



IJRSLCE

International Journal
of Research on
Service-Learning &
Community Engagement

Volume 13 | Issue 1

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Recommended Citation

Cruz Gutierrez, W. H. (2025). Topic modeling as a technique for studying the institutionalization of service-learning in higher education. *International Journal of Research on Service-Learning and Community Engagement*, 13(1).
<https://doi.org/10.37333/001c.146331>

Topic Modeling as a Technique for Studying the Institutionalization of Service-Learning in Higher Education

Wilmer Hernan Cruz Gutierrez

Abstract

Service-learning in higher education has emerged as a significant area of research in recent decades. While this notable growth reflects the academic and scientific community's interest in the subject, it also introduces new challenges for researchers navigating the field, as the vast universe of information requires more time and knowledge to identify relevant ones. In response to these challenges, this document employs a natural language processing technique designed to extract data from an extensive corpus of documents and identify underlying or latent themes. The technique, known as *topic modeling*, was applied to 354 documents from the Scopus database to uncover hidden patterns and themes. The analysis revealed a model of institutionalization of service-learning grounded in critical principles of social justice. This model prioritizes local, diverse, and complex realities; emphasizes the perspective and participation of key stakeholders; is legitimized by frameworks of social responsibility and sustainable development; and is directed toward cultivating citizens with critical awareness and social commitment.

Keywords: *institutionalization, higher education, social responsibility, sustainable development, topic modeling*

El Modelado de Temas como Técnica para Estudiar la Institucionalización del Aprendizaje Servicio en la Educación Superior

Wilmer Hernan Cruz Gutierrez

Resumen

El aprendizaje-servicio en la educación superior se ha convertido en un área de investigación importante en las últimas décadas. Si bien este notable crecimiento refleja el interés de la comunidad académica y científica en el tema, también presenta nuevos desafíos para los investigadores que se desenvuelven en este campo, toda vez que el vasto universo de información conlleva mayor tiempo y conocimiento para identificar información relevante. En respuesta a estos desafíos, este documento ofrece una técnica de Procesamiento del Lenguaje Natural (PLN) diseñada para extraer datos de un extenso corpus de documentos e identificar temas subyacentes o latentes. La técnica, conocida como modelado de tópicos, se aplicó a 354 documentos de la base de datos Scopus para descubrir patrones y temas ocultos. El análisis reveló un modelo de institucionalización del aprendizaje-servicio basado en principios críticos de justicia social. Este modelo prioriza las realidades locales, diversas y complejas, enfatiza la perspectiva y la participación de los actores clave; se legitima en marcos de responsabilidad social y desarrollo sostenible; y está orientado a formar ciudadanos con conciencia crítica y compromiso social.

Palabras clave: *institucionalización, educación superior, responsabilidad social, desarrollo sostenible, modelado de temas*

Editors' Note: Translation provided by Wilmer Hernan Cruz Gutierrez

Global sustainability agendas, notably the 2030 Agenda (UN General Assembly, 2015), urge higher education institutions to foster societal transformation by cultivating citizens with the desire and capacity to build democratic, equitable, and just societies and open the door to educational innovations such as service-learning (SL; Mortari & Ubbiali, 2021). The reason for this is that SL invites educational institutions to go beyond the passive acquisition of theoretical knowledge, integrating curricular content with the realities and needs of communities, and taking communities as the axis of action and field of learning, not from a vertical and paternalistic approach but from a supportive approach of co-construction of knowledge as a social good, which therefore serves not only the personal development of the student but also the community and its dynamics of justice, democracy, and fraternity (Tapia, 2010, 2019, 2021).

The possibility offered by SL as an effective pedagogical approach, with the ability to articulate academic learning with community service, has garnered increasing interest in higher education (Gill et al., 2023), spurring a significant rise in academic and scientific production in all academic disciplines (Salam et al., 2019), and transcending borders and continents (Choi et al., 2023; Sotelino-Losada et al., 2021) and with a constant increase in recent decades (Tijmsa et al., 2023). Reflecting this trend, Hallinger and Narong (2024) report that approximately 75% of all scientific production on the subject has been produced since 2010.

However, while the increase in scientific production reflects a significant interest in enhancing the understanding and application of SL (Sotelino-Losada et al., 2021), it also introduces new challenges in the scientific field, especially for those interested in approaching the subject or deepening their analysis. The challenge is that the greater the proliferation of content, application of theories and methods, and their respective outcomes, the greater the challenge for the scientific community to identify and analyze the current state of the field, advances, and relevant studies (Linnenluecke et al., 2019).

In an effort to address these challenges and thus offer alternatives for those interested in SL in higher education, this study introduces a natural language processing (NLP) technique known as *topic modeling*. The capacity of the technique to discover, organize, and analyze thematic patterns, and in turn provide transparency and replicability to the research (La Hoz-M et al., 2021), has been put into practice in one of the research topics that turns out to be among the most urgent currently in the field of SL in higher education, namely, the institutionalization of SL in higher education (Gill et al., 2023).

SL and Its Institutionalization in Higher Education

One example illustrating the challenges of researching SL when it is a topic characterized by extensive and ever-growing literature can be found by examining its definition. Mortari and Ubbiali (2021) highlight the diversity of definitions of SL, noting that while this reflects the richness of context-sensitive practices, it simultaneously turns out to be a sign of the weak definition of SL since overdefinition ultimately demonstrates the lack of definition of an object.

Nevertheless, for the purposes of this article, SL is defined as a pedagogical innovation that emphasizes the role of both students and communities in the processes of learning and teaching, understanding that the relationship between these actors corresponds to a dynamic and dialectical interaction. The connection that exists between students and society seeks to articulate learning goals with social needs, understanding that each of the actors is capable of learning, teaching, and serving. Among the expected impacts is the transformation of the social reality of the communities while fostering critical, civic, participatory, and collaborative skills (Bringle & Hatcher, 1996; Deeley, 2015; Tapia, 2021).

In this regard, collaborative and reciprocal engagement between students and communities underscores the alignment of SL with the core missions of universities (Bringle & Hatcher, 2000). In today's academic landscape, the university's mission emphasizes active, collaborative, and socially relevant learning processes that enable students to develop personally and professionally with a strong commitment to civic participation oriented toward the common good. Accordingly, the integration of SL into university curricula serves to fulfill their institutional mission and responsibility to transform and improve justice, democracy, and inclusiveness of societies. In other words, universities seek to fulfill their institutional social responsibility through SL (Corrales Gaitero & Andrade Zapata, 2021; Martínez, 2022).

One-way universities pursue their social responsibility through SL is not only by highlighting the convergences between the university's mission and the premises of SL but also by integrating SL into the cultural, structural, and procedural frameworks of the university. More specifically, the cultural dimension refers to the integration of the SL into the values, norms, beliefs, policies, philosophy, mission, vision, and identity of the university. The procedural dimension focuses on the methods and practices by which the SL is incorporated into the teaching and learning dynamics of the university. This encompasses both interinstitutional and intrainstitutional management, including processes such as curriculum and financial management, recognition and dissemination procedures, faculty training, and interdepartmental and university–community interactions, among others. The third and final dimension is the structural dimension, which pertains to the institutional recognition and support provided by the university through the establishment of dedicated structures, such as specialized units, that are responsible for promoting and coordinating the SL within the university (Bringle & Hatcher, 1996, 2000; Furco & Miller, 2009; Holland, 1997).

The aforementioned can be summarized as the process of institutionalizing SL in higher education (Bringle & Hatcher, 2000; Ti et al., 2021). The goal of this process is to integrate social learning as an integral, permanent, and legitimate part of the university. This integration renders social learning initiatives more sustainable, enduring, and meaningful for the institution, communities, and civil society (Bringle & Hatcher, 2000).

Despite the clear alignment between SL and the core mission of higher education, universities continue to encounter several internal challenges that impede the effective implementation of this approach. This is the case with traditional academic administrative management schemes of universities, where social programs and the relationship between the university and the community are assigned to isolated units (e.g., offices of social outreach or community engagement). As a consequence, at the institutional level, that is, structural, cultural, and procedural, the university's social mission becomes separated from its other core functions, namely, teaching, management, and research (Forero-Jiménez, 2019). It is also common that SL initiatives encounter resistance and skepticism from faculty (Heffernan, 2011), and those faculty committed to SL frequently lack the necessary financial, administrative, and training support (Ti et al., 2021). Finally, teaching and learning processes in higher education are not uniformly applied across all disciplines or curricular areas; rather, they are typically confined to so-called “soft” disciplines, such as the social sciences, or considered marginal practice that can only be completed together with the curriculum, that is, in a cocurricular manner (Butin, 2006). This, in turn, leads to social activities being regarded as occasional, sporadic, and lacking continuity (Tapia, 2019).

The aforementioned is presented in various systematic reviews on the subject, which highlight that, although the potential to foster meaningful, socially engaged learning of SL is widely recognized, various factors—such as lack of faculty time, pedagogical training, funding, and reward and recognition systems; and disarticulation between departments, disciplines, research processes, teaching, and extension, among others—make the processes of institutionalization in higher education a pressing issue with potential for development and improvement in its research and implementation (Cunningham & Smith, 2020; Tijmsa et al., 2023).

Then, SL has emerged as a rapidly expanding area of scholarly inquiry. Within this context, its institutionalization is viewed as a process that not only is relevant and necessary but also holds potential for further development. In these circumstances, topic modeling is introduced as a methodological alternative for identifying latent information and thus obtaining inputs that facilitate the identification of structural and central themes contributing to the approach and understanding of the defining characteristics of SL institutionalization in higher education.

Topic Modeling

Topic modeling is an NLP technique. NLP can be defined as the ability of a computer/machine to understand, interpret, and produce natural language, that is, human language (Grisales et al., 2023). Within

this framework, topic modeling is regarded as an unsupervised NLP technique that extracts data from a large collection of documents to identify underlying or latent topics (Verma & Yuvaraj, 2023).

Regarding previous information, two aspects merit highlighting: unsupervised learning and latent information. For the first concept, it is important to note that automatic information processing can be either supervised or unsupervised. The key difference is that in supervised processing, the researcher must manually code a set of documents and thereby create code sheets, which will be used as an input set to train the information processing model, whereas the second method omits this step and performs it automatically (Asmussen & Møller, 2019; La Hoz-M et al., 2021). The strength of unsupervised techniques lies in their ability to save time and minimize the need for prior knowledge of the researchers in the field (La Hoz-M et al., 2021). The second concept, latent information, refers to hidden semantic patterns, that is, information that may not be evident in the direct observation of the data but can be inferred using statistical models (Verma & Yuvaraj, 2023).

According to the contributions of authors such as Chen et al. (2023), Gillings and Hardie (2022), Grisales et al. (2023), La Hoz-M et al. (2021), and Verma and Yuvaraj (2023), three strategies stand out as the most applied in topic modeling: (a) Latent Semantic Indexing, which constructs a matrix of terms based on their frequency across documents and from which the most relevant terms are identified through dimension reduction processes; (b) Probabilistic Latent Semantic Analysis, which conceptualizes topics based on the probabilistic distribution of words, that is, it does not consider the frequency of words but measures the likelihood that a word belongs to a topic (this approach is particularly effective in identifying relevant documents that might not be easily identified since it does not make direct use of search terms but of their synonyms); (c) Latent Dirichlet Allocation (LDA), which uses multinomial distributions (a type of discrete probabilistic distribution) to model how topics are distributed in a document and how words are distributed within topics, which is thus conceived as a mixture of several words and the document as a mixture of several topics. Then, the document will have a multinomial distribution over topics and the topics a multinomial distribution over words. LDA turns out to be a Bayesian version of the Probabilistic Latent Semantic Analysis method (see La Hoz-M et al., 2021).

Topic Modeling as a Support for In-depth Literature Analysis

Although topic modeling is very useful for identifying themes or topics within a corpus of many documents, authors such as Asmussen and Møller (2019) have pointed out that this analytical approach has been infrequently applied in literature review studies; therefore, they advocated for the use of topic modeling as a method, which can then serve as a basis for in-depth analysis.

In keeping with the goal of providing topic modeling, and its LDA technique, for literature reviews that are transparent, replicable, time-efficient, independent of the researcher's prior expertise, and free from the prior classifications, categorizations, or labeling, La Hoz-M et al. (2021) enhanced the use of topic modeling in literature review processes by introducing a novel computational tool. The primary objective was not to present new forms of data processing but rather to facilitate a deeper understanding of, and particularly, the application of LDA in literature reviews and its underlying mechanisms of data cleaning, preprocessing, inferencing, and postprocessing (La Hoz-M et al., 2021).

The tool created by these authors is called LDAShiny and is available at: <https://github.com/cran/LDAShiny>. LDAShiny is part of the open-source environment R in the Comprehensive R Archive Network (CRAN). Although the authors point out that there are 59 NLP-related packages in the R ecosystem, eight of which implement topic modeling through LDA, LDAShiny package is the only one that offers a graphical user interface. The package and its interface are intuitive, enabling researchers to employ it without prior statistical, programming, and machine learning knowledge (La Hoz-M et al., 2021).

Methodology

The present investigation accessed the tool LDAShiny through the integrated development environment for the programming language (R Studio). After downloading and installing the data package and library,

the graphical interface was launched via a web browser. This interactive environment provided access to tutorial material on the use of the package, the preprocessing (loading and cleaning the data), the inference (applying the LDA approach and modeling), and the postprocessing (analyzing results). The methodological design primarily followed the contributions of La Hoz-M et al. (2021), the creators of the tool.

The application of Topic Modeling aimed to answer the research question: What are the latent themes and emerging patterns in the academic literature on the institutionalization of SL in higher education? Consequently, the main objective was to employ topic modeling techniques to identify latent thematic structures along with their corresponding subthemes and relevant documents.

Initially, search terms were identified based on keywords derived from the research question and objectives. “Service-learning,” “higher education,” and “institutionalization” were selected. Following the recommendations of Kugley et al. (2017) and Linnenluecke et al. (2019), a Boolean operator (AND, OR, NOT) search strategy was employed. The identified word groups and their configurations were as follows: group A: “service learning” OR “service-learning”; group B: “higher education” OR “higher-education” OR “university” OR “college” OR “post secondary” OR “post-secondary”; group C: “institutionalization” OR “institutionalisation” OR “institutionalizing” OR “institutionalising” OR “institutionalised” OR “Institutionalised.”

The database used for the search and selection of scientific articles was Scopus. Although Scopus is relatively new, with coverage from 2004, it boasts a vast and diverse collection, comprising 90 million documents, 17 million researcher profiles, and access to 7,000 publishers. Consequently, Scopus is considered the largest multidisciplinary database and the most comprehensive resource for the social and education sciences (Jrad, 2023).

The search strategy was implemented as follows: Each group represented a distinct search block. Groups A and B were applied to the “Article title, Abstract, Keywords” Section, and group C was extended to the “All fields” section. The search was conducted on December 15, 2023.

Supported by the advantage that topic modeling has in addressing large quantities of documents to find more precise latent thematic structures without requiring a large time investment for the researcher (La Hoz-M et al., 2021), and the fact that a greater variety of document types can serve to avoid search and publication biases (Suri, 2020), it was decided not to define exclusion or inclusion criteria based on document type, time, language, or region.

Processing of Information

After applying the search terms and selection criteria to the databases, a CSV file was downloaded from Scopus. The obtained file contained the following metadata used in the technique: title, keywords, and abstract. The extraction file type was determined based on its capacity for information retrieval and the type of file that can be read by the software. To select the optimal format, tests were conducted by downloading all the options, reading tests of the software, and comparing the amount of information retrieved.

Treatment of Information for Topic Modeling

As mentioned, the package used was LDAShiny. It applies the LDA technique, which is the most widely used and validated in research using topic modeling (Rüdiger et al., 2022). The package streamlines all the steps required for the application of the LAD technique, that is, preprocessing, inference, and postprocessing. An additional advantage is the integration of the graphical user interface, which facilitates an intuitive exploration of scientific literature and enables the generation of information in tables and graphs that can be exported in various formats (La Hoz-M et al., 2021).

The parameters of La Hoz-M et al. (2021) were adopted for the preprocessing, model configuration and application, and postprocessing phases. These authors are the creators of LDAShiny and have confirmed the legitimacy and usefulness of these configuration parameters for exploratory studies in literature.

Results

A total of 354 documents were extracted for Scopus after the data cleaning process that primarily involved removing duplicate entries and reading the title and abstract to assess the relevance of texts (Hallinger & Kovačević, 2023).

Preprocessing

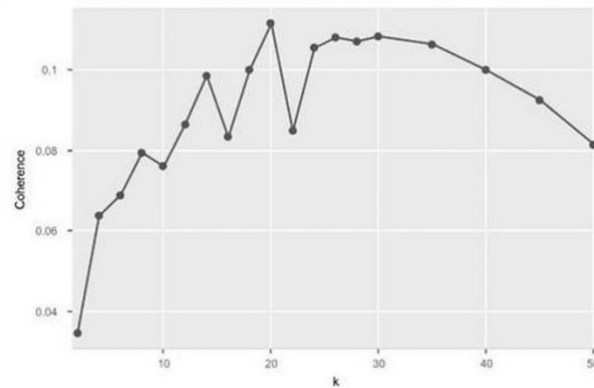
This first process aimed at normalizing the data, that is, reducing the dimensionality of the dataset matrix to a standard form by eliminating meaningless or unweighted terms. It is important to note that the preprocessing phase is an iterative and nonstandardized process where different configurations (with different N-grams, with or without reduction to the root, with or without elimination of potentially empty words, etc.) can be applied to find coherent thematic models. The use of empty words was kept because this step discards words that are very frequent (e.g., articles, pronouns) but have no lexical meaning (La Hoz-M et al., 2021), which reduces the computational complexity of data mining and thus improves the performance of the analysis. For noise reduction, the R package “stopwords” (Multilingual Stopword Lists) was used (available at: <https://cran.r-project.org/web/packages/stopwords/index.html>). The stopwords package has been employed and validated in previous studies (Verma & Yuvaraj, 2023).

Derivation, tokenization, and sparsity techniques were also implemented during this phase. Derivation reduces a word to its root form, which further decreases the dataset’s dimensionality and improves computational efficiency (Asmussen & Møller, 2019). Tokenization refers to the separation of morphemes (words) into N-grams. Although unigrams are the most commonly used unit in topic modeling (Verma & Yuvaraj 2023), the corpus under analysis includes compound words represented as bigrams (e.g., SL, community engagement, social justice, higher education, social responsibility). Treated independently as unigrams, these terms lose meaning and complicate analysis. In addition, the use of bigrams can also reveal other types of dependencies of words with related meanings (Asmussen & Møller, 2019). Sparsity techniques were applied to eliminate both rarely used terms that appear in very few documents, as well as possible errors in the data (e.g., misspelled words). This technique reduces the dimensionality of the dataset without sacrificing essential information. In accordance with La Hoz-M et al. (2021), a cutoff of 0.95 was applied, where terms appearing in less than 0.5%–1% of the articles are candidates for being discarded. As a result, the number of terms decreased from 38,113 to 5,463.

Inference

In this phase, the goal is to determine the appropriate parameter k , that is, the number of topics that best represent the thematic structure of the field. This process follows the premise that an excessively high k yields a large number of very specific topics, while an overly low k results in topics that are too general (La Hoz-M et al., 2021). To determine the optimal number of topics, the coherence method, comparison of four methods, perplexity, and harmonic mean can be employed.

In this study, the coherence method was used. It is widely used in topic modeling techniques, and its results allow to identify the optimal number of words that encompass the most relevant information in each topic by measuring the frequency with which the principal keywords co-occur (Blair et al., 2020). The configuration of each parameter was executed in accordance with the proposal of La Hoz-M et al. (2021). The results of this process are summarized in Figure 1.

Figure 1.*Graph of Coherence Method for Bigrams*

To ascertain the optimal number of topics, a graph plotting the number of topics (k -axis) against their corresponding coherence values (y -axis) was analyzed. The objective was to identify coherence peaks to ensure the selection of a logical, interpretable, and semantically robust model. The graph showed high values in the range $k = 20$ to $k = 35$. A subsequent qualitative review of the models with 25, 30, and 35 topics led to the conclusion that the model with $k = 32$ offered the best balance between specificity (clearly differentiated topics) and coverage (without being overly vague).

Postprocessing

For configuring and adjusting the model, the parameters recommended by de La Hoz et al. (2021) were maintained in terms of the number of times the model checks and adjusts the assignments of words to topics in the sampling process (iterations: 1,000), the initial number of iterations that are discarded before starting to sample the model (bur-in: 100). For the parameter to regulate the distribution of topics (α value), the formula of Griffiths and Steyvers (2004; cited by de La Hoz et al., 2021) was followed, yielding an α value of 2.08. The results are presented in Table 1, which enumerates the 32 topics along with their constituent subtopics and provides scores for both coherence (internal consistency of the words within each topic, i.e., contextually coherent words) and prevalence (the frequency or importance of the topic in the whole corpus).

Table 1.*List of Topics and Their Respective Contents*

T	label_1	Coh	Prev	top_terms
t_1	local_partners	0.065	2.263	model, learning, university, schools, program, media, students, local, partnership, practical
t_2	international_service	0.059	3.048	students, health, international, experiences, service, learning, educators, care, international service, program
t_3	service_learning	0.038	2.847	projects, learning, university, third, service, development, innovation, practices, communication, information
t_4	informa_uk	0.072	2.851	implementation, provide, analysis, study, strategies, institutionalisation, academic, courses, identified, learning
t_5	service_learning	0.055	3.426	students, impact, participation, positive, self, study, people, increased, learning, attitudes
t_6	learning_programs	0.069	2.805	knowledge, curriculum, programs, learning, activities, assessment, academic, university, outcomes, service
t_7	community_engagement	0.13	3.273	community, engagement, community_engagement, south, african, university, learning_community, book, learning, power
t_8	methodology_approach	0.048	3.045	approach, learning, design, value, science, teaching, four, approaches, stakeholders, projects
t_9	service_learning	0.03	5.799	learning, service, service learning, academic, practice, research, pedagogy, field, university, institutionalizing
t_10	learning_servicelearning	0.165	3.316	service learning, university, learning_sl, students, methodology, learning, end, training, degree, results
t_11	civic_engagement	0.029	3.095	university, community, service, engagement, united, education, states, research, state, united states
t_12	community_partners	0.141	3.154	interviews, study, using, perspectives, qualitative, practice, students, learning, framework, analysis
t_13	based_research	0.047	2.571	research, diverse, society, us, complex, attention, learning, specifically, ethical, focuses
t_14	social_responsibility	0.073	2.759	responsibility, change, learning, service, social_responsibility, business, management, important, service learning, students
t_15	higher_education	0.148	3.942	education, higher, higher_education, education_institutions, learning, institutions, role, service, system, service learning
t_16	community_based	0.058	3.224	programs, learning, based, experiential, students, community, opportunities, community_based, experiential learning, service
t_17	sustainable_development	0.174	3.08	development, sustainability, sustainable, transformative, sustainable_development, learning, specific, concept, change, capacity
t_18	higher_education	0.05	3.029	institutions, based, universities, colleges, service, faith, colleges_universities, faith_based, students, learning
t_19	engineering_education	0.132	3.276	engineering, design, students, project, student, first, learning, year, program, real
t_20	learning_methodology	0.089	3.38	methodology, results, university, analysis, commitment, de, social, teaching, learning, scale
t_21	community_engagement	0.117	2.205	language, learners, school, learning, program, skills, presents, high, university, models

t_22	civic_engagement	0.15	3.833	engagement, civic, civic_engagement, students, movement, student, engaged, engagement_movement, national, leadership
t_23	pre_service	0.126	3.047	project, teachers, teacher, students, experience, educational, training, rural, learning_project, service
t_24	case_study	0.144	2.858	case, case_study, study, studies, learning, making, service, university, oriented, different
t_25	community_based	0.084	2.674	volunteers, students, study, learning, student, university, differences, volunteer, service, groups
t_26	social_work	0.063	2.913	work, reflection, social, process, skills, students, social_work, professional, experience, learning
t_27	intergenerational_service	0.149	2.66	participants, students, intergenerational, older, life, home, provided, elderly, adults, elders
t_28	research_service	0.034	2.56	learning, service, research, service_learning, faculty, partnerships, development, assessment, practice, scholars
t_29	social_justice	0.162	2.9	social, justice, social_justice, critical, citizenship, university, learning, service, social_change, diversity
t_30	service_learning	0.166	3.273	faculty, members, faculty_members, research, institutional, learning, service, institution, service_learning, efforts
t_31	community_based	0.095	3.971	community, communities, partnerships, partners, based, community_partners, local, learning, community_based, community_partnerships
t_32	service_learning	0.082	2.922	students, course, courses, public, student, service, content, college, learning, disciplines

Note. Coh = coherence; Prev = prevalence

Analysis of the Results

The interpretation of Table 1 is based on the premise that a “topic” is not a simple category but rather a set of words that frequently appear together in other “topics.” Consequently, while multiple topics may be anchored by the term “service-learning,” they diverge in their semantic contexts, thus revealing distinct facets of the concept. An example can be found by comparing T9 (*service_learning, academic, practice*) and T10 (*learning_servicelearning, university, students, methodology*). While T9 refers to the discourse on the practice and academic research of SL, T10 focuses on its methodological implementation from the university and student perspective. Similarly, it is expected that the same term will appear in both a topic label and its keyword list (e.g., “service-learning”). As mentioned earlier, the technique identifies groups of words that co-occur in documents. Based on these groups, it suggests a label comprising the most prominent terms.

This technique also allows subtle nuances used in the language of the documents to be captured, such as *service_learning* and *learning_servicelearning*. As mentioned, the results are inputs that point to different forms of latent information. The researcher then determines whether these subtleties are relevant. In this case, it is not the subtlety of the label that indicates relevance but rather the elements that compose it. These two findings serve as a basis for the researcher to refine the labels and thematic categories in subsequent, more in-depth analyses.

This does not exclude the analysis and modification of the inputs themselves. This may be necessary when an automatically generated label, despite featuring the most prominent term, lacks sufficient thematic relevance and risks misinterpretation. An example of this is T4 “informa_uk.” A review of the most relevant articles on this topic reveals that they are published by the group “Informa UK Limited” (part of Taylor & Francis). For the purposes of this study, this information was retained for descriptive and explanatory purposes, but it serves as a good example of the need for initial data refinement. In this case, such refinement would entail changing the T4 label to “Institutional Implementation Strategies,” which would align more closely with its constituent elements and the other topics.

Having clarified the aforementioned points, a first approach to the interpretation of the results focuses on topics that stand out for their high coherence and prevalence scores. Among those with elevated coherence values, that is, well-structured topics, sustainable development (t17) appears. With the highest coherence score, sustainable development emerges as the ideal framework for promoting the institutionalization of SL in higher education. Its subcodes suggest that it is characterized by a transformative approach and a focus on change that prioritizes learning and the acquisition of capacities and skills that enable such transformation.

Subsequently, SL appears in themes t30 and t10. Although SL appears as a central theme across several themes (namely, themes t3, t5, t9, t10, t30, and t32), their thematic content, that is, their subtopics, varies. Themes t30 and t10 are distinguished by an institutional focus, highlighting students and teachers, who, according to the high-coherence value of the themes, appear as key actors. Moreover, it seems that the processes of learning/training, research, methodologies, and evaluation of results are the key aspects for addressing these stakeholders in the analysis of institutionalization.

These are followed by themes t29 (social_justice) and t22 (civic_engagement), which, according to their subcodes, suggest a social justice and critical approach aimed at fostering a movement of civic engagement and leadership among students.

Regarding the themes with high-prevalence values, that is, the dominant themes across the corpus, SL reappears in themes t5 and t9. Theme t9, being the most dominant overall, underscores the academic dimension, which, on the one hand, invites an exploration of the theoretical foundations, pedagogical approaches, and research methodologies of SL as they relate to processes of institutionalization, and, on the other hand, suggests considering an institutionalization proposal that integrates the essential functions of the university, giving equal importance to the fields of learning and pedagogy and to the functions of research and service. Theme t5, for its part, seeks to ensure that the focus also includes the impact of SL on students, highlighting the development of learning, skills, and attitudes that, in relation to the other subthemes that also have a high prevalence, are oriented toward fostering leadership, participation, and civic engagement.

The themes occupying the second (t31: community_based), third (t15: higher_education), and fourth (t22: civic_engagement) positions seem to consider the university's role in forging connections with the community as another key aspect. These themes emphasize a conception of the community both as an interlocutor and as a field of action and learning, and conceive the acquisition of civic competences, social commitment, and leadership in students as a way of contributing to and influencing the realities of the community.

A third type of analysis corresponds to semantic similarity as a basis for developing thematic categories. The first category corresponds to the foundations and nature of SL (themes t3, t5, t9, t30, and t32). As mentioned earlier, the principal university actors are faculty and students, which suggests that institutionalization processes should consider their roles and perspectives. Similarly, high-prevalence data indicate a proposal for institutionalization that integrates pedagogical, academic, research, and practical processes and functions.

Within this group, it is also worthwhile to examine the themes with the lowest prevalence, which show less consolidation and could therefore be interpreted as potential lines of development. In this respect, t3 and t32 are particularly noteworthy. Their contents point to various institutional processes, such as (a) curricular management and the integration of SL into courses, disciplines, and departments; (b) the promotion of SL as an innovative educational practice; (c) the alignment of SL with the university's third mission and its public service responsibility; and (d) the development of processes of communication, information, and dialogue within universities. Regarding the latter, there is a semantic overlap with the other content on SL. Specifically, the processes of communication and interlocution are linked to the promotion of participation of students and teachers, fostering greater dialogue of knowledge between disciplines and departments and facilitating the interlocution that should characterize practices and service projects associated with the university's third mission.

Another group of themes is represented by t13 and t28, which correspond to the theme of "research." According to the subcodes, the institutionalization of the SL appears to promote research processes that are

situated, ethical, practical, and measurable. These processes are characterized by collaboration with society and aim to address the diverse, complex, and specific realities of societies and how the university responds to these realities through its SL processes. It is worth noting that the topics have a low prevalence, which suggests that the integration of research processes situated in specific social contexts and approached from and toward multifaceted problems and perspectives is not dominant within the dynamics of the SL institutionalization.

An institutionalization process that goes beyond an institutional or academic approach and emphasizes a community-based approach emerges as another important theme, not only in themes t16, t25, and t31, where it is explicitly mentioned, but also in themes such as t1, t7, t12, and t21. These themes encourage the university to develop a model that prioritizes experiential learning with a local scope and dimension, wherein communities assume an active, collaborative role in the SL processes (themes t1, t16, and t31). Theme t25, for its part, seems to allude to the fact that the model to be institutionalized must be distinguished from other community-based models that not only leave aside the learning dimension but also overlook the active role of societies along with the dynamics of cooperation. Similarly, the content of themes such as t7 and t11 suggests that the institutionalization process should be sensitive and draw on regional perspectives and conceptions of SL, for example, research on civic engagement in the United States (t11) or a possible South African approach to community engagement focused on addressing power relations (t7). A final theme of this group suggests that approaching complex and local realities and processes of alliance and collaboration with community partners should prioritize qualitative methods with community partners (t12). It is noteworthy that the content related to qualitative research and interviews does not belong to a methodology theme (i.e., not in t8 or related themes such as t13 or t28) but is instead associated with the community partners theme, which, together with the other content that promotes a focus on community, reciprocity, and cooperation, such as reference and promotion of the methodology, suggests a process of institutionalization based on situated research processes grounded in diverse voices and perspectives, with the community being central.

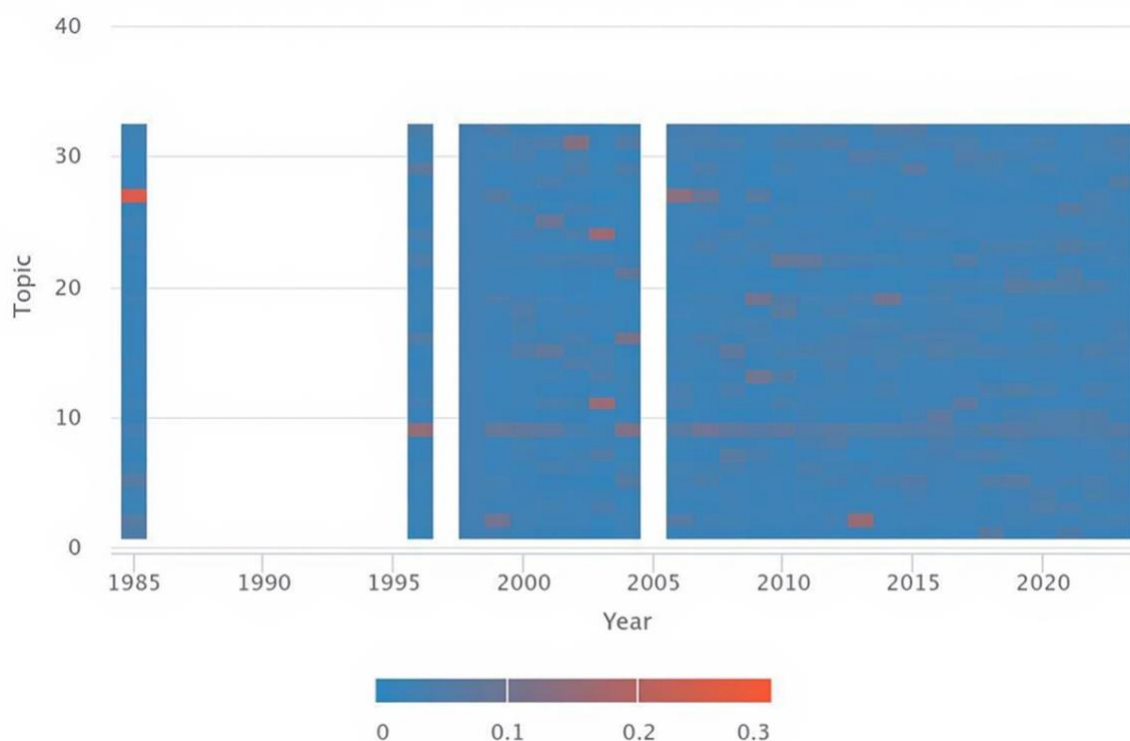
The next semantic group comprises themes t15 and t18, which explicitly mention higher education. The terms “system” and “education_institutions” appear to provoke debates on how SL should be institutionalized at the system level, thus involving cultural, structural, and procedural aspects of the university. Other content seems to advocate for articulating the university’s own characteristics that facilitate and legitimize these institutionalization processes.

In the content of the themes of higher education, the term “role” is coupled with “service.” Compared to other contents and themes, this role appears to be linked to training students in civic commitment, promoting mutual and reciprocal engagement with communities, and addressing complex, close, and specific social realities.

These last two issues, sustainability and social responsibility, share the subcode “change.” In the case of t9, it is accompanied by “transformative.” When considered alongside the other themes analyzed, the proposal for an institutionalization of SL from a critical, political, and social justice approach seems to be consolidated.

One final type of data to analyze is that provided by one of the graphical tools available in the LDAShiny package, which illustrates the distribution of topics over time using a heat map. In this visualization, the *x*-axis represents time in years and the *y*-axis corresponds to the 32 identified topics. Warm colors, such as red or orange, indicate a high prevalence of a topic during a specific period, and cool colors, like blue, denote a lower prevalence (see Figure 2).

This visualization enables the identification of topics not addressed in previous analyses, such as intergenerational service (t27). According to the graph, this topic exhibited a high prevalence initially but lost prominence over the years. In contrast, topics t9 (service_learning) and t15 (higher_education), along with their respective themes, emerged in the mid-1990s and have maintained constant peaks over time, which coincides with their high frequency in the topic table. From this, it can be concluded that they are stable, structural, and cross-cutting contents essential for understanding the process of institutionalization.

Figure 2.*Heat Map of the 32 Topics*

On the other hand, topics such as t17 (sustainable_development) and t14 (social_responsibility) display less consistent trends, with specific peaks in certain years. It could be taken as input or incentive for further in-depth analysis to determine whether these peaks may be associated with global movements such as the implementation of the Sustainable Development Goals in 2015, which emphasize the role of education in sustainability or national regulatory frameworks that encourage the institutionalization of the SL in universities. Research interested in analyzing peaks and plateaus from debates and social, political, equity, and social rights events could also be enriched from the insights provided by this type of graphical tool.

Conclusions

The research on the institutionalization of SL in higher education, conducted through the analysis of topic modeling, has identified several recurrent and significant topics that provide the researcher with a robust starting point for further inquiry. In line with the perspectives of Butin (2003) and Mitchell (2008), and again underscored by high-coherence values, the results indicate that the process of institutionalization of SL in higher education attains coherence and structure with other topics (e.g., processes, characteristics of the university, mission, function) when it shifts away from traditional paradigm and toward social justice and SL frameworks, where power relations, critical reflection, the addressing of structural inequalities and vulnerabilities, and the active and reciprocal participation of all actors must be prioritized in articulating with the dynamics of the university, its training and research processes, and its relationship with the community. Within this framework, SL in higher education should be oriented toward transformations and changes in the structures and dynamics of adverse and complex social realities (Butin, 2003; Mitchell, 2008).

The results suggest that the institutionalization process is characterized by an approach that is sensitive to the university's unique features; it is also participatory, democratic, and reciprocal, in which students, teachers, community partners, and the community serve as the primary actors. In this way, the emphasis on engaging the voices and perspectives of all stakeholders, especially those of the community, in a reciprocal, cooperative, and mutual way, appears to be a defining characteristic of the dynamics of interaction between university and society that the process of institutionalization promotes. Different subtopics, especially those that scored high in prevalence, seem to emphasize the cooperative, reciprocal, and mutual nature and fundamental role of community actors in SL initiatives. This observation aligns with the core principles of SL, which emphasize reciprocal relationships and responsiveness to community-identified needs (Bringle & Hatcher, 1996).

The data also seem to propose two main frames of reference to support and legitimize the processes of institutionalization: sustainable development and responsibility. Under these frameworks, the role of higher education appears to be directed toward the transformation of adverse, diverse, and complex realities through the vision of an active university that is sensitive to the immediate realities, beginning with the local, and through the training of sensitive, critical, socially, and politically committed citizens who recognize their role and responsibility as agents of change. Actually, in some cases of institutionalization (e.g., Archila et al., 2022; Corrales Gaitero & Andrade Zapata, 2021; Martínez, 2022), the interpretation of the role of universities is framed within topics such as topics 14 (social responsibility) and 17 (sustainable development).

In these studies, sustainability and social responsibility emerge as key framework for promoting the institutionalization of SL. Their importance becomes evident when the institutionalization of SL is considered an indicator of the university's social responsibility (Martínez, 2022), when it is employed as a pedagogical strategy by socially responsible universities (Corrales Gaitero & Andrade Zapata, 2021), or when social responsibility is taken as the axis that articulates SL and the university's own identity (Archila et al., 2022).

This finding also aligns with the manner in which SL is institutionalized, where the starting point is the coherence between the objectives of sustainable development and different aspects of the university, such as the institutional mission (Almendras-Chacana & Pérez-Lorca, 2019; Salterain et al., 2022), the university statutes (Martínez, 2022), or compliance with regulations such as those of standardization and international organizations (Corrales Gaitero & Andrade Zapata, 2021).

In addition to the processes of interinstitutional management with the communities, the data also account for various internal processes critical to the institutionalization of the SL, such as (a) curriculum management and, with it, the pedagogical and methodological articulation of the premises of the SL in the courses and their corresponding phases of design, implementation, and evaluation; (b) the articulation with national and regional reference frameworks that allow for a situated and contextualized approach, sensitive to both the characteristics of the university and the local social context of which it is a part; (c) processes of information dissemination, communication, and dialogue among the university's disciplines and departments that allow for an exchange of knowledge, strengthen internal networks, and support a systemic approach to institutionalizing SL that affects the cultural, processual, and structural dimensions of the university.

Likewise, the data prompt an exploration into enhancing the consistency and prominence of research processes within the institutionalization of the SL, especially related to the implementation, outcomes, and practical applications of SL initiatives, as well as on how these initiatives contribute to an understanding of the diversity, specificity, and complexity of social realities, and the creation of SL proposals situated and contextualized to local and nearby realities.

Finally, within the analysis of the results, the values of theme t9 are striking: Despite its high centrality, it exhibits low coherence (0.03, the second lowest among the 32 themes). Its lack of structure appears to be inherent to the nature of the SL concept, which is characterized by multiple, different, and nonconsensual definitions (Butin, 2010), suggesting that this score may be the result of the diversity of definitions and, therefore, of interpretations and approaches. Although this aspect of the term has shown the need for clear conceptualizations in the literature for decades, in the framework of institutionalization, this ambiguity and

lack of consensus can serve as an advantage since it opens the door for the university itself, in a participatory and democratic way among its members and from its own particularities (its mission, its creed, its funding, the social and political context to which it belongs, etc.), to formulate its own definition of SL, which has been shown as a key aspect for the institutionalization of SL from the cultural dimension of the university, positively influencing the appropriation, and understanding of the term by the university community (Mercer & Brungardt, 2007; Snijder et al., 2022; Tijsma et al., 2023).

Based on these results and analysis, it can therefore be concluded that the topic modeling is a valuable alternative for revealing information that can serve both as background knowledge prior to detailed analysis and as a complement to that analysis. Moreover, the technique demonstrates an ability to identify latent information and organize it into categories or subcategories, all without requiring prior classification, coding, or labeling. Therefore, this article advocates for the consideration of such methods to enhance transparency and replicability and to minimize risks in the analysis, such as researcher bias or lack of prior knowledge, and thus further enrich the field of SL research in higher education.

Implications for the Field and Practice of SL

In addition to providing evidence of the viability and usefulness of alternative methodologies, such as topic modeling, for analyzing thematic structure and identifying latent information, the results are offered as frameworks for diagnosing and planning processes for the institutionalization of SL in higher education. Institutions can use these frameworks to compare their own initiatives with the identified thematic discourses, recognizing both areas of convergence that reinforce their initiatives and areas that have not been addressed or have only been addressed partially. These areas could be further developed in aspects such as teacher support, formalizing community partnerships, or impact assessment. Thus, the results reflect the overall landscape of the field, enabling each institution to situate itself within it.

Second, by revealing which words tend to be grouped together, the technique also provides input for analyzing those that are systematically separated, so much so that they end up forming different topics. This semantic distance makes it possible to hypothesize about fragmentation in the institutionalization of SL. For example, the discourse on the efforts of teachers (t30) is separate from the discourse on community partners (t1). The findings here invite universities to explore possible “thematic bridges” which, following the aforementioned example, could lead to the establishment of SL committees in which the participation of external partners is a requirement and in which, based on their popular knowledge, they can strengthen the proposals generated by teachers together with the learning processes they lead. Other possible examples can be found among topics with practical aspects (e.g., t10) and topics with mission aspects (e.g., t16), which can be seen as an invitation to seek processes for auditing and supervising what is promulgated in policies and documents and what is appropriated in practice. Thus, in addition to allowing universities to see the institutionalization process as more fragmented than monolithic, it also ends up offering inputs for them to seek strategies to strengthen their processes through evidence of distant topics and the possible thematic bridges that connect them.

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