Chapter 258

Acquisition of knowledge about the dual graduation model: Focus on discovering knowledge in text in a systematic review

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ABSTRACT
Dual degree models promote cooperation between universities and businesses. They are models that combine a theoretical-practical phase of learning in higher education institutions with a practical phase developed within partner companies, focusing on the development of real problems. In addition to Germany, countries such as Austria, Denmark, Finland, France, Holland, and Switzerland are the ones with the highest number of dual programs implemented. In this sense, the objective of this study was to identify the basic knowledge about the dual graduation model, in the light of the German model, based on the text mining technique. The acquisition of knowledge was conducted in a corpus composed of 18 articles that dealt with higher education, arising from the systematic review, and which were in English. The results made it possible to correlate the terms obtained from the application of mining methods or tasks, through specific algorithms, with the findings in the literature. To conclude, all the indicators obtained from the systematic review and the most relevant terms indicated in the text mining were correlated, generating a representative flow of the elements of the dual graduation model.

1 INTRODUCTION

The present study presents an analysis of the knowledge representation of the dual degree model, in the light of the German model, based on the correlation of knowledge obtained from a systematic literature review with text mining.

In essence, the dual model incorporates theoretical and practical teaching in a shared way, aiming to train professionals who are adherent and prepared for the challenges of the labor market (ERTL, 2020; JACQUES; LANGMANN, 2016; ODEH et al., 2017). However, as a result of focus change in the composition of the labor market, which required higher-level skills, the European Commission pointed to the need for transfer and exchange of professional education (VET) vis-à-vis higher education (HE) (DURAZZI; BENASSI, 2018). This permeability, both from an educational and socio-economic point of view, emphasizes compatibility between VET and HE curricula, the acceptance of learning outcomes obtained from EPF for HE, and the assessment of acquired skills (SPÖTTL, 2013). It is important to emphasize that EFP and ES form their institutional bases in complementary different conditions, starting with financing structures, arriving at financial regimes, governance, regulation, state influence, market mechanisms, or interested parties (WOLTER; KERST, 2015).

On a national level, the German Federal Institute for Vocational Training (Bundesinstitut fuer Berufsbildung – BiBB) suggests the role and scope limits of dual study programs when correlated with VET. However, for ES there is no federal standard for contracts, nor for the salaries of enrolled students, depending on specific local regulations or individual negotiations between the student and the company (GRAF, 2013; GRAF; POWELL, 2014). As reported by Hofmann et al. (2019) and Weich (2017), these are the contracts that specify the cooperation, functions, and responsibilities of the partners in the program, regulating the admission criteria and determining the thematic integration of the study and professional practice phases.

Thus, to understand the dual model and its application in higher education, Canto (2022) structured a community of practice to discuss the model based on the knowledge of domain specialists (experts). However, the different questions led the author to carry out a systematic review to identify basic knowledge about the model. A literature review is a systematic investigation of secondary studies used to map, find, critically evaluate, consolidate, and aggregate results of relevant primary studies on a specific research question or topic, as well as identify gaps to be filled, resulting in a report coherent or in a detailed synthesis (DRESCH; LACERDA; ANTUNES JÚNIOR, 2016), was essential for the initial understanding. However, as the data are available in textual format, from natural language, not comprising the same structure adopted by all the information available in the digital context, the need arose to seek validation from the Knowledge Discovery in Text (Knowledge Discovery in Text). Text – KDT) (FELDMAN; DAGAN, 1995).

KDT, according to Wives (2004), is defined as a useful technique to identify, and receive relevant information and be able to add it to previous knowledge, changing the current state of knowledge, so that a given situation or problem can be solved. KDT involves several knowledge-intensive tools (techniques, methods, and methodologies) to search for useful information from a data source, including text mining, a technique that is reflected in several Text Mining software available, based on known models (symbolic, connectionist, or evolutionary).

In this logic, this article presents how the identification, application of text mining, and validation of the main findings that supported the structuring of the representative flow of the guiding elements of the dual graduation model took place.

2 THEORETICAL FOUNDATION

In HE, the dual model relates work and study in close cooperation between university and company (MAIER et al., 2019; PARLOW; ROCHTER, 2015; ZHANG; SCHMIDT-HERTHA, 2019), combining two different places to learn and study (PARLOW; ROCHTER, 2015). Known as 'dual study programs, or 'dual degree models', this model was introduced at the Universities of Cooperative Education in Baden-Württemberg and has become an example of an export model (GRAF, L. et al., 2017), a significant educational option for German higher education over the last 15 years (ERTL, 2020).

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In dual degree programs, governance requires the existence of a university, the employer(s), and the students, depending on three types of contracts, namely: (1) between the student and 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, L. et al., 2017; HAASLER, 2020; HOFMANN; SACHSE; SMETTAN, 2019; POGATSNIK, 2018). The university and the company operate through cooperation contracts, which define the roles and responsibilities of the partners in the program, as well as regulate the curricular organization, the thematic integration of the study and collaboration phases, and the admission and permanence criteria (GRAF, 2018; HOFMANN et al., 2019; WEICH et al., 2017). Students enroll at the university and usually have a contract with the company (work or internship), fulfilling all legal requirements, with or without salary (PAVLICEVIC et al., 2015). It is an integrated model of theoretical teaching at the university and practical learning at the company, where content coordination and study time take place in two learning locations (BARBOSA, 2019).

For companies, the value of dual study programs lies in developing high-performing young people, redirecting them to a job-based training route, as well as attracting talented trainees before they graduate from higher education, and facilitating job transfer. the knowledge between companies and higher education institutions (WEICH, 2017). In the view of students, the advantage lies in the combination of obtaining a higher education degree and developing practical skills from experience with an employer, often leading to permanent jobs, and relatively high salaries upon completion of the course (ERTL, 2020). For the university, the challenges posed hover over a solid funding model, the implementation of organizational and knowledge integration, and the culture of communication between partners (BARBOSA, 2019).

In Germany, the Universities of Cooperative Education (UCE) and the Universities of Applied Sciences (UAS) absorb 80% of the dual study programs (20% and 59%, respectively) (GERLOFF; REINHARD, 2019; GRAF, 2018). Among the thematic areas offered, the two largest are engineering (27% of students), representing around 600 programs (38%), and business studies (40% of students), responsible for around 540 (34%) programs (HAASLER, 2020). Access to dual study programs generally requires a high school diploma (Abitur) and because they are in high demand, they include a high workload. Students generally take no breaks between semesters, only taking vacations as regular employees (GRAF, 2013; GRAF, 2018).

Although there are no cases in the literature of investigations that point to specific and standardized indicators for the application of the dual model in other countries, Graf and Powell (2014) conducted interviews and collected some data in Germany and abroad that allowed tracing paths for the application of the model. , pointing out that the greatest probability is in the modified transfer, in which countries include the elements appropriate to their reality, instead of clinging to utopian ideas to introduce a complex system. Euler (2013) pointed out that there is no standard model for transferring the dual system, since for almost all countries a dual model depends on the industry, occupational area, company size, different forms of

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training, combinations of locations of learning, curricular characteristics, existing didactic implementations and the legal basis that allows the tasks and responsibilities to be carried out. That is the transfer of a system or individual components of the dual model, not as a copying process, but as a selection and adjustment of processes, must be understood and determined by the objectives and structural conditions of the potential recipient, with adaptations to better serve to goals and cultures (BAETGHE; WOLKER, 2015; GRAF; POWELL, 2014; EULER, 2013; DEISSINGER, 2000).

In studies on the representation of knowledge in the dual model, Canto (2022) carried out a systematic review of the literature, which included 21 articles that specifically reported on how the German model of dual study is applied in SE, as well as its visible application. à-vis with the EFP. From the literature analyses, the author structured a macro plan, encompassing the dual model as a whole, which made it possible to design a comprehensive analytical framework (FIG. 1), based on the primary sources of the study.

Figure 1 - Macro view of the main findings in the literature on the dual study model
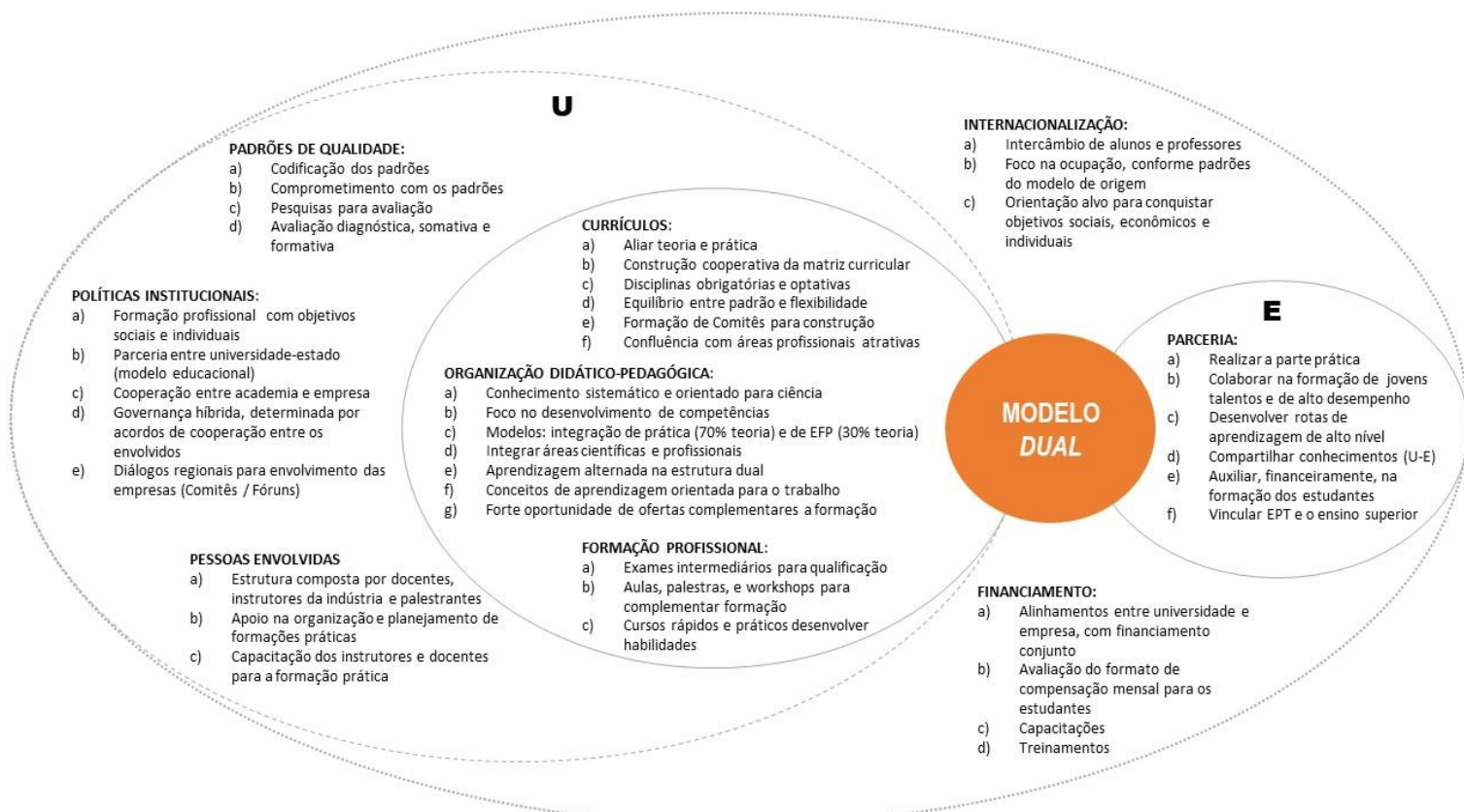
Source: Canto (2022, p. 96).

In addition to the macro view of the main findings in the literature, Canto (2022) used as a basis the analysis of the representativeness of the keywords to identify the basic constructs of the model, which were later correlated with the application of text mining (text mining), focusing on the Discovery of Knowledge in Texts (Knowledge Discovery in Text – KDT), to validate the findings and guide the

construction of a knowledge representation framework for the dual degree program, as detailed in the results and discussion topic.

The discovery of knowledge in text, according to Dixon (1997), goes through the stages of information retrieval, from the selection of documents that contain the information sought to the extraction of information, with the indication of the relevant items for the construction of the data, by mining, where patterns and relationships are sought in the data, and interpretation, where the data are analyzed, generating the outputs, in natural language format. KDT uses different techniques for knowledge representation, including text mining techniques.

The various text mining software available, based on known models (symbolic, connectionist, or evolutionary) have evolved and advances in this area are reflected in the possibilities of summarizing, classifying or categorizing, and clustering texts (WIVES, 2004). Still, the processing of natural language (Processing in Natural Language - NLP) contributes to simulating human cognition, from the characterization and explanation of the diversity of linguistic observations, whether in dialogues, writing, or any other. Thus, the integration of NLP and KDT techniques aims to automate the process of transforming textual data into information to enable the acquisition of knowledge (SCHIESSL; BRASCHER, 2011).

In the next topic, it is possible to understand how knowledge was extracted through the application of KDT, supported by text mining, based on the findings of the systematic literature review.

3 METHOD

The first stage of recognition of the constructs of the dual study model was based on a systematic literature review, where 21 studies were properly investigated, as reported by Canto (2022). To expand the acquired knowledge, documentary research was carried out based on the analysis of the websites and documents of the reference institutions identified in the foundation, namely: the Cooperative State University of Baden-Württemberg, the Duale Hochschule Baden-Württemberg (DHBW[1]); the Duale Hochschule Latinoamérica (DHLA[2]); the Colombo-German Chamber of Industry and Commerce for German International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit – GIZ[3]); and the Chamber of Commerce and Industry Brazil-Germany (Deutsche-Brasilianische industrie- und Handelskammer - AHK[4]).

Complementing the documentary survey, an unstructured interview was carried out via web conference with three experts on the German dual study model (a senior specialist, a native, who composed the community of practice, a representative of the AHK, and one of the GIZ) and the analysis of the

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[1] Available at: https://www.dhbw.de/english/home, access in April/2020.
[2] Available in: https://www.ahk-colombia.com/es/formacion-dual/duale-hochschule-latinoamerica, access in April/2020..
[3] Available at: https://www.giz.de/en/worldwide/12055.html, access in April/2020.
[4] Available at: https://www.ahkbrasilien.com.br/, access in April/2020.

empirical research called 'Analysis of the potential of a dual Brazilian model of professional training: final report' (PEREIRA; BAUER, 2020).

The second stage was divided into three phases, namely: Phase 1 – focus on identifying dimensions, categories, and indicators from the literature; Phase 2 – focus on mining the texts that formed the study corpus; and phase 3 – consolidation of knowledge and elaboration of the constitutive elements of the dual model. This study will deal with phase 2, the discovery of knowledge in the text (Knowledge Discovery in Text - KDT), from text mining.

Phase 2 started with Text Mining, which is "a method to support researchers and derives new and relevant information from a large collection of texts" (HEARST, 1999, p. 6), serving to validate the findings. of the first stage. Knowledge extraction was conducted in a corpus composed of 18 articles from the systematic review that was in English. The collection stage consisted of forming the knowledge base (corpus), pre-processing or cleaning the data to remove noise and preparing the data (unwanted characters, spelling and morphological correction, semantics, and vocabulary normalization) and the mining, when methods or mining tasks were applied through specific algorithms, thus allowing the interpretation of the results obtained. In TAB. 1 are the tools used in the processing phase, their description, and their purpose.

Table 1 – Tools used for text mining.

FERRAMENTA	TOOL DESCRIPTION	OBJECTIVE
Word Counter	To calculate the number of words, phrases, and compound terms.	Discover terms with the highest incidence in the corpus.
Voyant Tools (ROCKWELL; SINCLAIR, 2016)	To generate various graph formats for analysis	Check the variation in the incidence of terms, and generate the word cloud, in addition to the distribution of the corpus.

Source: Canto (2022).

The next topic, then, is the detailing of the phases required for the identification and validation of the key terms that guided the dual graduation model, based on the German model.

4 RESULTS AND DISCUSSION

The basic analysis of the literature pointed to 21 (54%) studies that specifically dealt with the context of SE, or correlated with EFP (DEISSINGER, 2000; GERLOFF; REINHARD, 2019; GRAF, J. et al., 2017; GRAF, 2018; HOFMANN et al., 2019; JACQUES; LANGMANN, 2016; MALLWITZ, 2013; ODEH et al., 2017; PAVLICEVIC et al., 2015; POGATSNIK, 2018; VAIRAKTARIS; MALLWITZ, 2014; WOLTER; KERST, 2015); (BAETHGE; WOLTER, 2015; DURAZZI; BENASSI, 2018; ERTL, 2020; REIN, 2017; ZHANG; SCHMIDT-HERTHA, 2019); SPÖTTL, 2013), in addition to three prominent references (GRAF, 2013; GRAF; POWELL, 2014; EULER, 2013) and empirical research (PEREIRA; BAUER, 2020).

Based on verification of the similarity of the knowledge reported in the studies, a significant set of constituent elements, which represented the main constructs addressed, were identified, as reported in the study by Canto (2022, p. 93-94), namely:

a) Governance - is associated with the conditions of a dual study program to provide a good integration between university and company, with consolidated partnerships (U-E) and connection with the government, guaranteeing an adequate organizational structure and cooperation, in a hybrid way (DEISSINGER, 2000; EULER; 2013; GRAF; POWELL, 2014; BAETHGE; WOLTER, 2015; PEREIRA; BAUER, 2020).

b) Financing - focuses on shared participation in dual system expenses, availability of student support (job, internship, or other support) investment in recruiting and training people, training and formalized partnership for importing the model (DEISSINGER, 2000; EULER; 2013; GRAF, 2013; BAETHGE; WOLTER, 2015; DURAZZI; BENASSI, 2018).

c) People - comprises indicators related to education and the availability of a highly qualified team (teachers, instructors, speakers, technical-administrative staff, company), training of high-performance students, among other stakeholders (government, state, hybrid management) necessary for the execution of the model (GRAF; POWELL, 2014; PEREIRA; BAUER, 2020; ERTL, 2020).

d) Curriculum - built in cooperation, based on the guiding principles of competence, special attention to the practice of training, flexibility (conditions and size of companies or economic sector), minimum standards required (basic and customizable), which meets the university, the student and the company (DEISSINGER, 2000; BAETHGE; WOLTER, 2015; GRAF et al., 2017; GRAF, 2018).

e) Training profile - focus on identifying training occupations in specific areas, with training itineraries that increase the flexibility and mobility of qualified professionals, reduce the risk of exclusion, and raise the level of education (EULER; 2013; GRAF; POWELL, 2014; BAETHGE; WOLTER, 2015; PEREIRA; BAUER, 2020).

f) Learning model - the interweaving of dual learning in different locations, with the definition of the integration model (EFP or EFP+ES), different proportions of time, in different operational phases, intensity and diversified form, development of work-oriented concepts, in real situations, with teaching and learning at the university and in the company (cooperative education) and a focus on skills (DEISSINGER, 2015; DURAZZI; BENASSI, 2018; GERLOF; RENHARD, 2019; HOFMANN et al., 2019).

g) Quality Standards - minimum requirements to ensure quality, namely: graduates' level of competence, employability conditions, implementation of organizational requirements at different levels, commitment to standards, availability with the teaching process, professional differentiation, scope and level of commitment (EULER; 2013; GRAF; POWELL, 2014; PEREIRA; BAUER, 2020).

h) U-E infrastructure - support for the development of the dual study program, with the availability of information and communication technologies (TICS), personalized company spaces (practical training), and educational institution environments, among others (COCKRILL; SCOTT, 1997; DEISSINGER, 2015; CARUSO et al., 2016; DUDYREV et al., 2018; PEREIRA; BAUER, 2020).

i) Complementary training - dual forms that expand training, in different areas of occupation, in the company or at the university, with a focus on complementing the professional profile, opening differentiated social paths in the format of projects, internships, transformation and social responsibility, applied research, equal opportunities and social inclusion (DEISSINGER, 1997; ATTWELL et al., 2008; EULER, 2013; JACQUES; LANGMANN, 2016; ODEH et al., 2017; HAASLER, 2020; PEREIRA; BAUER, 2020).

j) Application strategies - focus on priority objectives to be pursued with the implementation of dual training, involvement of economic sectors or industries, career opportunities, integrated curriculum, knowledge transfer (U-E), self-directed learning, reflective practice, transformative learning, rotation cycles, community research and internship, integrated work, including collaborative activities such as coordination, cooperation and co-construction (EULER; 2013; GRAF; POWELL, 2014; GRAF et al., 2017; GERLOF; RENHARD, 2019; ERTL, 2020; PEREIRA; BAUER, 2020).

Others – focus on employability, intercultural competence, internationalization, student mobility, innovation, global competitiveness of cooperation, appreciation of education, and acceptance of professional education (GRAF; POWELL, 2014; PEREIRA; BAUER, 2020).

In parallel, categories and indicators were identified in four scientific studies and the empirical study: (1) institutional division for higher education proposed by Baethge and Wolter (2015); (2) definition of the structure of the curricular arrangement by Deissinger (2000), with six indicators; (3) institutional conditions for transferring dual models, arising from the findings of Graf and Powell (2014); (4) constituent elements of the dual model pointed out by Euler (2013), with eleven indicators; and (5) essential indicators for implementing the model in Brazil, arising from the empirical study by Pereira and Bauer (2020), with eight indicators. Based on these findings, a content analysis was systematized, following the logic of Bardin (2006). Content analysis is a "set of communication analysis techniques that uses systematic and objective procedures for describing the content of messages" (BARDIN, 1993, p. 38), consolidating the searches of phase 1.

For phase 2, it was decided to use only the 18 studies in English, due to the representativeness of the sample, due to the divergence of languages (English, German, and Portuguese). With the corpus defined, the pre-processing stage began, aiming to prepare the texts for analysis, when the bibliographic references, citations, footers, subtitles, tables, figures, authors, journals, and terms in German were removed from the texts (explanatory), since this content did not add value in extracting knowledge from the corpus. The texts were saved in the "docx" format, and accepted in the two tools used in the study (Voyant Tools® and World Counter®).

Using the World Counter® tool, 113,892 words were identified, with 763,555 characters, in 4,323 sentences and 1,128 paragraphs. The reading level, assessed using the Dale-Chall readability formula, was 'university level'. In TAB. 2 are the 10 (ten) single, double and triple terms identified.

Table 2 – Main terms of the corpus

	UNIQUE	DOUBLES	TRIPLE
1º	Education (1419 – 4%)	Higher Education (689 – 9%)	Dual Study Program (222 – 8%)
2º	Dual (955 – 3%)	Dual Study (413 – 6%)	Vocational Higher Education (66 – 2%)
3º	Training (946 – 3%)	Study Programmes (255 – 4%)	Vocational Education Training (63 – 2%)
4º	Higher (785 – 2%)	Vocational Training (208 – 3%)	Dual Study Courses (61 – 2%)
5º	Vocational (774 – 2%)	Cooperative Education (192 – 3%)	VET and Higher Education (56 – 2%)
6º	Study (759 – 2%)	Education Training (160 – 2%)	Universities Applied Sciences (51 – 2%)
7º	Students (586 – 2%)	Dual System (158 – 2%)	Dual Study Program (49 – 2%)
8º	System (551 – 2%)	Baden Württemberg (109 – 2%)	Higher Education Institutions (37 – 1%)
9º	Programs (494 – 2%)	Labour Market (108 – 1%)	Higher Education System (35 – 1%)
10º	University (433 – 1%)	Cooperative Studies (85 – 1%)	Between Vocational Higher (32 – 1%)

Source: Canto (2022, p. 133)

There was a correlation between the results of text mining and the terms identified in the keywords of the selected articles. It should also be noted that the most representative keywords were used to create the search syntax in the indexed databases[5], directing the search. Among the terms with the highest

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[5] (TITLE-ABS-KEY("Advantages of dual Study" OR "Dual Education" OR "Dual Learning" OR "Dual Study" OR "Dual Study Program" OR "Dual System") AND TITLE-ABS-KEY("Professional qualifications" OR education OR training OR

incidence, mining pointed to: "Education", "Dual", "Training", "Study", "Programmes", "University", "Dual Study", "Dual Study Program", "Dual System", "Cooperative Education" and "Cooperative Studies".

In the analysis of the representativeness of the keywords, and not only the terms used, 'dual' was highlighted, followed by cooperative/collaborative, as pointed out by the findings arising from mining. Still, "Higher Education" (1st) and "Vocational Education Training" (3rd), with a high incidence, despite not having been used in the search strategy, indicate that the base of the theoretical foundation is adherent to the mining findings, as well as the terms "Baden Württemberg, Cooperative Studies, Vocational Education Training and Universities Applied Science". These findings indicated that the bibliometric verification showed results similar to those of text mining, guaranteeing the scientific characteristics, with the necessary rigor and relevance.

The relationship between rigor and relevance is an indispensable and basic characteristic of any scientific research, as emphasized by Havner et al. (2004). In this line, it corroborates with Romme (2003) when he emphasized that rigor in conducting research allows greater interaction between the theoretical and practical world, and with Van Aken (2004) when he emphasized that relevance acts as a facilitator for later use by organizations as it served to solve the problem, or a class of problems. Thus, to observe the representativeness of the texts in each of the studies and extract relevant knowledge, text mining algorithms were applied to the pre-processed corpus.

The Software Voyant Tool®[6] , an open source Web-based reading and text analysis environment was used from the Reader tool. In FIG. 2, the bars represent each document, the higher they are, the longer the text. The longest was by Graf (2018), followed by Wolter and Kerts (2015), Baethge and Wolter (2014), Spöttl (2013), and Deissinger (2000), with a proportion of 19% and 20% in the total sample, the namely: 8477 (19%) words, 7498 (19%), 6906 (19%), 6884 (20%) and 6708 (20%) respectively. About vocabulary density, the highlights were Pavlicevic (2015), Odeh et al. (2017), Pogatsnik (2018), Mallwitz (2014) and Jaques and Langmann (2016) (0.302; 0.302; 0.295; 0.291; and 0.291, respectively). It is noteworthy that the studies by Baethge and Wolter (2015) and Deissinger (2000), along with those by Graf and Powell (2014), Euler (2013) and Pereira and Bauer (2020), were the guiding principles, since contemplated the categories and indicators of the German model of dual study.

"Cooperative education" "Cooperative studies" OR "Cooperative university" OR "Cooperative universities")) AND (LIMIT-TO (OA, "all")) AND(LIMIT-TO(DOCTYPE, "ar")).
[6] https://voyant-tools.org/

Figure 2 - Representativeness of studies in the corpus
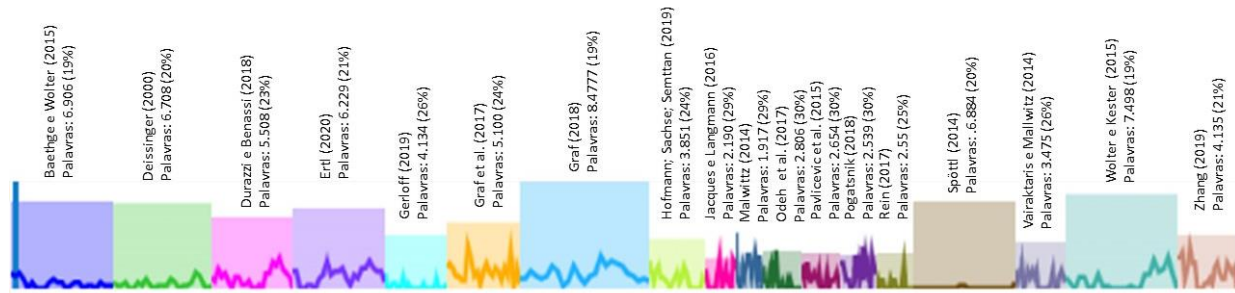
Source: Elaborated from the Voyant Tools® Software

The most frequent words in the corpus were education (968), dual (934), study (767), training (670), and students (553), being present in the 18 documents, according to the Summary tool. When all the words were compared, the ones that were configured as distinct were: VET, segment (BAETHGE; WOLTER, 2015); VET, polytechnic; academies (DEISSINGER, 2000); stem, formation, skill (DURAZZI; BENASSI, 2018); employers, integrating, trainees (ERTL, 2020); DHBW, internalization, foreign, programs (GRAF et al., 2017); gradual, programs, layering (GRAF, 2018); UCE (University of Cooperative Education), compensation, informatics (HOFMANN; SACHASE; SMITTAN, 2019); program, UAS (University of Applied Science), unskilled (JACQUES; LANGMANN, 2016); and science, risk, effective, quantify (MALLWITZ, 2014).

To identify the most representative words, which are associated with the terms of the search string, the Cirrus tool from the Software Voyant Tools® was used, generating a cloud of words (FIG. 3). These words graphically reinforce some findings found throughout the study, with emphasis on terms that are directly associated with the dual study model, perceived in the analyzes of domain specialists, such as practical, knowledge, work, firms, professional, vocational, companies, graduate, university, social and mobility.

Figure 3 - Cloud of words extracted from the corpus

Source: Elaborated from the Voyant Tools® Software

Five terms showed a higher relative frequency in the corpus, namely: dual, education, higher, training and vocational. To verify the incidence variation of the five terms, Y axis, and in the 18 texts that make up the corpus, on the X axis, the Trends tool was used, as shown in FIG. 4. The five terms were highly frequent in virtually all texts, with emphasis on 'education', with a linear distribution throughout the corpus. This finding suggests that all authors present this term as a focus, but with emphasis on Id's 1, 15, 16, 17 and 18 (BAETHGE; WOLTER, 2015; REIN, 2017; SPÖTTL, 2014; VAIRAKTARIS; MALLWITZ, 2014 ; WOLTER; KERST, 2015). It was observed that the texts have the main terms with a relative frequency, which demonstrates that they can and should be used for research in the area. It is also noteworthy that all analyses corroborate with those already performed in the World Counter® tool (FIG. 1), with similarity in the relevance of the terms.

Figure 4 - Relative frequency of the five terms applied to the corpusSource: Canto (2022, p. 136)
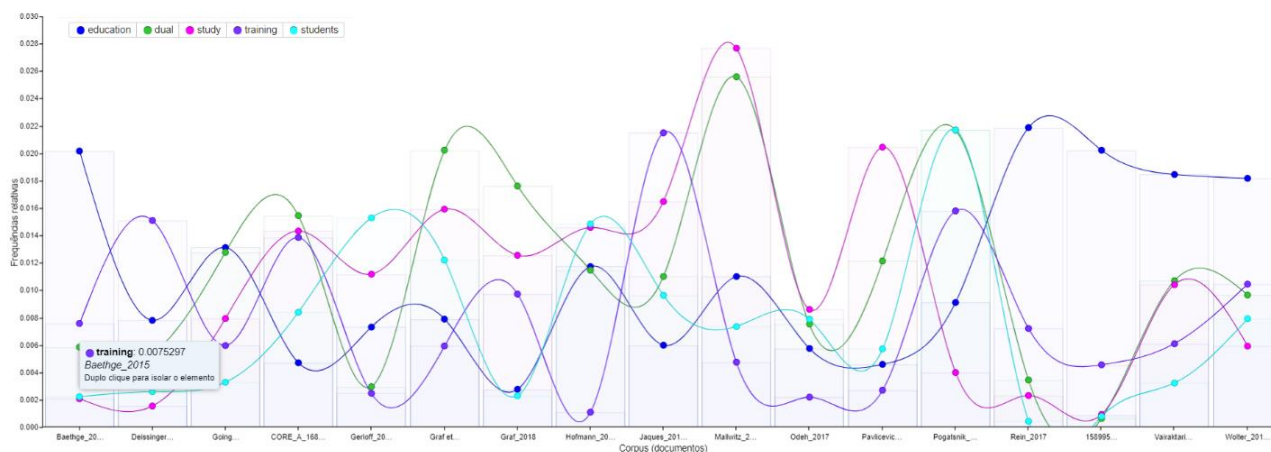
In the simple regression analysis, using Pearson's Correlation Coefficient, the level of correlation of the term 'education' with the others in the sample was verified. It was observed that the score remained below one (-1) for all terms, indicating that the frequencies varied inversely, that is, they increased for one term while falling for the other (FIG. 5). Regarding the significance of the correlation value ($p < 0.05$), it is observed that 'education' indicated a strong significance, which allows discarding the hypothesis that the values are randomly distributed. However, the validity of this measure depends on the assumption about a normal value of data distribution, and because the relatively small values, and frequency of text segments in a corpus, allowed inferring that this should be used with caution.
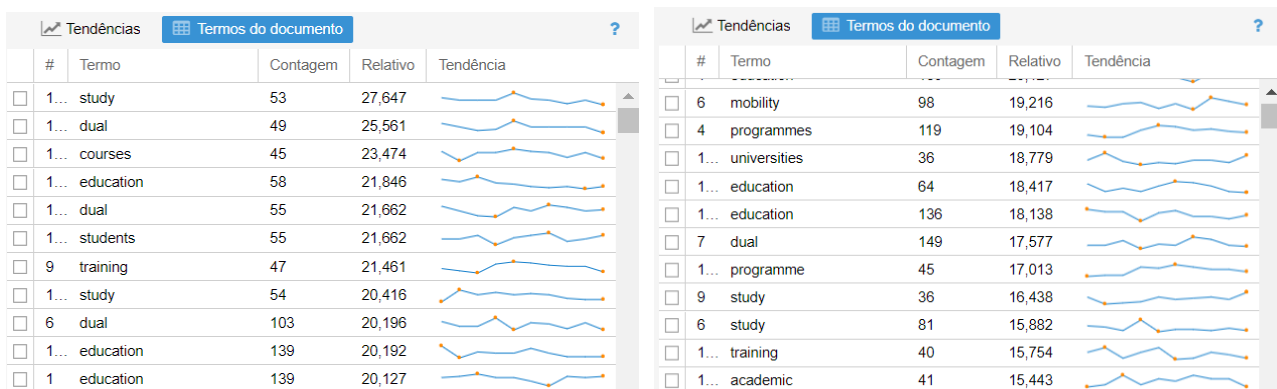
Figure 5 - Correlation level of terms frequency and significance

Correlações					
Termo 1	←	→	Termo 2	Correlação...	Significânci...
education			study	-0.47662812	0.0043745...
dual			education	-0.43663746	0.079709604
education			training	-0.09528173	0.43957734
dual			study	-0.0727464...	0.6119394
education			work	-0.0653589...	0.48005667
study			training	-0.0612903...	0.54057175
dual			work	-0.0550804...	0.5241912
dual			training	-0.0483212	0.6605457
study			work	-0.04316411	0.59626514
training			work	-0.0067314...	0.93057525

Source: Elaborated by the Author in Voyant Tools® Software

Next, the analysis of the relative frequency of terms in the corpus was performed. From the reordering by count and trend, by the distribution of relative frequencies among the documents in the corpus, it showed that the terms with the highest relative frequency are 'study' and 'dual' (27.6 and 25.5, respectively), and the highest absolute frequency are 'dual' and 'education' (score = 149 and 139, respectively). Observing the statistical measure of how much the relative frequencies of a term in a corpus are grouped into peaks (regions with higher values - peakedness), it was noticed that there was a significant oscillation for most terms, as shown in FIG. 6. However, among the 20 most relevant terms, it is noticed that 'courses', 'students', 'mobility', 'programmes', 'universities' and 'academic', which pointed to higher education, demonstrated significant relevance in the comparison made between documents in the corpus.

Figure 6 - Pattern of the most frequent terms in the corpus

#	Termo	Contagem	Relativo	Tendência
1...	study	53	27,647	
1...	dual	49	25,561	
1...	courses	45	23,474	
1...	education	58	21,846	
1...	dual	55	21,662	
1...	students	55	21,662	
9	training	47	21,461	
1...	study	54	20,416	
6	dual	103	20,196	
1...	education	139	20,192	
1	education	139	20,127	

| #	Termo	Contagem	Relativo	Tendência
6	mobility	98	19,216	
4	programmes	119	19,104	
1...	universities	36	18,779	
1...	education	64	18,417	
1...	education	136	18,138	
7	dual	149	17,577	
1...	programme	45	17,013	
9	study	36	16,438	
6	study	81	15,882	
1...	training	40	15,754	
1...	academic	41	15,443	

Source: Elaborated by the Author in Voyant Tools® Software

In more advanced research, we sought to assess the relevance and significance of the term 'higher' in the corpus, since it is a term that also directs to higher education. It was observed that this term has a significant relative frequency (13,870), ranking 30th, with the term 'DHBW' appearing right behind. Such trends indicated that the selected corpus brings the required approach, which corroborates the analysis of domain specialists. Also, a network graph of the terms that occurred most frequently was generated from the Link tool of Sofware Voyant Tools®, pointing out the most relevant term 'study' in the texts. What is inferred from the graph is that the terms arising from mining are directly correlated with the initial analyzes

carried out with the domain specialists, with relevance to the dual terms, education, study, training, students, governance, stakeholders, curriculum, firm, employers, job, extension, salary, industry, study, qualification, places, learning, higher, academic and social.

Thus, to consolidate all the proposed indicators in the five dimensions obtained from the literature, which come from the analysis of the domain experts, when correlated to the most relevant terms identified in the text mining, a representative flow of the elements of the dual graduation model was elaborated, as shown in FIG. 7.

Figure 7 - Representative flow of the elements of the dual graduation model source: Canto (2022, p. 139), com base nas dimensões de Baethge e Wolter (2015)
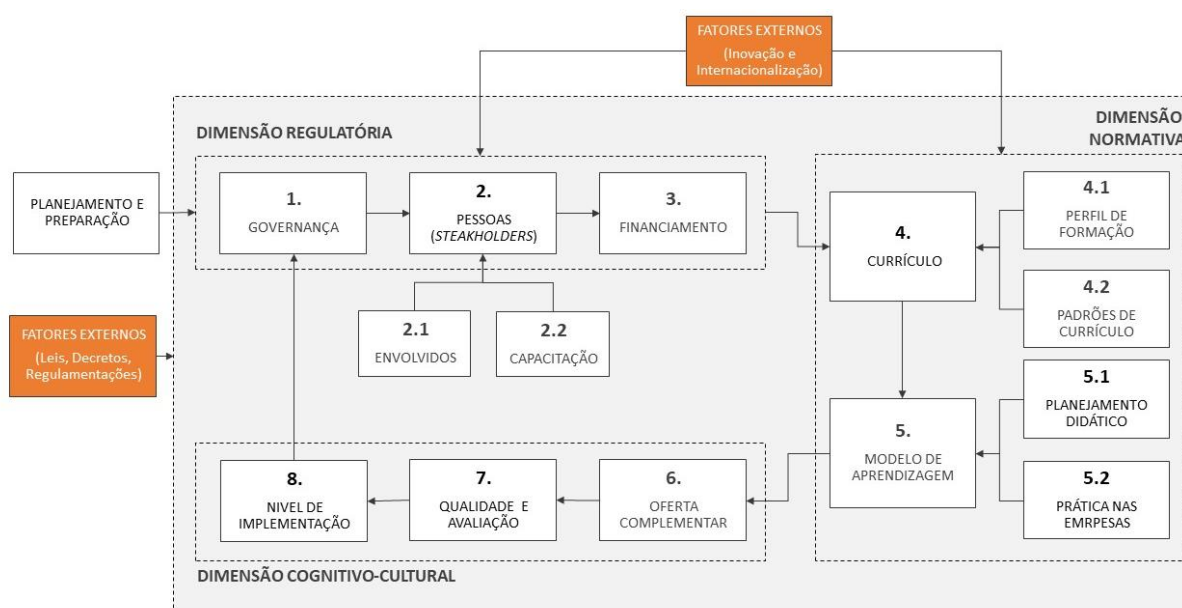
This stream presents a comprehensive framework that contributes to providing a macro view of the data that education institutions and organizations need to make use of the dual degree model, based on the German model.

In this way, the data model that guided the decision-making allowed for portraying and analyzing the knowledge about the dual graduation model. The consolidation of the data obtained from the analysis of the domain experts, which generated the selection of the initial items, correlated with the terms obtained in the text mining, brought the necessary certainty and relevance to guarantee the rigor in decision-making in the subsequent stages.

5 CONCLUSION

What was observed was that scientific studies, combined with empirical study and text mining, allowed identifying dimensions, categories and indicators that represented the dual graduation model, based on the German model. In this way, it was possible to identify the basic knowledge of the model, both those

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arising from the systematic review of the literature and those from the mining of texts, which correlated to consolidate the acquisition of knowledge.

Text mining made it possible to consolidate the initial survey that pointed to 11 guiding constitutive elements, forming from the final identification of eight of them that came to be considered as key activities of the German model of dual study, namely: governance, people, funding, curriculum, learning model, complementary offer, quality/evaluation and level of implementation. Planning and preparation and external factors (laws, decrees, regulations, innovation and internationalization) also have an important impact, as they consolidate the possibility of application, are essential inputs for decision-making on the application of the model.

Ultimately, the individual components of the dual model cannot be seen as a copying process for possible transfer, but as a selection of key activities that need fine-tuning for their deployment. And this analysis must be understood and determined by the objectives and structural conditions of the potential recipient, with adaptations that must be made to better meet the objectives and the local culture.

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