University-industry relationship: A dual degree model in the light of the German Practice Integration Program

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ABSTRACT

To fill the gap between the teaching-learning process and the business world, academia-industry collaboration is a different strategy in developing innovative learning models. It is a model that allows for joint work, coordinating initiatives to mutually boost innovation, offer opportunities to go from concept to action, encourage entrepreneurship and improve hard and soft skills. In this sense, and aiming at learning based on cooperation, the present study addresses the collaboration between a Professional and Technological Education institution in Brazil and an industry in the metallurgy area that acted in co-creation for the implementation of a higher technology course, following the assumptions highlighted in the conceptual framework for representing knowledge about the dual degree model. The article describes cooperative education and its goals, objectives, and benefits, as well as presents the application of the capabilities define and implement gifts of the proposed dual degree model.

Keywords: Professional Education, Cooperation, Dual degree, Innovation.

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INTRODUCTION

The close cooperation between university and business, allowing work and study to be related, is the synthesis of the *dual model* (Maier *et al*., 2019; Parlow; Rochter, 2015; Zhang; Schmidt-Hertha, 2019). It is a widely discussed, researched, and recognized model for integrating theory and practice, with a focus on solving real problems (Ertl, 2020; Jacques; Langmann, 2016; Odeh *et al*., 2017; Pavlicevic *et al.*, 2015)tag.

When it comes to higher education, the literature points to the dual study programme called the 'VET (Vocational Education and Training) integration model' and the 'practice integration model', both of which are the most significant in Germany. The first links a complete vocational training qualification and higher education, in a grouped way. The second focuses on programs that include phases of practical work in the company during higher education studies, without contemplating vocational training (Graf, 2018; Jacques; Langmann, 2016; Wolter; Kerst, 2015a). The two programs offer very different educational pathways, as well as a very different teaching model and modes of governance (Ertl, 2020).

According to Canto's (2022; 2023) scoping review, in the dual degree programs offered at the University of Applied Sciences (UAS) students obtain theoretical and scientific knowledge for practical application, with programs corresponding to 59% of the dual study models in Germany, while at the *University of Cooperative Education* (UAS) - UCE) the focus is on educating to support organizations and companies with academic knowledge, aligned with the business context and for technical decisions oriented to the labor market (Hofmann; Sachse; Smettan, 2019). The ECUs represent 20% of the universities with a *dual program* implemented and are followed by the Vocational Academies with 15% and the Universities with 6% (Graf, 2018), with 2/3 (1,228) of the institutions being public and 1/3 (364) private (Barbosa, 2019).

The focus of cooperation of the German model of *dual* study, observing the legislation in force in Brazil, hovers over the Institutions of Professional and Technological Education (EFA). EFA is a modality based on Decree 5,154/2004, which revoked Decree 2,208/97 in its Article 9, whose main objective is training for access to the labor market, both for students and professionals who need to expand their qualifications (Pereira; Bauer, 2020).

In higher education in Brazil, linked to EFA, a modality with full adherence to the implementation of the dual graduation model, there are no records of execution. Secondly, in Brazil there is no instrument to guide the potential application of the *dual* model, leaving the guidelines and referrals to the German-Brazilian Chamber of Industry and Commerce (AHK) and the German Agency for International Cooperation (GIZ).

Thus, the objective of this article is to present, in a synthetic way, the application of the constitutive elements that represent the knowledge of the dual graduation model reported in the *conceptual framework* proposed by Canto (2022).

LITERATURE REVIEW

Professional Education began in Brazil with Decree No. 7,566 of September 23, 1909. Until 1940 there was no single educational legislation for the entire country, and each state of the federation organized education (Fonseca, 1961). Between 1942 and 1946, Organic Laws were enacted, which constituted a set of six Decree-Laws for the reform of primary, secondary, industrial, commercial, normal and agricultural education. The Organic Laws, although they had the objective of offering professionalization to those who needed to quickly enter the labor market, did not achieve their objectives, because the middle classes were not interested in vocational education, remaining in propaedeutic secondary education, with access to higher education (Ghiraldelli Jr., 2008).

In view of this, and in need of manpower for the basic industry that was beginning to grow, in 1942, through Decree-Law No. 4,048, the government created the National Service for Industrial Learning (SENAI), a system of vocational education in partnership with industries and in parallel with the public network, offering a salary to study and start training in companies. With the same objective of professionalization, more linked to the interests and needs of entrepreneurs, in 1946 the National Service for Commercial Learning (SENAC) was created, through Decree-Law No. 8,621 (Ghiraldelli Jr., 2008).

With the problem of worker training still ongoing, the Federal Government approved in December 1996 the Law of Guidelines and Bases of Education (LDB), Law No. 9,394, in which secondary education was separated from technical and professional education. In Article 22, Chapter III, Title V of the LDB, Professional Education has the objective not only of training middle level technicians, but also the qualification, requalification, reprofessionalization of workers of any level of education, permanent technological updating and qualification at the secondary and higher levels (Canto, Aires, Freire, 2017). It is a complementary modality and its main objective is to provide training for access to the labor market, both for students and professionals who need to expand their qualifications (Pereira; Bauer, 2020). In articles 39 to 42, vocational education is conceived as "[...] integrated with the different forms of education, work, science and technology [...]", in order to lead "[...] to permanent development for productive life" (Brasil, 1996).

According to Decree 5,154/2004, which revoked Article 9 of Decree 2,208/97, the EFA provides for the development of education through courses and programs, in three areas, namely: (1) the initial and continuing education of workers (including integrated with youth and adult education,

or professional qualification); (2) vocational education at the secondary level; and (3) undergraduate and graduate professional and technological education (Brasil, 2004).

Since 2016, there has been cooperation between Brazil and Germany, based on the link between the Ministry of Education (MEC), through the Secretariat for Professional and Technological Education, and the German Ministry for Economic Cooperation and Development (BMZ), through the German Agency for International Cooperation (*Deutsche Gesellschaft für internationale Zusammenarbeit* – GIZ), for the provision of mid-level models based on *dual training*. The **Young Apprentice Programme**, the **Alternation Model** and the **Dual *Training Model*** are currently the three VET integration models in force that follow this proposal (Pereira; Bauer, 2020).

In **Undergraduate and Graduate Professional and Technological Education,** which integrates the different forms of education, work, science and technology, aiming to lead its students "to the permanent development of skills for productive life" (Brasil, 1996), there is no operationalization of the *dual* model. According to Article 39, § 3, **graduation** is organized based on the National Curriculum Guidelines (DCNs) established by the National Council of Education (CNE), included by Law No. 11,741/2008 (Brasil, 2008), by technological axes, in line with the socio-occupational structure of work and the requirements of professional training at different levels of development (CNE/CP No. 01/2021, Article 2).

In this modality, the Higher Technology Courses (CSTs) have "[...] curricular units, stages or modules that correspond to professional qualifications identifiable in the world of work" (Art. 29). Technologists are responsible for meeting a market demand by offering expert professionals within a specific area of knowledge (CNE/CP No. 1/2021). The courses follow the National Catalog of Higher Technology Courses (CNST), face-to-face and distance learning (MEC, 2016), with essential information on the professional profile of the technologist and on the organization of the training offer. The catalog also subsidizes the procedures of regulatory acts and, on the other hand, guides students, educators, education systems and networks, offering institutions, class representative entities, employers and the general public (MEC, 2016).

According to Graf *et al.* (2014), Brazil, organized and with large state programs of professional education, has a condition structurally identified in the S System and in the Federal Institutes, as they are cooperative universities already established as a historical reference of professional training. According to the authors, the German Academic Exchange Service (DAAD) pointed out that Brazil has particularly great potential in cooperation with the German companies of Greater São Paulo (AHK and GIZ), representing a necessary driving force in the overall structure of the *dual model*. In the same vein, the studies by Barbosa (2019) pointed to greater adherence to

SENAI and private universities when it comes to the application of the *dual model* in higher education in Brazil.

Another preponderant factor for the success of the model is the Internship Law (Law No. 11,788/2008), since it is the opportunity to link the student to the industry. In its Article 1, the law establishes that the internship is "the supervised school educational act, developed in the work environment, which aims to prepare for productive work [...]", being an integral part of the pedagogical project of the course to integrate the student's training itinerary (§ 1), in addition to aiming at the learning of skills specific to professional activity and curricular contextualization, developing the learner for civic life and work (§ 2). (Brazil, 2008).

The *dual model* can also broadly address the understanding arising from the extension curriculum (MEC Resolution No. 07/2018), which establishes the 'Guidelines for Extension in Brazilian Higher Education' and regulates the provisions of Goal 12.7 of Law 3,005/2014, which approves the National Education Plan (PNE 2014-2024), and provides other provisions. In its Article 5, the resolution brings the guidelines, the academic activities of extension of undergraduate courses, in the form of curricular components, and constitute an interdisciplinary, political, educational, cultural, scientific, technological process, which promotes the transformative interaction between higher education institutions and other sectors of society, through the production and application of knowledge, in permanent articulation with teaching and research (Brasil, 2018).

In fact, the *dual* model brings a different perspective to traditional education, since the abyss between universities and the labor market needs to cease to exist, because "[...] while 96% of academic managers believe that current academic training is adequate to meet the needs of the world of work, only 11% of business leaders, that is, those at the forefront of the productive sector, believe that academic training is adequate" (Valiati, 2021).[2] Based on this purpose, the present study was configured as a model duly validated in Brazil.

METHOD

In order to map the constitutive elements for the structuring of technological undergraduate courses, based on the German dual training model, Canto (2022) used a methodological path divided into three phases. The first included a Systematic Review of the Literature, following the PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) reporting guide proposed by Moher *et al.* (2009), in addition to a documentary research and an empirical research, duly validated with Domain Experts through unstructured interviews. The second was the validation of the concepts and included the mining of the texts (*text mining*), based on the *corpus* of the study from the previous

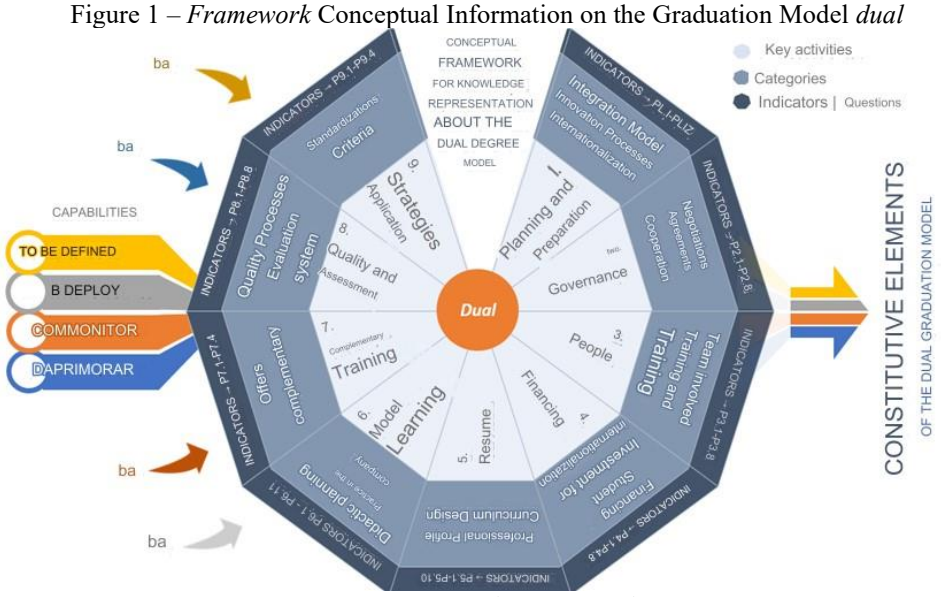
[2] Available at: https://politica.estadao.com.br/blogs/fausto-macedo/o-abismo-entre-as-universidades-e-o-mercado-de-trabalho-uma-realidade-brasileira-cada-dia-mais-assustadora/?utm_campaign=clipping_01102021&utm_medium=email& utm_source=RD+Station, accessed in October/2021.

stage. The third phase was the triangulation and consolidation of the data based on the structuring of the key activities of the *dual* model, with content analysis carried out by an experimental group, ensuring the necessary rigor and relevance. The findings are fundamental to the results of this study.

STUDY DESIGN

The analysis of this article was based on the application of the *conceptual framework* of knowledge representation on the dual graduation model , which pointed out the guiding constitutive elements proposed by Canto (2022), as shown in FIG. 1.

Figure 1 – *Framework* Conceptual Information on the Graduation Model *dual*



Source: Canto (2022, p. 176)

The nine (9) key activities and their respective categories guided the two capacities, define and implement, which served as the basis for the structuring of the Higher Course of Technology in Industrial Production Management, a model of cooperation between the university and the company. CHART 1 shows the details of each capacity, including the key activities, categories, and important factors that generated the guiding questions.

Frame 2 – Conceptual representation of the knowledge of the graduation model *dual*

ACTIVITY KEY	CATEGORY	SET CAPACITY Guiding Questions	DEPLOY CAPABILITY Guiding Questions	MONITOR CAPACITY Guiding Questions	ENHANCE CAPACITY Guiding Questions
PLANNING	Deployment model	**Q1.1 - Are there policies defined in the HEI to establish which model will be made available?** (undergraduate only - practice integration model; or for technical and graduation combined: VET integration model)	**Q1.4 - Have the previous steps of the DEFINE capacity been verified?** (required when defining the deployment of the chosen integration model)	**Q1.7 - Is dual vocational training being applied?** (strong correlation between the HEI, the company and the student, and the other *stakeholders* of the *dual model*)	**Q1.10 - Was AHK/GIZ's participation planned for internationalization?** (to assist in the design, construction and operation of the model, to consolidate the previous steps)
		Q1.2 - Is there a definition of which educational strategies will be followed? (theory and related practice, meaningful learning, new technologies, student-centered approach, focus on learning, meeting social demands and practices in the company)	**Q1.5 - Have the educational innovation trends adhering to the model been verified?** (resources, infrastructure, and educational models for the chosen integration model)	**Q1.8 - Are the definitions of the learning models being followed?** (involve the community, bring social demands and innovative solutions)	**Q1.11 - Are social, economic, and individual goals being maintained or enhanced in the model?** (to assist in the regional context, social responsibility and socio-economic development of the community)
		Q1.3- Is there *expertise* to work with work-integrated education? (think theoretical-practical activities in the HEI linked to practical activities in the company)	**Q1.6 - Have the possibilities of implementing the model with internationalization been verified?** (active U-E participation in deployment settings, can remain as standby)	**Q1.9 - Is the collaboration of the German Chamber of Industry and Commerce (AHK/GIZ) taking place?** (with a focus on academic mobility and dual certification)	**Q1.12 - Has the possibility of internationalization been foreseen, or is it consolidated?** (academic mobility, for faculty and students)
GOVERNANCE	Cooperation and governance agreements	**Q2.1 - Are the cooperation and governance agreements (HEI-Company-Student) already defined?** (the agreements follow the integration model that will be implemented – only HE or VET + ES)	**Q2.3 - Is there a sharing between HEIs and the Company for the implementation of the dual model ?** (shared organization, in accordance with current legislation, with a focus on theory and practice integrated with work)	**Q2.5 - Is governance hybrid and is it happening in a shared way?** (focusing on the shared division of model responsibilities)	**Q2.7 - Has governance seen differentiated opportunities in cooperation?** (as support for the extension curriculum as an opportunity of the model)

ACTIVITY KEY	CATEGORY	SET CAPACITY Guiding Questions	DEPLOY CAPABILITY Guiding Questions	MONITOR CAPACITY Guiding Questions	ENHANCE CAPACITY Guiding Questions
		Q2.2 - Are there prior alignments for the formalization of contracts? (The negotiation and cooperation agreements are already clear and the means of formalization already established - contract, agreement, partnership, others)	**Q2.4 - Is there a presence of Committees to define the principles of the dual model ?** (hybrid governance, shared responsibilities, cooperation agreements and alignments for application in the two learning sites)	**Q2.6 - Is shared practice taking place in both learning sites?** (follows what was foreseen in the previous steps, with shared responsibilities)	**Q2.8 - Does governance include national and international partnerships for the model?** (to ensure mobility and double certification)
PEOPLE (*stakeholders*)	Structure for action Shared	**Q3.1 - Is there a pre-defined team, made up of HEI and company managers?** (with the competencies required to conduct the governance of the cooperation, in addition to acting in the execution of the model - course coordinator, teacher, instructor, lecturer, pedagogical, laboratory technicians, among others)	**Q3.3 - Is there representation of all segments for the implementation?** (managers for legal definitions, responsible for the organization of practical training, technical and pedagogical for the construction of the curriculum, company instructors for practice, teachers with competence for theoretical-practical support)	**Q3.5 - Are HEI professors and company instructors being monitored?** (focus on sharing between university professors and company instructors)	**Q3.7 - Have the required skills been developed in cooperation?** (focusing on supporting IES professors to work in practice and company instructors for the necessary mediation)
		Q3.2 - Is there a policy for the identification of skills, or for training? (to collaborate with the different processes of execution of the *dual* model, or even to empower everyone involved)	**Q3.4 - Is there any implementation of training/qualification for those involved?** (for all the people involved, with support for practical planning in the company)	**Q3.6 - Do the policies implemented mitigate the risks of sharing between people?** (focusing on theoretical and practical implementation in cooperation, throughout the course)	**Q3.8 - Are training/qualification policies being improved to expand the professional experience of those involved?** (assist in shared execution and ensure model differentials)
FINANCING	Funding for Educational Processes	**Q4.1 - Is there a policy to ensure the support and funding of educational processes?** (for teachers, instructors, shared infrastructure, hours/activity for model building, recruitment and training)	**Q4.3 - Is there any presence of policies implemented for educational financing?** (company participating in the educational financing, with a focus on the reward for the students – intern, work or subsidy for the payment of tuition, in the allocation of human hours for the	**Q4.5 - Are the investments for the international partnership in place?** (focused on the costs for the partnership with AHK/GIZ/DHBW, the allocation of human hours for the construction of the model, the operationalization of exams and	**P4.7 - Investments for the International Partnership (AHK | GIZ | DHBW) are present?** (focus on funding for mobility and dual certification of the *dual model*)

ACTIVITY KEY	CATEGORY	SET CAPACITY Guiding Questions	DEPLOY CAPABILITY Guiding Questions	MONITOR CAPACITY Guiding Questions	ENHANCE CAPACITY Guiding Questions
			construction of the model and training)	double certification)	
		Q4.2 - Is there a policy or cooperation agreements for investment in the internationalization of the model? (involves the costs of the partnership of the Brazil-Germany Chamber of Industry and Commerce)	**Q4.4 - Is there a focus on the costs of the partnership with internationalization?** (Support for AHK/GIZ/DHBW, operationalization of exams and dual certification)	**Q4.6 - Are the investments for the execution of the *dual* model in place?** (it is regularly checked that all those involved are included in the educational financing policies)	**Q4.8 - Are investment policies in internationalization being improved?** (focus on exchanging experiences, living with different languages and cultures)
CURRICULUM	Curriculum structuring committees	**Q5.1 - Is there a committee set up to structure the professional training profile?** (think of political, educational, technological, and economic level committees)	**Q5.3 - Is it verified that the professional profile and curriculum design focus on innovative areas?** (delimiting the modality of supply and meeting the demands of the company and the labor market, with a focus on employability)	**Q5.5 - Is the pre-formatted curriculum meeting the dynamics of the dual model , as expected?** (it turns out that the pre-defined minimum requirements are being monitored)	**Q5.7 - Is the graduate's professional profile being evaluated and improved?** (focus on flexible strategies to reduce dropout and raise the level of education)
					Q5.8 - Is the curriculum design being evaluated and improved? (with flexible learning strategies, knowledge adhering to a changing world, to reduce dropout and raise the level of education)
		Q5.2 - Is there a committee set up to structure the curriculum design? (think of political, educational, technological, and economic level committees)	**Q5.4 - Is it verified that the pillars that govern the *dual model*, theory and integrated practice, are being implemented?** (concepts of work-oriented learning, links between learning sites, identification of scientific and technological areas, academic and professional competencies arranged in compulsory and optional subjects)	**Q5.6 - Is the planned professional profile adherent to the execution and according to what the company expects from the dual model partnership?** (the minimum requirements pre-defined in the course structuring are being monitored)	**Q5.9 - Is the alignment between the professional profile, the curriculum and the work experience being evaluated and improved?** (regularly check that shared learning concepts are happening and being work-oriented)
					Q5.10 - Are there surveys, or other strategies, to measure the success of the implemented curriculum? (to ensure adherence, application of shared strategies, reduce dropout, increase employability and provide support to the academic community)

ACTIVITY KEY	CATEGORY	SET CAPACITY Guiding Questions	DEPLOY CAPABILITY Guiding Questions	MONITOR CAPACITY Guiding Questions	ENHANCE CAPACITY Guiding Questions
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LEARNING MODEL	Knowledge Sharing	**Q6.1 - Is there a didactic-pedagogical committee set up to structure the learning model?** (committees that deal with the organization and execution of the proposed learning model, based on competency-based work)	**Q6.3 - Is it verified that the pillars that govern the *dual* model are being implemented?** (integrated academic regulations, strong presence of a scientific nature, competency-based model, intermediate exams to ensure professional qualification, meaningful learning, constructivist and student-centred approaches, mediation by technologies)	**Q6.5 - Is the didactic planning happening as planned?** (check if the pre-defined minimum requirements for the learning model are being monitored)	**Q6.8 - Is the company's preparedness monitored and can it be improved?** (to verify if there is an understanding of the strategies for using the model, ensuring the didactic-pedagogical requirements)
				Q6.6 - Are theory and practice happening in an integrated way? (check if the team includes people with practical experience in the company and theoretical experience in academia, working integrated)	**Q6.9 - Is there an improvement in joint action, aiming to increase curricular mobility and flexibility?** (to check for new opportunities and broaden the scope of the model)
		Q6.2 - Is there preparation of the HEI team and the company(ies) for the integrated practice? (from the selection of the team, through the planning, organization and application of the learning model)	**Q6.4 - Is it verified that the trained team is managing to implement the integrated practice?** (understanding of the course curriculum, the performance in the company, the minimum infrastructure required, the teacher-instructor relationship, the necessary training)	**Q6.7 - Is the work/internship being contemplated and happening as planned?** (there are study and internship/work regulations, with active cooperation between U-E, mobility possibilities and double certification, when partnering with AHK/GIZ)	**Q6.10 -- Is there support for the team in the company to ensure integrated practice?** (to check that the application is consistent with what the previous steps pre-define and improve the approach where necessary)
					Q6.11 - Are there constant team improvement campaigns to ensure efficiency and effectiveness in the integrated practice? (to ensure that IES professors and company instructors act in a shared way, with the exchange of experiences and improvement of the model)

ACTIVITY KEY	CATEGORY	SET CAPACITY Guiding Questions	DEPLOY CAPABILITY Guiding Questions	MONITOR CAPACITY Guiding Questions	ENHANCE CAPACITY Guiding Questions
ADD-ON OFFER	Extension and social acceptance	**Q7.1 - Is there a provision for additional training to expand professional competence?** (activities, courses, programs, events, social involvement), aiming to expand the *dual principle* - thinking, practicing and doing)	**Q7.2 - Is it possible to verify which team is managing to implement the complementary offers?** (personalized requirements, flexibility of offer, confluence with attractive professional activities, support services to society, social responsibility projects, community support - Extension/Curriculum)	**Q7.3 - Are the add-on offers being executed as intended?** (The complementary offer is carried out in an integrated way, with proposals for programs, projects and courses to serve the community and society, and monitored for opportunities for improvement)	**Q7.4 -- Was the extension curriculum included in the model and can it be improved?** (to verify joint action, as a complementary offer that integrates society, the HEI and the company, with efficient and effective results and compliance with the legislation in force)
QUALITY AND EVALUATION	Learning assessment	**Q8.1 - Are there any differentiated learning assessment strategies?** (models that ensure quality at the tactical, operational and strategic level)	**Q8.3 - Is it verified that the pre-defined evaluation strategies have a quality level?** (professional differentiation, commitment and availability, focus on pre-established standards, comprehensiveness in strategic and innovative occupations)	**Q8.5 - Are the predicted quality standards happening as planned?** (check that the quality standards provided for the two learning sites are being monitored to ensure the required level)	**Q8.7 - Is there any improvement in the strategies used to ensure the level of quality, thinking about teaching-learning, innovation and mobility?**
		Q8.2 - Is there a provision for diagnostic, summative and formative assessments? (models for all levels, both theoretical and practical, to measure student performance throughout training)	**Q8.4 - Is it verified that the evaluation system is being implemented as planned?** (focusing on diagnostic assessments—tics and leveling, formative with different forms of application and summative, encompassing integrated knowledge)	**Q8.6 - Is there a follow-up to verify that the competencies are being implemented?** (focus on the competencies and skills developed, ensuring the assessment of learning, both theoretical and practical)	**Q8.8 - Is there any improvement from the participation of the German Chambers of Industry and Commerce (AHK/GIZ) in dual certification exams?**

ACTIVITY KEY	CATEGORY	SET CAPACITY Guiding Questions	DEPLOY CAPABILITY Guiding Questions	MONITOR CAPACITY Guiding Questions	ENHANCE CAPACITY Guiding Questions
APPLICATION STRATEGIES	Standards and criteria for model deployment	**Q9.1 - Is there a timeline of the steps to be followed for the implementation of the model?** (always following the two main pillars of support, theory and integrated practice, from the beginning of the training, *a sine-qua-no condition* of the *dual)*	**Q9.2 - Is it verified that the model is being implemented with the expected level of commitment?** (it has the criteria for formalizing the *dual,* involving all *stakeholders* and defining all stages)	**Q9.3 - Is it verified that the main questions about the model are being monitored?** (corresponds to the German model, integrated practice, cooperation for all stages, students with work/internship, governance, focus on professional training, valorization of training in society)	**Q9.4 - Are the standards and criteria pre-established in the previous steps implemented and being improved?** (focus on joint action, integrated practice, the possibility of academic mobility, double certification, differentiated and innovative experiences)

Source: Adapted from Canto (2022, p. 169-174)

APPLICATION ENVIRONMENT

As for the choice of the educational institution researched, it was intentional, as it is part of the largest network of professional education institutions in the country and in Latin America, the National Service for Industrial Learning (SENAI), through the SENAI Santa Catarina University Center, UniSENAI. SENAI was the highlight of the references of Graf *et al.* (2014), Barbosa (2019) and Pereira and Bauer (2020), as it is similar to the Universities of Cooperative Education that apply the *dual model* in Germany. Regarding the Company, it is from the Metallurgical area of the Itajaí Valley region, in the State of Santa Catarina, Brazil, which indicated the interest in the implementation of the *dual* model. Thus, the implementation period began in November 2021 and was consolidated in August 2022 when the inaugural class of the first cooperative class took place.

POSITIONING

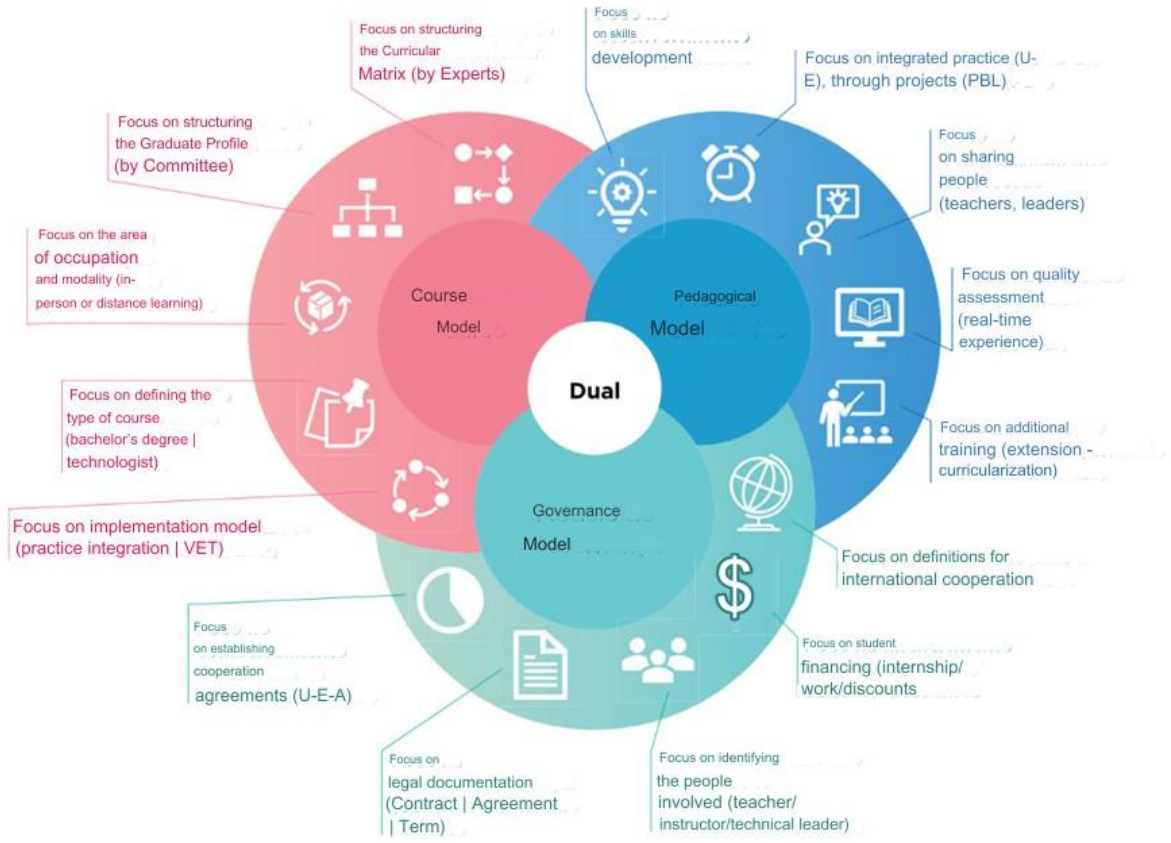
The initial motivation comes from the researcher's experience of more than 25 years with working in higher education, specifically with EFA, and from previous knowledge about the *German dual* model . Thus, to ensure the rigor and relevance that are fundamental to the study, the researcher relied on the scientific assumptions proposed by Hevner *et al.* (2004).

SOURCE OF APPLICATION

Based on the *conceptual framework* proposed by Canto (2022), a *checklist* was structured as a new artifact in flow format, in order to be used to mediate the consolidation and execution of each step. This flow was used to guide the validation meetings that took place in person with the representatives of the management of the HEI and the Company, as well as with the technical experts

and the Course Coordinator. The model was based on three strategic focuses arising from the *framework*, based on the guiding questions proposed, namely: (I) course model; (II) governance model; and (III) learning model, as shown in Fig. 2.

Figure 3 – *Framework*: *check-list* for the implementation of the graduation model *dual*



Source: Prepared by the author based on Canto (2022, p. 179, FIG. 45)

All directions for implementation followed the *framework's recommendations*, as shown in Fig. 1 and Chart 1. In summary, this study presents the pilot project that was implemented in partnership with the Company, representing the Employers' Union of Metallurgical, Mechanical and Electrical Material Industries (SIMMMEB) in the southern region of Brazil.

RESULTS AND DISCUSSION

The implementation began with informal conversations about the possibility of applying the *dual* model based on the involvement of everyone to understand the concept, origin and guidelines for structuring a higher technology course, focused on EFA. The guiding principles and differentials identified were obtained from the conceptual *framework*, the main artifact, which reflects the search for the acquisition of knowledge applicable to the organization (Gibbson *et al.*, 1994), becoming the "meeting point between the internal environment, the organization itself and the external environment" (Gill; Hevner, 2011, p. 238).

GOVERNANCE MODEL

For all types of dual study programs , governance requires that there be a university, the employer(s) and the students, depending on three types of contracts, namely: (1) between the student and the company certified as a practical partner; (2) between the practical partner and the university; and (3) between the university and the student (Ertl, 2020; Graf. *et al*., 2017; Haasler, 2020; Hofmann *et al*., 2019), where the university-company-student relationship forms the 'Dual Study Program Triangle', as reported by Jacques and Langmann (2016).

Unlike VET integration models, where the German Federal Institute for Vocational Training (BiBB - *Bundesinstitut fuer Berufsbildung*) suggests the role and limits of coverage of dual study programmes, in the integration of practice model there is no federal standard for contracts or salaries of enrolled students, depending on specific local regulations or negotiations between the student and the company (Graf, 2013; Graf *et al.*, 2014). These are the contracts that specify the cooperation and the roles and responsibilities of the partners in the programme, regulating the admission criteria and determining the thematic integration of the study and professional practice phases (Hofmann *et al.*, 2019; Weich *et al.*, 2017)tag.

According to Graf (2013), governance implies flexibility between companies and educational institutions, but it is the university that sets the educational standards for the participating companies, considering that companies have significant influence when it comes to establishing dual degree programs, as they can choose between different models of educational practices.

Thus, in the key activity 'governance', cooperation and governance indicator (P2.1), the definition of the roles and responsibilities of the partners in the program was initially listed, regulating the admission criteria and determining the thematic integration of the predefined phases of study and professional practice, established through cooperation contracts, corroborating the approach made by Hofmann *et al.* (2019) and Weich *et al.* (2017). For the indicator formalization of contracts (P2.2), as there is no pre-defined standard in the literature, it was decided to follow a jointly structured model, where the object, responsibilities and obligations were established, as well as the counterpart of each party, university-company, company-student and student-university, as recommended by Jacques and Langmann (2016).

'People (*stakeholders*)', a key activity that includes the category structure for shared action (P3.1), brought the requirement of a pre-defined team, formed by all levels of management, reaching the operation, and focused on the identification of the competencies required to conduct governance and the others responsible for the execution of the model (course coordinator, teacher, instructor, lecturer, pedagogical, laboratory technicians, among others). Both the university and the company had a competency identification policy (P3.2), which allowed allocating the right people for each demand, despite the need for training to make everyone aware of the progress of each stage, as well

as expanding the competencies required to work together, as recommended by Pereira and Bauer (2020), Graf *et al.* (2014), Euler (2013), Baethge and Wolter (2015) and Deissinger (2000).

Regarding the professors, they are from the HEI, but new hires took place to meet all the proposed curricular units. The company identified *expertise* to work with the IES and the entry of new employees took place through a Selection Process. As reported by the Company's Director, "*it is impressive how the dual model has affected the professionals of this company with extensive experience and with degrees in the area, as they are manifesting themselves positively to act as instructors for this course*". This is a very positive point to leverage the course, as everyone involved is familiar with the principles of the dual degree model. For the shared infrastructure for the practical classes, the Course Coordination, the technical responsible for the implementation of the training offer and the company worked in cooperation, as recommended by the dual study model in all its essence.

For the key activity 'financing', category of educational processes (P4.1), the HEI and the company had guidelines and policies to ensure support for educational processes, both in terms of infrastructure and inputs for studies. Also, in the indicator that deals with implementation policies for educational financing (P4.3), it was agreed that the company and the HEI would focus on subsidies (discounts) to assist in the value of the course tuition, as well as the availability of internships and strategic scholarships. The grant considered students from the community, as well as employees who showed interest in being part of the class, evaluating opportunities for new hires. In the same way, HEIs and the company acted jointly regarding the necessary investments to subsidize the allocation of human hours for the shared construction of the professional profile and curriculum design.

Complementary to all these referrals, for the indicator that deals with cooperation agreements to invest in the internationalization of the model (P4.2), in partnership with AHK/GIZ, there was a consensus that actions will be conducted later in favor of mobility and double certification. In the words of the IES Management, *"it is impressive how the entire construction of the model in partnership led the company to think of mobility and double certification as a factor of lesser relevance, remaining in the background, when it was believed that this would be the point of greatest attractiveness in the model"*. According to the organization, *"the most important thing was to design the tailor-made model, to meet and contribute to the evolution of the company's business, since there is a lack of specific graduation models with this focus and the possibility of this partnership" (Google Meet validation, on 06/09/22)*.

It should be noted, however, that such a design does not follow the guidelines set by Pereira and Bauer (2020), since in their analyses the authors emphasized that the model is consolidated from initial alignments with the Federal Ministry for Economic Cooperation and Development (BMZ) and the Federal Ministry of Education and Research in Federal Institutions (BMBF), through the Federal

Institute of Professional Training (BiBB) and national support from the Brazil-Germany Chamber of Commerce and Industry (AHK). with the aim of consolidating the joint offer from the beginning of the negotiations. However, it is corroborated by Euler (2013) and Graf *et al.* (2014) when they emphasized that the greatest probability lies in the modified transfer, in which countries include the elements appropriate to their reality, rather than introducing a complex system. Secondly, as Euler (2013) emphasized, there is no standard model for a transfer of the *dual* system, since for almost all countries the model depends on the industry, the occupational area, the size of the company, the different forms of training, the combinations of learning sites, the curricular characteristics, the existing didactic implementations, and the legal basis that allows the tasks and responsibilities to be carried out.

COURSE TEMPLATE

According to a systematic review of the literature carried out by Canto (2022; 2023) on specific action for higher education, the studies obtained focused on the 'model of integration of practice', part-time or full-time, as one of the possibilities of training offer (Deissinger, 2000; Gerloff; Reinhard, 2019; Graf *et al*., 2017; Graf, 2018; Haasler, 2020; Hofmann *et al*., 2019; Jacques; Langmann, 2016; Mallwitz, 2013; Odeh *et al*., 2017; Pavlicevic *et al*., 2015; Pogatsnik, 2018; Vairaktaris; Mallwitz, 2014; Wolter; Kerst, 2015b). Thus, for the key activity 'planning', an implementation model indicator (P1.1), the HEI and the Company agreed to follow this model, with preference for Higher Technology Courses (CSTs), or technological graduation, as they are focused on meeting a specific demand in the area.

According to Rein (2017), this model focuses on proficiency, focusing on academic and scientific training, which provides specific and knowledge-based disciplines. In the indicator educational strategies (P1.2), which focuses on linked theory and practice, on meaningful learning, on the use of new technologies for the educational process, in a constructivist and student-centered approach, the option was to use the HEI's own methodology, since it focuses on an education based on competencies and with the guiding principles of *dual* training. as well as meeting social demands and applied projects.

For the indicator *expertise* to work with the demands of cooperative education (P1.3), it is noteworthy that the HEI already had the *necessary expertise* to act in response to the immediate demands of the industry, which accelerated the progress of the implementation, as there was already a pre-defined science and focus. In other words, the HEI has its own methodology for the development of integrative projects, with pre-defined steps to take place in partnership with the company, identifying the real problems and creating study standards to reach possible solutions.

The key activity 'curriculum', in the curriculum structuring committee category, focuses on the importance of structuring Technical Committees to develop the professional profile of the graduate and build the curricular matrix of the course. To support this stage, the methodology of the HEI was used as a complement, which over its 20 years has reached a higher degree of maturity, consolidating itself at the international level as a reference for professional training and at the national level as an important instrument to meet the growing demands of the industry in relation to the training of new professionals (SENAI/DN, 2019). This methodology adheres to the proposal of the *dual model*, but each institution can make use of its own way of executing committees for the construction of the curriculum, as reported by Euler (2013).

To define the professional profile (P5.1), which points to the description of what ideally a graduate should be able to accomplish in the professional field, corresponding to an occupation, according to the Brazilian Code of Occupations (CBO), the following steps were followed: analysis of the labor market and trends in technological areas; the mapping of roles and the definition of general competence; the establishment of what the student is expected to do; the mapping of socio-emotional skills; the identification of intermediate occupations; and other training offers, with a focus on identifying the skills needed for professional practice. It is noteworthy that competence, in this study, is understood as "the mobilization of knowledge, skills, and attitudes to perform typical functions and/or activities, according to quality and productivity standards required by the nature of work" (SENAI/DN, 2019, p. 25).

Thus, to validate the profile, a multidisciplinary committee or technical-advisory forum was established, involving HEIs, companies, among other bodies of relevance to the proposed model, as emphasized in the approach of different studies in the review (Coletti, 2019; Deissinger; Hellwig, 2005; Durazzi; Benassi, 2018; Graf, 2018; Haasler, 2020; Odeh *et al.*, 2017; Pavlicevic *et al.*, 2015; Remington, 2017; Wolter; Kerst, 2015b; Zhang; Schmidt-Hertha, 2019). The Committee's analysis considered the working conditions, the organizational systems, the relationships between the different functions, the results of production or services, the future demands, the technological and organizational context of the occupations involved, the generation of new knowledge, skills and attitudes (capacities) inherent to the occupation, serving as a starting point, or even as the target of a clearly defined and standards-based process. Such assumptions corroborate what Deissinger (2005) pointed out.

It is important to note that, according to the National Catalog of Higher Technology Courses (Art. 27 of CNE/CP No. 1/2021), the professional profile of technological undergraduate courses is already organized by "[...] professional qualifications identifiable in the world of work" (Art. 29), being responsible for meeting a market demand, offering specialized professionals within a specific area of knowledge, different from the generalist training of academic modalities. The characteristics

of the training offered by technologists are focus, speed, insertion in the labor market and methodology, directed towards competency-based training. The speed of training is linked to a lower workload of the courses offered, since they are focused on applied knowledge, in two or three years, aiming at the rapid insertion of the student in the labor market (Brasil, 2016). As reported by the IES Management, *"it is very important that management understands the importance of technological undergraduate courses, this needs to be on the radar of managers when approaching companies, as the dual model is a giant opportunity to show the full potential of a partnership".* Still, for the Director of the Company, it is important to understand that *"the technologist is a strategic differential because the course is focused, lasts from 2.5 to 3 years, is sufficiently suitable for customization, translating into a strategic combo between HEI and the Company".*

The second indicator focused on the elaboration of the curricular matrix (P5.2), which provides the development of technical skills and knowledge (or contents) related to the competencies identified in the professional profile. It is the result of the process of defining and organizing the elements that make up the curriculum and that must ensure the development of the skills demanded by the world of work (SENAI/DN, 2019, p. 47). The elaboration of the curricular matrix followed a set of five sequential, articulated and interdependent stages, each with very specific purposes, namely: (a) analysis of the professional profile; (b) definition of modules; (c) structure of the curricular units; (d) internal organization of the curricular units (syllabus); and (e) structure of the training itinerary (SENAI/DN, 2019, p. 51). Thus, the professional profile and the curricular matrix were built to meet the CST in Industrial Production Management, in the area of Control and Industrial Processes, contained in the CNCST with 2,400 hours, whose professional profile of completion reports that the graduates will have competence to:

> Plan, supervise and apply production processes. Plan the logistics of moving the product in the industry. Evaluate and optimize material flows, layouts, and production lines. Supervise the selection and treatment of raw materials. Control the quality of processes. Coordinate work teams. Specify information techniques for manufacturing management and control. Survey, perform expertise, issue report and technical opinion in their area of training. (MEC: CNCST, 2016, p. 24).

The CNCST, launched in 2016, is an information guide on the technologist's competence profile, which presents the minimum workload and the recommended infrastructure for the course, also serving as a basis for the National Student Performance Exam (ENADE) and for the EFA regulation and supervision processes. The CNCST organizes and guides the offer of courses, inspired by the DCNs and in tune with the dynamics of the productive sector and the expectations of society.[3] According to the legislation, the curriculum of the CSTs is focused on a certain professional area and

[3] Available at: http://portal.mec.gov.br/catalogo-nacional-dos-cursos-superiores-de-tecnologia-, accessed in April/2020.

must also observe the principle of continuity, in order to ensure the progressive advancement of the student in his learning and schooling process, avoiding interruptions and repetitions of studies and experiences (Brasil, 1996).

The degree of responsibility of this technologist can be considered high, as the professional will work with technologies considered advanced and of high added value. In addition, two intermediate exits were contemplated, that of Industrial Administrative Supervisor (CBO 1401-05, by approximation) and that of Production and Operation Manager (CBO 1421-05). Although the entire course of the offer is clear, the indicator that deals with the team trained to implement the integrated practice (P6.4) requires constant evaluation, because only the execution will allow us to verify whether the approaches are really student-centered and mediated by the teacher and the instructor, both in theoretical classes and in their correlation with the actual practice.

PEDAGOGICAL MODEL

The next key activity conducted in cooperation was that of the 'learning model', which in the knowledge sharing category presents two indicators, one for the structuring, organization and execution of the learning model (P6.1) and the other for preparation for integrated practice (P6.2). This axis deals with didactic-pedagogical actions that, in an integrated and complementary way, are used for the development of teaching and learning processes.

Thus, the learning model proposed, and validated by the company, follows the guiding principles of pedagogical practice, namely: interdisciplinarity, mediation of learning, meaningful learning, emphasis on learning to learn, encouragement of creative thinking and innovation, encouragement of the use of educational technologies, preparation for the world of work and support for social practices, the integration of theory and practice, the assessment of integrated learning and contextualization. In addition, student-centered learning, collaborative learning supported by digital tools, online modalities (such as MOOCs[4], SPOCs[5] and COOCs[6]) with knowledge sharing, as well as co-creation of knowledge as a theoretical-practical framework that guides the proposed pedagogical practice (Maier *et al.*, 2019)tag.

In the words of the IES Management, "*this is a learning model under construction, with a lot of shared work, with a checklist for decision-making, where it was agreed how the classes will be, with a lot of practice, even hands-on, with all the significant differentials that must be covered, from preparation to the beginning of the course, and throughout its progress*". A model that relies on "*shared participation in all its essence, in a surprising way*". As the Director of the Company reinforced, "*it is a model that will be a success... How lucky these students are!*", because the

[4] *Massive Open Online Courses* - MOOCs
[5] *Small Private Online Courses* - SPOCs
[6] *Corporate Open Online Courses* - COOCs

"*expectation is the best possible, a project of many hands where we will make a great history*", and that "*lucky us to be able to provide this opportunity*".

For the activity 'complementary offer', in the category of extension and social acceptance, whose indicator refers to the importance of providing differentiated opportunities in the application of *the dual* model (P7.1), these are supported by the Extension Policy, which provides for four opportunities for interaction between students, company and community, namely: social programs, development of integrative projects, meeting real demands; professional development courses; and support the specific demands of society, with regard to the technological involvement of professional processes. These initiatives were considered pertinent for the execution within the principles of the *dual model*, as well as for the definition of the real projects that will be established within the curricular units (disciplines) of Applied Project, which will take place within the company, responding to a real problem, with an emphasis on interdisciplinarity.

The category 'quality and evaluation' pre-defines how the process of evaluating teaching and learning will take place, as well as the quality of the *dual* model, at its tactical, strategic and operational levels. The learning assessment indicator (P8.1) provides clear guidelines for how assessments take place, based on the principle of competence development. And, for the evaluation of integrative projects that take place within the discipline of Applied Design, the HEI has its own regulation, which was considered to guide and guide the evaluation by all those involved.

The assessment (diagnostic, formative, summative), respecting the principles and concepts that guide its realization, is based on the development of pre-defined capacities. According to the IES methodology, "capacities are understood as potentials that people can develop throughout their lives and that make them able to perform certain actions, activities or functions" (SENAI, 2019, p. 52-53), they are transversal activities and independent of specific content in the area.

However, for the quality assessment (P8.2), HEIs and the company will create the guiding strategies. Along these lines, "*local planning, mapping, initial mobilization and all other processes bring assertiveness, but they need to be understood constantly, at different moments of deeper dialogue, seeking to evaluate the quality of each stage*" (Company Director), so that the expected quality is known. According to Zhang and Schmidt-Hertha (2019), although many countries have already adopted the German model of *dual education*, the results were not necessarily the desired ones, and this is due to the extreme difficulty in combining the theoretical and practical part. For the authors, as guidelines for the desired quality process, it is necessary to follow what is advocated by the *dual models*, in order to better promote the development of higher education, as well as cooperation, with university and company being oriented towards application, students with the opportunity to acquire qualifications (complementary offer) and undergraduate diploma and, with multifaceted and practice-related curriculums, with content focused on innovation.

The last key activity, 'application strategies', which includes the category of standards and criteria for the implementation of the model, and which focuses on the definition of a schedule with the steps to be followed for the implementation of the model (P9.1), what was observed is that the steps taken so far allowed to lead the two main pillars of support of the model, of integrated theory and practice, *a sin-qua-nom condition* for the implementation of the *dual model*. However, Spöttl (2013) pointed to strategic fields of application that need to be monitored, namely: a) employability, with a focus on the scientific aspect, aiming at planning, assuming responsibilities and guidance; b) the development of competences, with a focus on knowledge and understanding, 'theoretical' proficiency, methodological and analytical skills; c) curriculum oriented in a more cognitive way and designed according to the system of scientific disciplines; and d) curricular approaches for the reflection of theoretical systems and the understanding of abstract processes, with a scientific approach. In summary, for the author, the main objective is to understand the theoretical and methodological structures of a model, and not to qualify for specific professional tasks. These strategic fields of application guided the key activities and will serve as a contribution to the implementation.

It is important to note that in order to collaborate with the different processes of execution of the *dual model*, the interviews conducted by Zhang and Schmidt-Hertha (2019) clearly pointed out the concerns with the conditions of the company and those of the HEI, the courses evaluated, the practical experience and scholarships in the company, the problem solving, the plans after the dual study, The flexibility of major changes, income after graduation, the pace of the theoretical and practical phases, administrative facilities and internationalization, which are important factors at the beginning of the journey and differentials in the full involvement of the different *stakeholders*. Then, the competence and personality of beginners in the dual study programs, according to Weich *et al.* (2017), need to collaborate to broaden the strong focus on practical qualifications and employability.

SUMMARY OF THE APPLICATION OF THE MODELS

Based on the notes made by Spöttl (2013), Weich *et al.* (2017) and Zhang and Schmidt-Hertha (2019), there is total integration between those involved, as reported by the management of the HEI, because "*the steps taken so far show that there is a great integration for the model to really happen, with great involvement of everyone*". It is also verified that there was the presence of Committees to define the principles of the *dual model* (P2.4), both for the professional profile and for the structuring of the curricular matrix.

In the company's report on the application of the *conceptual framework*, it is observed that, in essence, the "*focus is on the* ***solution of a real problem****, involving the participating industry, with the intention of enhancing and making the course a significant differential for students*". Then, for the

company, "*the proposed model is more focused, has a* ***curriculum that meets a more immediate and specific demand of the industry****, and can be applied within the company itself*"; and where "*the* ***desire aroused in the company's employees to participate as teachers****, thinking about its application, monitoring and support for practical execution*" was considered highlighted. In the area of social responsibility, the CEO reported that "*the* ***company subsidizing the tuition fee for the course is of paramount importance and relevance*** *to society* [...]".

Governance has shared responsibilities, in accordance with the current legislation, with the HEI being responsible for the execution of the course and for the alignments for the application of theory and practice in the two learning sites, showing that there is a concern with hybrid governance, as advocated by Spöttl (2014); Euler (2013); Graf (2013). The cooperation agreements established were formalized based on a Cooperation Agreement (agreement), where the main responsibilities are defined.

Among the methods and techniques of work of the graduates, listed by the experts who made up the Committee are: technical procedures; diagnostic methodology; maintenance techniques, quality, handling of finished products, supply and dissupply of lines, human relations (of people) and problem solving; quality and productivity tools; techniques for evaluating results; and teamwork techniques, with a focus on critical thinking and logical reasoning. The technologist may also coordinate work teams or be part of a multidisciplinary or interdisciplinary team.

As observed throughout the detailing of the categories and their indicators, this model can address, in a broader way, the understanding arising from the extension curriculum, as recommended by MEC Resolution No. 07/2018, which established the 'Guidelines for Extension in Brazilian Higher Education' and regulated the provisions of Goal 12.7 of Law 3,005/2014, which approved the National Education Plan (PNE 2014-2024), because it brings in its context a whole concern with social responsibility.

It is important to note that in Latin America, the basis of support for the dual study model, following the standards of the German model, is the *Duale Hochschule Latinamerica* (DHLA[7]), endorsed by *the Duale Hochschule Baden-Württemberg* (DHBW), which is in operation in five countries (Colombia, Ecuador, Peru, Mexico and Brazil). The DHLA system is made up of ten universities that are members of the network, based in Colombia and Ecuador, which offer academic programs in the *dual model* in partnership with more than 1,000 companies in the five Latin American countries. In Brazil, support for the model is provided by the German-Brazilian Chamber of Commerce and Industry (AHK).

[7] Available in https://www.dhla.org/dhla/. (our translation).

FINAL THOUGHTS

The characteristic of *dual* training lies in the connection between three dimensions, understood as a triad of educational objectives, which encompasses the interests of society, the economy and the individual. The characteristic of social responsibility proposed by the German model occurred in Brazil with the social commitment of the university, when the need arose to curriculate the extension activities, which aims to carry out the dialogue between the university and society, in a two-way street, which allows both the internal and external public of the university, participate in the process of knowledge creation and transmission.

The ***conceptual* framework** was decisive to guide the implementation of the model, but it was observed that both the HEI and the Company showed insecurity about the step that should be taken, placing the decision-making power over the conduction of the entire process (the researcher).

The strong university-business cooperation, the role of the university as a vector for the exchange of knowledge, far beyond teaching and research, and the interaction with society make the *dual* model an innovative proposal that adheres to the Brazilian educational context through EFA. Secondly, although learning and work belong to different worlds, the main function of vocational education institutions remains training to meet the needs of the labour market, helping industry to identify new technical skills and build them on the basis of personalised teaching offerings. The *dual model* proved to be fully adherent to meet the needs of the world of work.

In summary, the cooperation between university and company is the starting point for the implementation of *dual programs* in undergraduate courses, and it is necessary that the partners offer structures and human resources that are coordinated for the pedagogical challenge of cooperation, in an institutionalized way, through work with regular committees for the creation of curricula and monitoring of courses (pedagogical resources). In essence, the basic requirement for eligibility of the *dual* model in Brazil is the existence of a higher education system that is able to provide practical training, as well as companies that have human resources for cooperation work. EFA in Brazil has this characteristic, as the institutions that work in this type of education develop their training offer with a focus on preparation for the world of work.

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