economic and environmental life (Álvarez, 2020). Without losing focus CTS that establishes relationships between these areas to get ahead.

The CTS approaches of the past decade in training, from classroom settings, demonstrated the use of digital technologies, with positive results during the pandemic so that educational systems did not stop working and educational media did not collapse. This could be verified with another exercise carried out during the pandemic for the training of digital skills for Latin American basic education teachers, as an initiative of the COMPEDIGI course of the Interconecta-AECID project carried out by the UNED-CAB-OEI. This course allows us to understand on a small scale how the development of science is linked through the tool of technology for the benefit of society and its impact on the formation of citizens.

This study indicates that despite the fact that there are few investigations carried out on this subject, the definition of digital competences is diverse and that “*studies on the concept of CD (digital skills) such as those of the OECD (2003), Unesco (2006) and the European Commission (2012), in general, which also began to define a list of digital skills for the profile of subject users of these technologies, linked to an international context, but it is mostly European. What remains true is that according to UNESCO reports (2006), digital competence is one of the eight essential competences for development throughout life. Therefore, it is listed alongside other essential skills such as literacy, multilingualism, math skills, science, technology and engineering, social skills such as “learning to learn”, citizenship, entrepreneurship and sensitivity skills and cultural expressions.*”(Montesano, M et al, 2023). It means, then, that the conceptual definition of digital competences must be deepened in order to move forward.

## **CONCLUSIONS: DID WE DO IT RIGHT?**

The truth is that what was proposed by the CTS approach for the production and validation of knowledge by the learner from a “laboratory” or practice center, became possible on the computers of each learner. The currents of these ideas, from the seventies of Knorr and Cetina (1981) who argued that the construction of scientific knowledge does not differ much from the way other workplaces work, where productive activity is structured and controlled with the assignment of tasks to divide the work and direct it to different audiences; could be verified with virtual teaching. In the same way that the digital skills that the teachers or students had achieved in their courses could be verified.

Varasavsky’s proposals on technological styles, Katz’s works regarding technological

change affected by the economy, and Sábato's CTS relationships in the development dynamics, were revealed during the pandemic. We could address the question of Kreimer (2007) "whether questioning the role that science and technology play in our countries weakens or strengthens them." Ask ourselves again, what did the pandemic show about the strengthening of the development of those relations between S&T promoted from the academic environment, if the pandemic generated the channels so that the strengthening of the role of knowledge is based on a greater democratization, and leaves the "circles of initiates" (whether they are from the social sciences or from the exact and natural sciences) to question society as a whole, showing that it is a cultural practice that could be mobilized to address vast social problems."

An element that can support processes to improve the social perception of science and thus capture those interested in developing a scientific culture among citizens; because in these centers the professionals who respond to the demands of scientific research required by social needs in general are trained, such as the recent COVID-19 pandemic that has required all human knowledge to begin to alleviate the health crisis that afflicted To the whole world. With this, the challenges related to the computer resources necessary to join distance education were presented, especially in training in experimental sciences; where trial and error and the models that represent the phenomena to be studied are basic. In this regard, the curricular designs of the training

faced specific challenges that were surely seen in flipped classes and in the complementarity of synchronous and asynchronous classes, which they were not able to fully resolve. The future for the appropriate use of ICT in distance or face-to-face training, or in the development of concepts and scientific skills, is an urgent need that must be met by current university trainers.

The pandemic has made it clear that we are reflecting on the role of science and technology in our lives; It has shown that the teachings and the modified curricula must continue to develop that sense of STS, but also that we have developed digital skills such as creating presentations, designing infographics, editing images, working in distant teams, developing wiki projects, connecting as now and crossing geographical borders. to be together, manage virtual classrooms, record, edit, etc., etc. etc

In other words, we have also learned and taught to better search for and filter the amount of existing information, to extrapolate ideas about what we thought we knew or learned, to apply that knowledge and create new ones, and even have the ability to innovate. These are digital skills that show us something we didn't think we had: a good relationship between a product of scientific research and innovation such as ICT and its derivatives. And I leave you for your own reflections on the CTS relationships, appropriate with IT, to which the pandemic has subjected us to virtuality.

The answer could be: we have done well in some parts, not so well in others, but I think that overall it can be said that as a society we are making progress.



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