# SECONDARY VOCATIONAL EDUCATION BASED ON SCIENCE, TECHNOLOGY, AND SOCIETY, ALLIED TO TECHNOLOGY PARKS


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## Abstract

This article examines the benefits of Secondary Vocational Education (SVE) being based on the Science, Technology, and Society (STS) movement allied with Technology Parks (PqTs). Based on theoretical research, the study methodology used a qualitative, exploratory and descriptive approach. The results indicate that the STS and entrepreneurial education in the PqTs aim at the socio-economic development of the region where they are located and are recognized as elements that stimulate transformations culturally, socially, economically and in the SVE.



**Keywords**: STS. Secondary vocational education. Technology parks.


## 1. Introduction

Technology Parks (PqTs) contribute to economic, social, and cultural transformation, promote science, technology, and innovation, that is, they are environments that stimulate close links with knowledge centers and enable companies to transform research into a product.

As a result, these enterprises influence Secondary Vocational Education (SVE) and, in the same vein, the educational model proposed by the Science, Technology, and Society (STS) movement. This movement presents a way to create a new proposal for technical education and encourage the incorporation of its principles into the technical-vocational curriculum, enabling a new construction of knowledge, linked to a proposal for entrepreneurial education.

As a result, and based on the principles of the STS approach, this article investigates actions directed to SVE that are geared towards the community around the PqTs, so that they are regarded as a reference to be used in the tactical analysis of educational processes.

Nowadays, knowledge has become the basis for innovation processes and a valuable asset for income generation, due to the added value that it can impress on products and production processes (DAVENPORT; PRUSAK, 1998; DRUCKER, 1999; NONAKA; TAKEUCHI, 2008; SVEIBY, 1998).

**Knowledge has become the basis for innovation processes**

Thus, the search for knowledge has promoted crucial benefits for efficiency and competence in different tasks, presenting itself as a fundamental element for society, as it is at the center of innovation actions, creating benefits for citizens. And so, vocational education has the great challenge of preparing individuals to act in the context of the so-called Knowledge Age, which demands better-prepared people able to deal with rapid technological change.

In Brazil, the National Curriculum Guidelines for Secondary Vocational Education, known as NCGs, define the aspects regarding the structure and organization required for the implementation of vocational education in public and private institutions.

These guidelines propose technical education in line with the professionalization itineraries of the work world. In its framework are the principles of the proposal for a vocational education that is in line with the need to prepare professionals who can see, understand, and participate in both the social environment and the productive sector.

In vocational education, the NCGs are the rules that guide the process of training individuals, coming from a qualitative view, to face contemporary challenges. However, there is an imbalance in Brazilian education that has created inequalities. In this environment, vocational education is a strategy for technical and technological development, but also the mitigation of social disparities, assuming economic development as a fundamental element to placate extreme inequality (MAUÉS; GOMES; MENDONÇA, 2008).

It is in this context that the present work puts forward a proposal to strengthen SVE by adhering to the culture of the STS movement, which aligns with entrepreneurial education, in interface with the dynamics of a scientific and technological organization developed in the PqTs.

Technology Parks help entrepreneurs and attract attitudes that promote the insertion of innovative thinking in the surrounding regions, solidifying the use of scientific knowledge in the social context, within the STS approach of teaching with the purpose to bring the development of scientific literacy to education environments.

**Vocational education is a strategy for technical and technological development**

In other words, students could develop their capacity for research in the PqTs environment, which offers conditions to train individuals that are more competent and equipped for professional and civic life.

Therefore, this study seeks to bring subsidies from a fresh look at SVE, aligned with the approach proposed by STS teaching and entrepreneurial education, with the PqTs as a stimulating element. The methodology used was a qualitative, exploratory, and descriptive approach, based on theoretical research.

The justification for the development of this subject is the fact that school education cannot be certified assimilation of knowledge that trains people to use technology, because the school needs to form individuals that are aware, who can face the complexity and challenges of contemporary life. Therefore, it is necessary to educate conscientious citizens to analyze information and social and technological changes, so that they can deal with innovations and the successive transformations of knowledge in all areas (KENSKI, 2007).

The STS movement demands different attitudes towards teaching, learning, and issues involving technology and human development, with the incorporation of a cognitive process appropriate to the development of entrepreneurial education in secondary education, promoting SVE around the PqTs.

Hence the importance of vocational education correlating actions and endeavors aimed at economic development, with the possibility of building and rebuilding knowledge, as society needs to enable its citizens to work in a globalized world.

Thus, following the problem stated herein, this article aims to address the STS based on SVE developed in PqTs.

## 2. The STS approach

Globally, curricula with an emphasis on Science, Technology, and Society (STS) have emerged in the 1960s as a way of preparing students for citizenship, aiming to provide an approach to scientific content in a social context (AULER; BAZZO, 2001; SANTOS; MORTIMER, 2002).

In the academic field, the emergence of the STS movement reflected the need to have a broader understanding of the role of science and technology in society. According to Aikenhead (2005), it was from a historical coincidence that, in the period between the late 1970s and early 1980s, the phrase "Science, Technology, and Society" was most pronounced in various places, while a broad consensus was built between educators about the need for innovation in the process of science education.

Classical science teaching, which rose after World War II, tended to reduce practical knowledge to something manipulable (CACHAPUZ, 1999), that is, science teaching rested on a series of distorted views of scientific activity and placed science as non-theoretical and empirical, a rigid view of the scientific method, with knowledge management based on a purely analytical, cumulative and linear approach, considering the production of knowledge as an individualist, elitist, decontextualized and socially neutral process (TEDESCO, 2009).

With a critical difference regarding the traditional essentialist view of science and technology, STS studies have enabled a heterogeneous work environment, with an interdisciplinary nature, since it deals with disciplines that discuss the sociology of scientific knowledge, education theory, history of science and technology, among other approaches. Thus, these studies also embrace the social perspective of science and technology, considering their predecessors and even their environmental consequences (GARCÍA PALACIOS *et al*., 2003).

Emphasizing the innovative aspect of this new culture, Garcia Palacios et al. (2003) state the need to understand the relationship between science and technology not as an autonomous activity, but with an internal logic of development resulting from a cognitive method and a code of conduct. In fact, this relationship is a social process or product, in which moral values, professional interests, economic pressures, and other elements, neither purely epistemic nor technical, are decisive in the origin and consolidation of scientific ideas and technological artifacts.

With the emergence of the STS proposal, it becomes clear that the structuring of the idea of convergence of the scientific and the technological world, while preserving the characteristics of each culture, built over the years, produces a new unit, known as technoscience. This concept operates in a much broader context than disciplinary academic science because it creates an inevitable opening with an interdisciplinary and even transdisciplinary nature (PRAIA; CACHAPUZ, 2005).

**Technoscience has brought changes in the way of interpreting the world**

With a daily presence in people's lives, technoscience has brought changes in the way of interpreting the world and the events that occur in it. Praia (2005) explains that, due to the peculiarity of current science, society is moving towards an increasingly technological universe, because today it is unwise to think about the construction of scientific knowledge outside the context of its vertiginous technological development.

This contact between science and technology produces such a bond that, when incorporating social issues, one can no longer perceive the possibility of separating them. Thus, due to this intertwining, Praia & Cachapuz (2005) highlight that epistemological, praxiological, and axiological relations between the binomials science and technology (S-T); science and society (S-S); and technology and society (T-S), when combined, are the STS trinomial.

From the outset, the development of STS studies and programs has gone in three major directions (GARCIA PALACIOS et al., 2003):

a) within the scope of research, the STS stands as an option for traditional academic thinking on science and technology, promoting a new view of scientific activity within a social context;

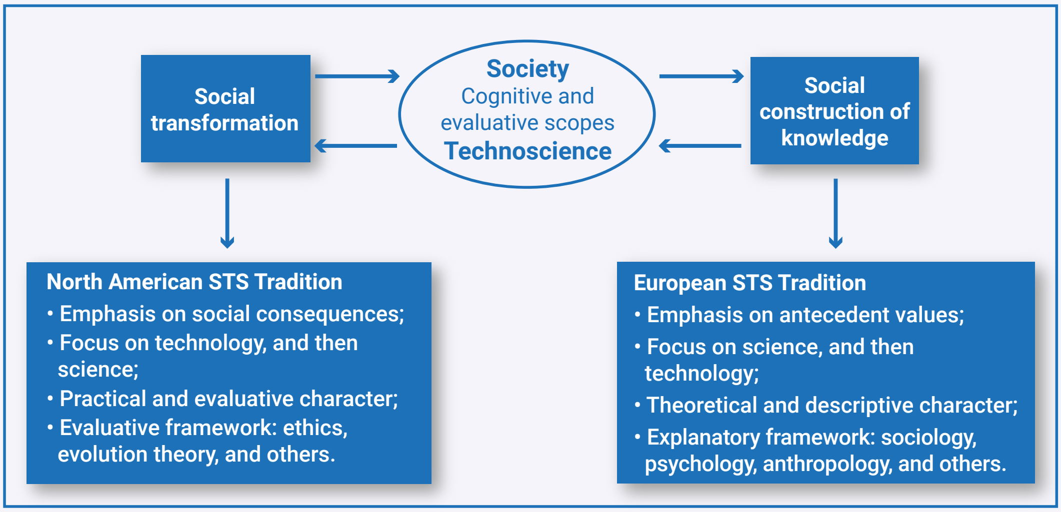
b) in the context of public policies, the STS studies defend the social regulation of science and technology, stimulating the development of democratic mechanisms that promote more openness to scientific and technological policies;

c) in the field of education, the new image advocated for science and technology in society has promoted the emergence of STS programs and study materials for secondary and university education in various countries.

Two lines of thought motivated this STS movement: the European and American traditions. They spread around the world, reaching Brazil, and enabled understanding within a social context, and systematic thinking of new approaches to science and technology, with more realistic objectives in education, given the new problems posed by technological development (BAZZO, 2014).

According to Figure 1 below, the American tradition is more focused on the study of the social and environmental consequences of science and technology, while the European one is more focused on analyzing how a variety of social factors influence scientific-technological changes (GONZÁLEZ GARCÍA; LÓPEZ CEREZO; LUJÁN, 1996 *apud* GARCIA PALACIOS et al., 2001). That is, there is a view of STS studies with a more practical, applied, and evaluative perspective; and a more theoretical and descriptive one.

**Figure 1 - American x European Tradition**




Source: Adapted from Bazzo & Bazzo (2014).

Both traditions have different approaches, although they have a common assumption, which is to establish an academic reaction to the logical empiricism of the philosophy of science, converging on the STS studies that have a critical social stance against scientism and technocracy (BAZZO, 1998).

> The European tradition started with the academic institutionalization in Europe; promoted emphasis on antecedent social factors; gave primary attention to science and secondarily to technology; it preferably assumed a theoretical and descriptive character; and its explanatory framework is the social sciences – sociology, psychology, anthropology. The American tradition started from the administrative and academic institutionalization in the United States; always emphasized the social consequences of science and technology; unlike the European tradition, it gave primary attention to technology and, secondarily, to science; practical and evaluative character is preferred in this tradition; and finally, its evaluative framework is related to ethics, education theory, among others (BAZZO, 1998, p. 221).

It should also be noted that this geographical classification of STS traditions uses an expository criterion since there are no intrinsic characteristics that require labeling by continent or any territorial space. Thus, this difference between them was only justified during the first two decades of STS studies (BAZZO, 1998).

Bazzo (2014) notes the contextualization that STS studies intend to undertake and seeks to converge both traditions since the links between science, technology, and society have analytical and heuristic uses that can serve as a foundation for didactic questions but do not at all offer a reliable picture of the multiplicity of the STS field, which is still in the process of evolution and transformation.

Table 1 presents the scope of the STS principles against the traditional conception.

**Table 1 - Comparison between conceptions of science and technology**

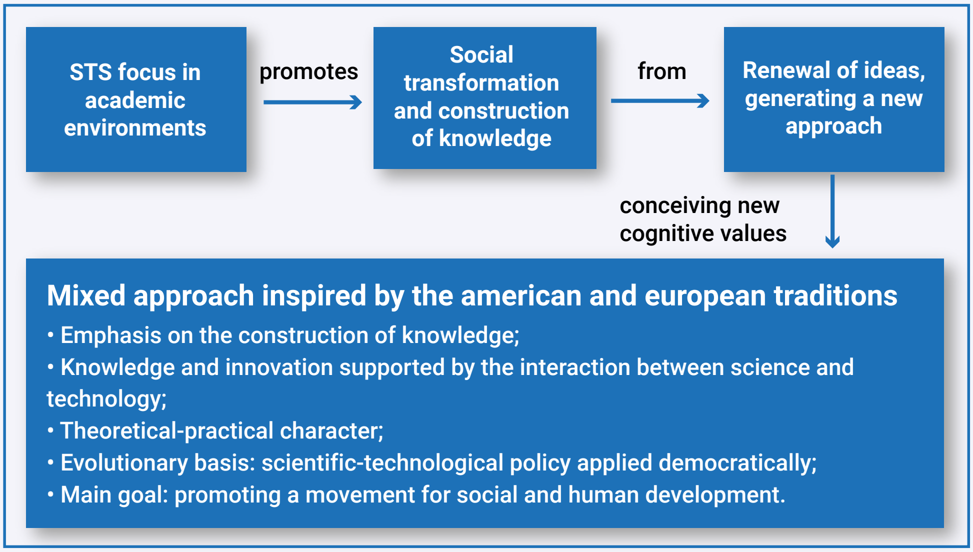
| **Inherited Conception** | **STS Conception (American or European Tradition)** |
| --- | --- |
| Science is the knowledge that reveals reality. | Scientific-technological development is a social process like any other. |
| Science is objective and neutral. There are no subjective factors or interests in its contents. | Scientific-technological changes have important impacts on social life. |
| The history of science consists of accumulating objective knowledge around extreme situations. | We share a democratic commitment. |
| Technology is the practical application of scientific knowledge. | There must be assessments and social control of scientific-technological developments. |

Source: Gordillo (2001) *apud* Pinheiro (2005).

Given the convergence of the lines that work with the concepts originated in the traditions that underpin the STS approach, a new way of understanding the scientific-technological world provides the generation of new trends, which guide the research on the study of the influence of science and technology on society and politics.

Therefore, the relationship between science, technology, and society must broaden horizons and be composed of a natural process of evolution and transformation of society, as presented in Figure 2, which presents a new proposal based on knowledge, and innovation.

**Figure 2- Proposal for an original approach**




Source: The authors.

The proposed approach for STS in the academic environment defends guiding characteristics that, synthetically, provide an image to be developed, whose elaboration meets the objective of analyzing the epistemological issues regarding the links between Science, Technology, and Society in the academic environment, with a special focus on Secondary Vocational Education.

In this sense, according to Silveira (2007), this approach goes beyond a mere academic exercise, or a fad, because it offers an environment in which scientific-technological policies can be applied democratically in educational spaces, with the perspective of promoting a movement for social and human development. However, the effective renewal in this context must overcome obstacles arising from certain entrenched conceptions and interests in the perpetuation of these ideas (SILVEIRA, 2007).

## 3. The link between PqTs, SVE, and STS

Technology Parks emerged during the 1950s in Stanford, California. In its genesis is an innovation because of the inherent mission of promoting intelligence, infrastructure, and services that are essential for the growth and development of knowledge and technology-intensive organizations (AMARAL, 2014; GIUGLIANI, 2011).

Built based on American models, the PqTs reached the Asian continent between the 1970s and 1980s, and the first venture was Tsukuba Science City in Japan (PHAN; SIEGEL; WRIGHT, 2005).

Likewise, Australia and Canada struggled to create their first ventures, which occurred in 1980. On the European continent, in the mid-1980s and throughout 1990, there was the advance of science and technology parks, including in Spain. That is, around 60% of the world's PqTs were created in a range of twenty years (ADÁN, 2012).

The progress of a region is measured by the promotion and enhancement of productive structures with the profile of a Technology Park (PqT). Thus, the focus of these ventures is on the creation, development, and consolidation of innovative environments that aim to foster economic, social and cultural transformation through innovation, stimulating entrepreneurship and the transfer of knowledge and technology (ASSOCIAÇÃO NACIONAL DE ENTIDADES PROMOTORAS DE EMPREENDIMENTOS INOVADORES, 2015).

The International Association of Science Parks and Areas of Innovation (IASP), which brings together PqTs and innovation environments worldwide, points out that organizations run by specialized professionals, both in physical and virtual spaces, have as their main scope to expand wealth of the surrounding community by providing high value-added services, fostering a culture of innovation and competitiveness among member companies and knowledge-based institutions (INTERNATIONAL ASSOCIATION OF SCIENCE PARKS AND AREAS OF INNOVATION, 2015).

The growth capacity of a PqTs and its member organizations is what drives the attraction of entrepreneurs, who seek to exchange tangible and intangible knowledge of human capital, as well as create alliances between those involved (PAZOS; BABIO, 2012).

The structure of a Technology Park endeavors to offer the proper conditions for an entrepreneurial culture to irradiate innovation. That is, ideas of innovative nature are edifying within the possibility of expanding and disseminating knowledge to stimulate the environment in the surrounding area, or even in the microregion where the PqTs are located.

In these environments, for the induction process in the surrounding areas to be adequate and efficient, the PqTs should consider in their mission to exercise actions that go beyond the incentive to entrepreneurship and innovation, also incorporating the idea of sustainability in its three dimensions: economic, environmental, and social. Influences from the outside environment enhance this aspect, which evokes social and political situations, leading to a healthy and positive interaction process within a sustainable economic development proposal.

To boost the development of a region, the common denominator among the projects with the profile of PqTs is the gathering of high technology products and services companies, in cooperation with educational institutions and the industry (AMARAL; SARTORI; CUNHA, 2013).

As a result, the actions of the Technology Park must be per the location and the region where it was implemented, so that it can guarantee the synergy between potentialities, competences, and needs, both of its organizations and the surrounding community.

Within this context, to share the knowledge produced within the PqT, it is necessary to know and enhance the surrounding reality, so that the community's wealth can be increased, highlighting the importance of promoting a culture of entrepreneurship and innovation in the area, with plans and actions aimed at encouraging the community. If these aspects are not considered, there is a risk that the park could become an "island of excellence", distancing itself from its social mission.

Therefore, PqTs circumscribe any venture that aims to implement a high-tech cluster, called "technopole", science park, science-technology park, science city, "cyber park", research and technology park, among others (ADÁN, 2012; UNESCO, 2015).

Different elements that integrate and cooperate to promote development are considered in the PqTs. Thus, to foster a knowledge-based economy centers for incubation, capacity-building and training, scientific research prospection, and development of technology is fundamental.

However, according to Buarque (2011), only education can turn Brazil into a center for generating knowledge capital, resulting in a more fair society due to the indiscriminate access to the instrument that will be able to improve the circumstances of those who apply themselves.

> The vectors for this revolution are based on: (a) education for all, with the highest quality until the end of high school, to ensure the same chances independent of social class; (b) ecological balance to build a sustainable development model that ensures the same chance between generations; and (c) the construction of a powerful scientific and technological system capable of making Brazil a center for the production and accumulation of knowledge capital (BUARQUE, 2011, p. 22).

From this perspective, the National Curriculum Guidelines for Secondary Vocational Education (NCGs), which regulate vocational education, present in their guiding principles the need for SVE to be structured by strategies that favor the integration between theory and the experience of professional practice in the context of the multiple dimensions of the technological axis of the course and the sciences and technologies, and should align with the socio-economic development and the productive arrangements of the region where it is taking place (CONSELHO NACIONAL DE EDUCAÇÃO, 2012).

Likewise, Cordão (2002) emphasizes, from his reflection on the National Educational Bases and Guidelines Law (BGL) and the new Vocational Education, that the technological revolution and the new approaches of work organizations ask for a new posture, demanding a participatory pedagogical project from schools. This project needs to meet the wishes of the agents involved (productive sector, market, society) and provide professionals with increasing doses of intellectual autonomy, increased thinking ability, initiative, critical thinking, and entrepreneurial spirit, as well as visualization and problem-solving skills.

Thus, there is a strong convergence of interests and needs from this sector, which are summarized in two premises:

a) vocational education needs to be reimagined to meet the dynamics of a globalized economy, committed to the sustainable use of technology, which implies social return. Vocational education needs to train professionals who can articulate the four pillars of education: learning to be, to do, to know, and to live together;

b) The productive environment, in this case, headed by the PqTs, lacks individuals that received a bolder education aligned with an entrepreneurial spirit, with the capacity and initiative to innovate, because it is from this profile that enterprises can advance and fulfill the objective of generating economic and social development in the surrounding region.

**Entrepreneurial education is natural and necessary within a model that provides sustainable, and innovation-oriented technological development**

This article suggests an STS approach to meet the needs presented herein, stimulating the incorporation of STS principles into the technical-vocational curriculum, enabling a new way to build knowledge, articulated within a view of entrepreneurial education. This proposal is linked to the reality experienced in the PqTs, where entrepreneurial education is natural and necessary within a model that provides sustainable, and innovation-oriented technological development.

## 4. Final considerations

The principles of the STS movement are essential to the curricula of technical and technological education courses, as they guide the student towards a questioning and critical stance, that is, conduct that goes far beyond school. However, this focus to be applied in the classroom requires investment in the initial and continuing education of vocational education teachers. Only in this way is it possible for one more step to be taken in the direction of a society that participated in the decision-making of scientific and technological matters.

By raising awareness of the relevance of the STS approach in the student's technical education, it is appropriate to elaborate a reflective exercise for the diffusion of a new proposal of technological education that considers the development of studies focused on science, technology, and society as a basic premise for the formation of future citizens.

STS education idealizes the dynamics of entrepreneurship and is an indispensable action that results in people who are more capable to create opportunities for action, innovation, and responsible and critical intervention in society, enabling the construction of new knowledge, opening new directions for its innovative character to emerge from personal or even collective initiatives.

The STS approach and entrepreneurial education encourage students' cognitive development, encompassing their thinking ability; creativity; focus and determination for problem-solving; among others. As the PqTs aim at the socio-economic development of the region in which they are settled, they are elements that stimulate cultural, social, and economic changes, and changes in SVE as well.

In this sense, from opportunities created by an environment of innovation such as the PqTs, well-qualified people who, in addition to technical competence, have a training developed to meet the requirements of a globalized economy, can better contribute to the development of the surrounding community.

**Those who have a critical and reflective background are better able to be part of a knowledge-based society**

Enterprises with this description, where the PqTs can foster an environment that builds citizens with the competence and ability to create, research, and have the initiative to innovate, demand people who favor innovative solutions, promoting sustainable economic and social development.

In this sense, those who have a critical and reflective background are better able to be part of a knowledge-based society, are more efficient at perceiving the interaction between science and technology, and cultural, social, and economic transformations.

It should be noted that all these ideas are in agreement with what is recommended by the NCGs for SVE when they state that technical-vocational education should be guided by work as an educational principle and research as a pedagogical principle. Thus, the STS teaching proposal converges and interacts between the various social actors: vocational education institutions, surrounding community (class entities, companies, government at its various levels, citizens) and technology parks.

In addition, the integration of factors that provide more interaction between SVE and social reality enables actions that generate innovative ideas and knowledge development, including job opportunities, the ability to undertake and develop innovative research, and the creation of new pedagogical projects.

## References

ADÁN, Carmen. El ABC de los parques científicos. **Seminarios de la Fundación Española de Reumatología**, [s. l.], v. 13, n. 3, p. 85-94, 2012. Disponível em: https://www.elsevier.es/es-revista-seminarios-fundacion-espanola-reumatologia-274-articulo-el-abc-los-parques-cientificos-S1577356612000267. Acesso em: 12 dez. 2019.

AIKENHEAD, Glen. Educación Ciencia-Tecnología-Sociedad (CTS): una buena idea como quiera que se le llame. **Educación Química**, [s. l.], v. 16, n. 2, p. 114-124, 2005. Disponível em: https://andoni.garritz.com/documentos/aikenhead_a_rose_by_any_other_name.pdf. Acesso em: 12 dez. 2019.

AMARAL, Roberto Rogério; SARTORI, Viviane; CUNHA, Cristiano José Castro de Almeida. Parques tecnológicos: a sinergia da hélice tríplice pela visão autopoiética. *In*: CONGRESSO INTERNACIONAL DE CONHECIMENTO E INOVAÇÃO, 3., 2013, Porto Alegre. **Anais** [...]. Porto Alegre: Universidade Federal de Santa Catarina, 2013. v. 3. p. 20-33.

AMARAL, Roberto Rogério do. **A arquitetura da liderança nos parques científicos e tecnológicos da Catalunha**: uma abordagem estratégica. 2014. Tese (Doutorado) – Programa de Pós-Graduação em Engenharia e Gestão do Conhecimento, Universidade Federal de Santa Catarina, Florianópolis, 2014. Disponível em: https://repositorio.ufsc.br/xmlui/bitstream/handle/123456789/128838/331652.pdf?sequence=1&isAllowed=y. Acesso em: 12 dez. 2019.

ASSOCIAÇÃO NACIONAL DE ENTIDADES PROMOTORAS DE EMPREENDIMENTOS INOVADORES (Brasil). **Ambientes de inovação**. [S. l.]: Anprotec, 2015. Disponível em: http://anprotec.org.br/site/sobre/incubadoras-e-parques/. Acesso em: 12 dez. 2019.
AULER, Décio; BAZZO, Walter Antonio. Reflexões para a implementação do movimento CTS no contexto educacional brasileiro. **Ciência & Educação (Bauru)**, Bauru, v. 7, n. 1, p. 1-13, 2001. Disponível em: http://www.scielo.br/pdf/ciedu/v7n1/01.pdf. Acesso em: 12 dez. 2019.

BAZZO, Walter Antonio. **Ciência, tecnologia e sociedade**: e o contexto da educação tecnológica. Florianópolis: Editora da UFSC, 1998.

BAZZO, Walter Antonio; BAZZO, Jilvania Lima dos Santos; PEREIRA, Luiz Teixeira do Vale. **Conversando sobre educação tecnológica**. Florianópolis: Editora da UFSC, 2014.

BAZZO, Walter Antonio. **Ciência, tecnologia e sociedade**: e o contexto da educação tecnológica. 4. ed. rev. Florianópolis: Editora da UFSC, 2014.

BUARQUE, Cristovam. **A revolução republicana na educação**: ensino de qualidade para todos. São Paulo: Editora Moderna, 2011.

CACHAPUZ, Antônio Francisco. Epistemologia e ensino das ciências no pós-mudança conceptual: análise de um percurso de pesquisa. *In*: ENCONTRO NACIONAL DE PESQUISA EM EDUCAÇÃO EM CIÊNCIAS, 2., 1999, [Valinhos]. **Atas do II Encontro Nacional de Pesquisa em Educação em Ciências**. Porto Alegre: UFRGS, 1999. Disponível em: http://fep.if.usp.br/~profis/arquivos/iienpec/Dados/trabalhos/A02.pdf. Acesso em: 12 dez. 2019.

CONSELHO NACIONAL DE EDUCAÇÃO (Brasil). Câmara Básica de Educação. **Resolução n. 6, de 20 de setembro de 2012**. Define Diretrizes Curriculares Nacionais para a Educação Profissional Técnica de Nível Médio. Brasília, DF: Ministério da Educação, 2012. Disponível em: http://portal.mec.gov.br/index.php?option=com_docman&view=download&alias=11663-rceb006-12-pdf&category_slug=setembro-2012-pdf&Itemid=30192. Acesso em: 12 dez. 2019.

CORDÃO, Francisco Aparecido. A LDB e a nova educação profissional. **Boletim Técnico do Senac**. Rio de Janeiro, v. 28, n. 1, p. 11-23, 2002. Disponível em: http://www.bts.senac.br/index.php/bts/article/view/546. Acesso em: 12 dez. 2019.

DAVENPORT, Thomas H.; PRUSAK, Laurence. **Conhecimento empresarial**: como as organizações gerenciam o seu capital intelectual. Rio de Janeiro: Campus, 1998.

DRUCKER, Peter. **Desafios gerenciais para o século XXI**. São Paulo: Pioneira, 1999.

GARCÍA PALACIOS, E. M. *et al*. **Introdução aos estudos CTS (Ciência, Tecnologia e Sociedade)**. [S. l.]: Organização dos Estados Ibero-americanos para a Educação a Ciência e a Cultura, 2003. Disponível em: bit.ly/2tcw2kK. Acesso em: 12 dez. 2019.

GIUGLIANI, Eduardo. **Modelo de governança para parques científicos e tecnológicos no Brasil**. 2011. Tese (Doutorado em Engenharia e Gestão do Conhecimento) – Programa de Pós-Graduação em Engenharia e Gestão do Conhecimento, Universidade Federal de Santa Catarina, Florianópolis, 2011. Disponível em: https://repositorio.ufsc.br/handle/123456789/95512. Acesso em: 12 dez. 2019.

GONZÁLEZ GARCÍA, Marta I.; LÓPEZ CEREZO, José A.; LUJÁN LÓPEZ, José L. **Ciencia, tecnología y sociedad**: una introducción al estudio social de la ciencia y la tecnología. Madrid: Technos, 1996.

GORDILLO, Mariano Martín *et al*. **Ciencia, tecnología y sociedad**. Madrid: Grupo Editorial Norte, 2001.

INTERNATIONAL ASSOCIATION OF SCIENCE PARKS AND AREAS OF INNOVATION. 2015. Disponível em: http://www.iasp.ws/home. Acesso em: 12 dez. 2019.

KENSKI, Vani Moreira. **Educação e tecnologias**: o novo ritmo da informação. Campinas, SP: Editora Papirus, 2007.

MARCONI, Marina de Andrade; LAKATOS, Eva Maria. **Fundamentos de metodologia científica**. São Paulo: Atlas, 2003.

MAUÉS, Olgaíses Cabral; GOMES, Elenilce; MENDONÇA, Fernanda Lopes. Políticas para a educação profissional média nos anos 1997-2007. **Trabalho & Educação**, [Belo Horizonte], v. 17, n. 1, 2008. Disponível em: https://periodicos.ufmg.br/index.php/trabedu/article/view/8571/6086. Acesso em: 12 dez. 2019.

NONAKA, Ikujiro; TAKEUCHI, Hirotaka. **Gestão do Conhecimento**. Porto Alegre: Bookman, 2008.

PAZOS, David Rodeiro; BABIO, Nuria Calvo. El rol de los parques científico-tecnológicos en el emprendimiento universitario: propuesta de un catálogo de indicadores de evaluación. **GCG**: revista de globalización, competitividad & gobernabilidad, [s. l.], v. 6, n. 2, p. 95, maio/ago. 2012. Disponível em: https://gcg.universia.net/article/view/430/rol-parques-cientifico-tecnologicos-emprendimiento-universitario-propuesta-catalogo-indicadores-evaluacion-. Acesso em: 12 dez. 2019.

PHAN, Phillip H.; SIEGEL, Donald S.; WRIGHT, Mike. Science parks and incubators: observations, synthesis and future research. **Journal of Business Venturing**, [s. l.], v. 20, n. 2, p. 165-182, 2005. Disponível em: https://www.sciencedirect.com/science/article/abs/pii/S0883902603001204. Acesso em: 12 dez. 2019.

PRAIA, João; CACHAPUZ, António. Ciência-Tecnologia-Sociedade: um compromisso ético. **Revista Iberoamericana de Ciencia Tecnología y Sociedad**, [Buenos Aires], v. 2, n. 6, p. 173-194, 2005. Disponível em: http://www.revistacts.net/files/Volumen%202%20-%20N%C3%BAmero%206/doss07.pdf. Acesso em: 12 dez. 2019.

SANTOS, Wildson Luiz Pereira dos; MORTIMER, Eduardo Fleury. Uma análise de pressupostos teóricos da abordagem C-T-S (Ciência – Tecnologia – Sociedade) no contexto da educação brasileira. **ENSAIO**: Pesquisa em Educação em Ciências, Belo Horizonte, v. 2, n. 2. p. 110-135, jul./dez. 2002. Disponível em: http://www.scielo.br/pdf/epec/v2n2/1983-2117-epec-2-02-00110.pdf. Acesso em: 12 dez. 2019.

SILVEIRA, Rosemari Monteiro Castilho Foggiatto. **Inovação tecnológica na visão dos gestores e empreendedores de incubadoras de empresas de base tecnológica do Paraná (IEBT-PR)**: desafios e perspectivas para a educação tecnológica. 2007. Tese (Doutorado em Educação Científica e Tecnológica) – Universidade Federal de Santa Catarina, Santa Catarina, 2007. Disponível em: https://repositorio.ufsc.br/handle/123456789/89600. Acesso em: 12 dez. 2019.

SVEIBY, Karl Erik. **A nova riqueza das organizações**: gerenciando e avaliando patrimônios do conhecimento. Rio de Janeiro: Campus, 1998.

TEDESCO, Juan Carlos. Prioridad a la enseñanza de las ciencias: una decisión política. [s. l.]: OEI, 2009. p. 11-20. (**Cuadernos Iberoamerica**, 3). Disponível em: https://www.oei.es/historico/cienciayuniversidad/spip.php?article3558. Acesso em: 12 dez. 2019.

UNESCO. **Programa en Pro de la Ciencia**: marco general de acción. Budapest: [s. n.], 1999. Texto Disponível em: http://www.unesco.org/science/wcs/esp/marco_accion_s.htm. Acesso em: 12 dez. 2019.