The Impact of HEIs on Regional Development:

Facts and Practices of Collaborative Work With SMEs

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Chapter 18
Higher Education, Active Learning, Co-Creation, Innovation, and Contribution to Regional Development:
A Bibliometric Analysis

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ABSTRACT

This chapter explores how higher education institutions (HEIs) that use active learning methodologies and promote co-creative and innovative environments can contribute significantly to regional development. The authors carried out a bibliometric analysis, considering the works published in journals indexed in the Scopus database for this purpose. The study aims to measure the scientific production of active teaching and learning methodologies, such as co-creation and innovation, and their contribution to regional development. The main results denounce that there is still a long way to go in exploring and emphasizing the links between HEIs, active learning, co-creation, innovation, and regional development. This path needs the involvement of the surrounding society, and private and public organizations, to be meaningful. HEIs urgently need to promote a shift in thinking about their educational practices. In today's world, complex challenges pose a real challenge to the future of higher education, and graduates who can meet these challenges represent added value to the higher education system.

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INTRODUCTION

In the current educational context, HEIs are under constant scrutiny. Key Performance Indicators put pressure on the system, and HEIs tries to respond by innovating in designing more attractive courses and conceiving innovative and challenging base learning programs (Foot et al., 2014, 2016). Challenge-based innovation programs focused on co-creation as a strategy to address the market's needs. Yet, to succeed in this quest for formative innovation, there is an evident need to rethink current teaching and learning paradigms to provide students with a more fruitful learning experience and impact the community (Villalba et al., 2018) and regional development. Scientific literature gives an extensive account of two extreme perspectives. On one side is the classic profile, where someone controls and determines the entire teaching-learning process, making the contents available in a condensed and expository way and condemning students to the passive condition of receiving and processing information. On the opposite side is the "facilitator" profile, in which the professor shares the teaching-learning process, inviting his students and other significant actors to active participation in which they are the leading educational actors in the process (Carron, et al., 2006). This chapter explores the state of the art of HEI's role in using active learning methodologies and promoting co-creative and innovative environments, contributing to regional development. The aim is to systematize existing studies and identify current gaps and future research trends. To this end, a bibliometric analysis of the literature will be carried out, considering for this purpose the works published in journals indexed in the Scopus database. We consider three critical goals: i) to evaluate the scientific production related to active learning methodologies, co-creation, and innovation by analyzing papers published by year, author, journal, keywords, subtopic, and country to identify the most relevant ones; ii) to analyze the structural knowledge clusters that underlie the network of co-citations among papers, authors, and journals; iii) to examine how the innovative attitude of HEIs contributes to regional development. For such purpose, we pointed out the research questions, material, and methods, and the main results related to the growth pattern of publications in HEIs, active learning, co-creation, and innovation; the annual production of published papers and citation; the top cited papers and most productive authors; the contribution by country and by affiliation; and network visualization, co-occurrence analysis of keywords.

RESEARCH QUESTIONS, MATERIAL, AND METHODS

Given the goals pre-identified for this chapter and based on bibliometric analysis, we intend to answer the following research questions (RQ):

RQ1: What is the growth pattern of publications focusing on the relationship between HEIs, active learning, co-creation, and innovation?
RQ2: What is the annual production pattern of published papers?
RQ3: What are the most cited papers and most productive authors?
RQ4: What country and affiliation have the most publications?
RQ5: Which structural knowledge clusters underlying the network of co-citations among papers, authors, and journals can be identified?
RQ6: How does this new attitude of HEIs address the issue of regional development?

To achieve these goals, two major tasks were first considered: defining the research criteria related to the topic under investigation and searching for and selecting documents. In the first task, two aspects of bibliometric analysis were combined: performance analysis and scientific mapping. The choice of this combination is justified by the intention to evaluate the research performance, the evolution, the composition of the intellectual structure, and the dynamics of the research line. If on the one hand, performance analysis focuses on fundamental indicators of scientific publications such as, for example, the number of documents, year of publication, journals, authors, and countries; on the other hand, science mapping allows the graphical visualization of research topics and subtopics, as well as the identification of relationships and links between them.

Therefore, the choice of database followed the standards of quality and reliability to ensure the same characteristics in bibliographic extraction. Thus, Scopus was chosen as one of the most essential and comprehensive databases. The search and collection of the information were carried out in papers published between the period from 1998 to 2022. In addition, several descriptors contained in titles, abstracts, and keywords were considered in the Scopus database, namely: "higher education", "active learning", "co-creation", and "innovation". Based on these descriptors, an initial search yielded 206 documents, subject to a selection process by applying exclusion criteria, thus limiting the search to English language papers. Using Boolean logic operators, the following research was conducted. Search topics (ST): ST1: "higher education" AND "active learning" AND "co-creation"; and ST2: "higher education" AND "active learning" AND "innovation". The diversity of such topics results from the lack of papers congregating the four keywords that make up the title of this chapter. The "regional development" was considered as a keyword, but considering the reduced number of papers, we decided to analyze the results with a focus on the regional development effect. The search performed resulted in 121 papers (excluding repeated papers).

Still, in the context of materials and methods, the collected papers listed in the references were analyzed based on their contribution to the topic under analysis. The various bibliographic information was downloaded in CVS (comma-separated values) format files and then imported into the VOSviewer software. Such information contained bibliographic data about authors, titles, year of publication, keywords, number of citations, and citation data. The analysis of the results went through two phases. The first phase focused on the statistical analysis of the identified data, specifically the analysis of productivity, the performance of scientific journals, and the most cited papers. The second phase involved the generation of bibliometric maps using the VOSviewer software, where authors' citations, co-authorship, and co-occurrence of authors' keywords were analyzed. Combining them made it possible to create groups identified by different colours, which allowed the analysis of the structural knowledge clusters underlying the network.

RESULTS

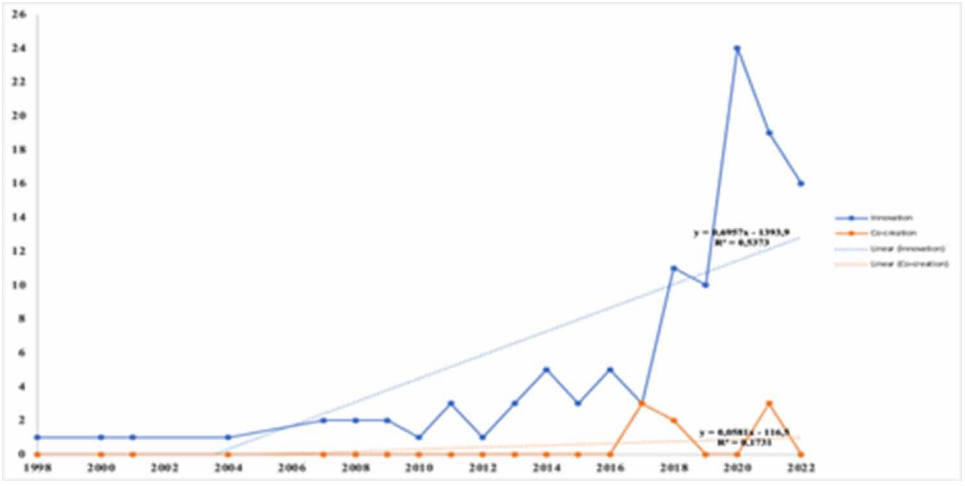
Higher Education, Active Learning, Co-Creation, and Innovation: Growth Pattern of Publications

Considering the papers collected, published in the range defined from 1998 to 2022, we obtained 121 non-repeated papers publications. The analysis was carried out from two different contents: i) the evolution of publications in the field of higher education, active learning, and co-creation, and ii) the evolution

of publications in the field of higher education, active learning, and innovation. In Figure 1, it's possible to observe the analysis of scientific literacy evolution through a bibliometric indicator known as Price's Law. The linear regressions for the number of publications per year, comparing "co-creation" with "innovation", show that more publications have been produced referring to innovation than co-creation. Innovation in higher education promoting active learning is in an exponential growth phase. Co-creation is content with no relevant expression once we only obtain eight publications between 1998 and 2022, although with a slight growth (Blau & Shamir-Inbal, 2017; Burford & Chan, 2017; Hedden, et al., 2017; Blau & Shamir-Inbal, 2018; Uskoković, 2018; IIonen, 2021; McQuillan, et al., 2021; Thomas & Bryson, 2021). In contrast, publications on innovation are almost in constant growth, with a representative number in the last five years.

The first three papers that explore the topics of higher education, active learning, and co-creation are Blau & Shamir-Inbal (2017), Burford and Chan (2017) and Hedden, et al. (2017). Blau and Shamir-Inbal (2017) explored the role of co-creation and co-regulation in a redesigned flipped learning model used in an academic course. The study concluded that co-creation and co-regulation can improve the effectiveness of inverted learning. Burford and Chan (2017) investigated the effectiveness of flipping a strategic marketing course. The paper found that flipping the course improved student engagement and learning outcomes, particularly in the application of marketing concepts. Hedden et al. (2017) examined the use of a constructivist active learning approach to teach sustainability in higher education. The authors used discipline-specific case studies and found that this approach can improve students' understanding of sustainability and their ability to apply sustainability principles in their respective fields. All the authors focus on the use of active learning strategies, such as flipped learning and constructivist approaches, to improve student engagement and learning outcomes. These studies concluded that these approaches could improve students' understanding of course material as well as their ability to apply what they have learned in real-world contexts. In addition, the studies highlight the importance of collaboration and co-creation in these learning environments, highlighting the benefits of involving students in the design and regulation of their own learning experiences.

Figure 1. Number of publications per year
Source: Own



Continuing the implementation of the digital technology's idea, Blau and Shamir-Inbal (2018) investigated the use of digital technologies to promote "student voice" and co-create learning experiences in an academic course. The paper founds that digital tools can facilitate student-centred learning and collaboration by allowing students to play an active role in shaping and regulating their own learning experiences. In turn, Uskoković (2018) explored the concept of the "co-creational classroom" as an extension of the flipped classroom model. The study suggests that a co-creational approach that emphasizes student participation in the design and implementation of learning activities can further improve student engagement and learning outcomes in the flipped classroom setting. The paper provides practical examples and strategies for implementing a co-creational approach in the classroom.

In 2021, Ilonen (2021) looks at educators' perspectives on creating entrepreneurial learning environments for entrepreneurship education in higher education. The paper argues that educators play a critical role in creating a learning environment that fosters entrepreneurial thinking and innovation and proposes a framework for developing such an environment. The paper highlights the importance of integrating experiential learning, feedback and reflection, and the use of real-world case studies in entrepreneurship education. McQuillan et al. (2021) focus on developing resilient graduates who can be future leaders in the workplace. The authors argue that HEIs have a responsibility to provide graduates with the skills and knowledge they need to navigate an increasingly complex and uncertain work environment. It proposed a framework for developing resilient graduates that emphasize the importance of experiential learning, personal development, and engagement with industry. In last, Thomas and Bryson (2021) study the use of a combined face-to-face and online real-time learning approach during the COVID-19 pandemic and beyond. The paper argues that this ambitious teaching approach can provide opportunities for greater inclusivity and engagement in higher education. It also proposed a framework for ambidextrous teaching that incorporates the use of technology to support student interaction and engagement.

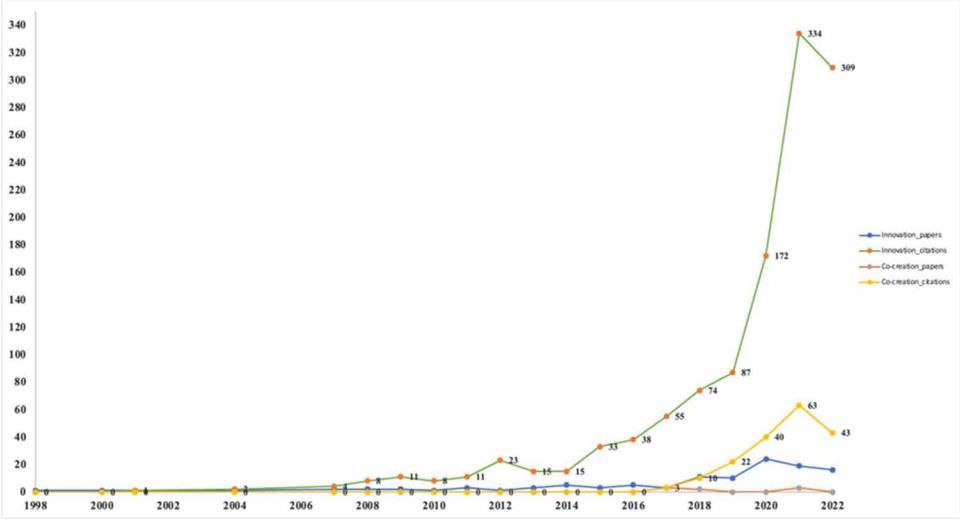
In contrast, and as we refer, publications on innovation are almost in constant growth, with a representative number in the last five years. The first paper is from 1998 (Visser, et al., 1998) and explores the benefits of involving students in the educational management and organization of medical education. The authors claim that students can provide valuable feedback and input on the quality and effectiveness of educational programs and interventions and that their involvement in decision-making can foster a sense of responsibility and ownership among students, The paper presents a case study of a medical school that implemented a student involvement program in which students participated in various aspects of educational management, such as curriculum development, assessment, and faculty evaluation. The authors report that the program was well received by both students and faculty and resulted in increased student satisfaction and improved communication between students and faculty. The study underlines the importance of creating a culture of participation and engagement in medical education in which students are viewed as active participants in the educational process. The authors hypothesize that student involvement in educational management and organization can lead to improved educational outcomes and greater overall satisfaction among students and faculty. Several years before the number of papers that related higher education, active learning, and innovation increased substantially. The papers published in 2022 provide a variety of perspectives on how innovative teaching methods can improve student learning outcomes and engagement in a range of fields, including business, physical therapy, engineering, business, and agroecology. The use of technologies such as serious games, podcasts, and Kahoot, as well as flipped and challenge-based learning, are among the active learning methods discussed. The COVID-19 pandemic is also a recurring theme, with several authors exploring the impact of distance learning on innovation and knowledge transfer. Overall, the papers highlight the importance of introducing active

learning into higher education to foster innovation and prepare students for the demands of the rapidly changing labour market.

Higher Education, Active Learning, Co-Creation, and Innovation: Annual Production of Published Papers and Citation

As pointed out, the scientific production in the period of analysis (1998-2022), presented in Figure 2, reveals an exponential growth of the papers related to higher education, active learning, and innovation. Until 2008 (more or less), such scientific production was inexpressive in both research topics (Jenkins & Ward, 2001; Washer, 2007). After that, the topic of innovation starts a progressive increase that becomes very evident from 2019 onwards; furthermore, co-creation shows only a timid growth in the number of citations starting from 2019. These considerations are validated by the citation curves presented in Figure 2, thus having a significant number of citations that represent the great influence of the publications presented in consecutive years.

Figure 2. Comparison of the number of publications and citations
Source: Own



Higher Education, Active Learning, Co-Creation, and Innovation: Top Cited Papers and Most Productive Authors

Regarding the topic of co-creation and considering the eight papers studied, the top three of the most cited papers were "Re-designed flipped learning model in an academic course: The role of co-creation and co-regulation" by I. Blau and Tamar Shamir-Inbal that tops the list with 200 citations. In parallel, the most cited paper on innovation, with 280 citations, is "Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math" by Elli, Theobald et. al., (2020). This information is presented in Table 1 and Table 2.

Table 1. Top 3 and top 10 most cited papers, co-creation

Title	Authors	Journal	Citations
Co-Creation			
Re-designed flipped learning model in an academic course: The role of co-creation and co-regulation	Blau & Shamir-Inbal (2017)	Computers and Education	200
Teaching sustainability using an active learning constructivist approach: Discipline-specific case studies in higher education	Hedden et al. (2017)	Sustainability (Switzerland)	45
Digital technologies for promoting "student voice" and co-creating learning experience in an academic course	Blau & Shamir-Inbal (2018)	Instructional Science	33

The most cited paper (Blau & Shamir-Inbal, 2017), as we highlighted, explores the use of a flipped learning model that emphasizes co-creation and co-regulation in an academic course. The authors claim that these two elements can help to increase student's engagement and motivation and improve their learning outcomes. The study was conducted in an HEI with students in a human-computer interaction course. The results show that the flipped learning model, which included collaborative activities and opportunities for students to take an active role in their own learning, was successful in improving students' understanding of the course material. The second most cited paper, by Hedden et al. (2017) focuses on the use of an active learning constructivist approach to teaching sustainability in higher education. Hedden et al. (2017) defends that this approach, which emphasizes collaboration and knowledge creation through social interaction, is suitable for sustainability education because it is consistent with the principles of sustainability itself. The paper includes several case studies of this approach used in different disciplines, including architecture, environmental science, and business. The authors found this approach to be effective in engaging students and promoting critical thinking and problem-solving skills, as well as helping students to see the relevance of sustainability to their own lives and future careers. The previous authors (Blau & Shamir-Inbal, 2018) continue the exploration of co-creation and co-regulation in learning, but with a focus on the use of digital technologies. The authors explore that digital tools can be used to promote student voice and collaboration in the learning process, and they provide several case studies to illustrate this point. These case studies involve a range of technologies, including online discussion forums, wikis, and collaborative note-taking tools. The results highlight that these technologies were effective in promoting student engagement and participation and helped to create a more student-centered learning environment.

On the side of innovation, Theobald et al. (2020) investigated the impact of active learning strategies on the achievement gap between underrepresented and non-underrepresented students in college science, technology, engineering, and mathematics (STEM) courses. The authors conducted a 15-year meta-analysis of data from 15 different institutions in the U.S., representing more than 500 STEM courses and more than 24,000 students. The results exhibited that active learning strategies, such as group discussions, problem-solving activities, and peer instruction, led to a significant improvement in overall student performance and a reduction in the achievement gap between underrepresented and non-underrepresented students. Specifically, the paper found that underrepresented students exposed to active learning strategies were 6.3% more likely to pass the course and 7.0% more likely to earn a grade of C or higher compared to underrepresented students in traditional lecture-based courses. The authors also found that the positive effects of active learning were especially pronounced for women and first-

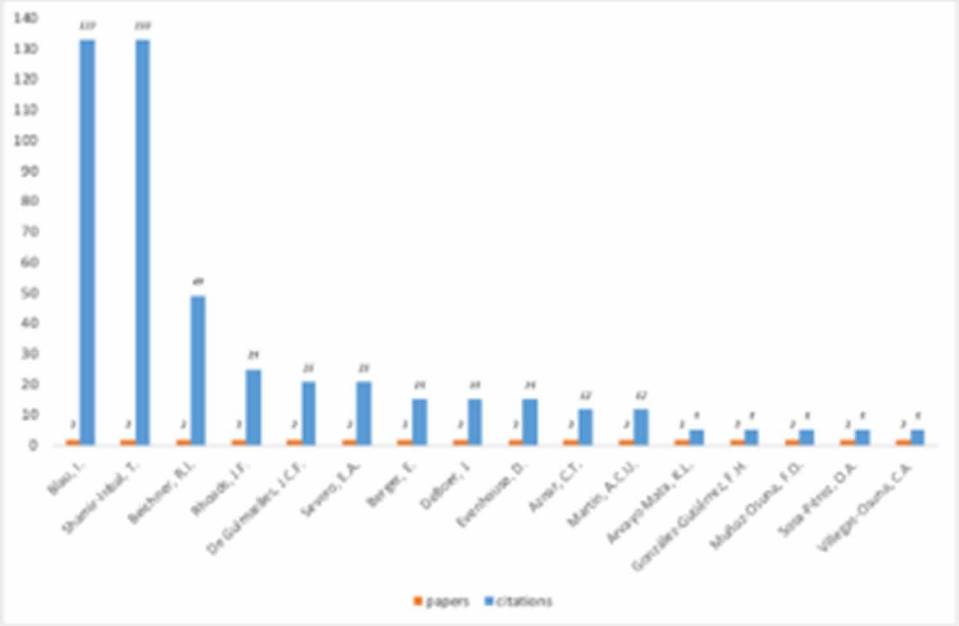
generation college students, suggesting that these groups may benefit the most from this approach. The other paper concentrates on various aspects of higher education and teaching and learning, including innovative and active learning strategies, educational technologies, and pedagogical approaches. They also emphasize the importance of developing competencies and skills relevant to the needs of students and society, such as sustainability, critical thinking, and problem-solving. And also recognize the role of instructors and educators in scaffolding learning and fostering student engagement and participation Galway et al. (2014), for instance, describe an innovative integration of online and flipped classroom models in public health higher education and Marvell et al. (2013) evaluate student-led learning and teaching during field research. Becker (2004) discusses the economics of higher education and how active learning can improve student outcomes, leading to innovation and economic growth. Cabero-Almenara et al (2019) focus on the technical and didactic knowledge needed to effectively use Moodle, an online learning management system that can support active learning in higher education. Foote et al. (2014, 2016) use the SCALE-UP model as a case study to examine the diffusion, enablers, and challenges of implementing research-based teaching strategies in higher education. Through a case study, McLoughlin and Alam (2014) demonstrate how Web 2.0 tools can be used to scaffold learning in social informatics. Finally, Tejedor et al (2019) discuss didactic strategies for promoting sustainability competencies in higher education. Overall, these paper emphasize the importance of active learning and innovative pedagogical strategies in higher education to improve student learning outcomes and prepare graduates for future challenges in a variety of fields.

Table 2. Top 3 and top 10 most cited papers, innovation

Title	Authors	Journal	Citations
Innovation			
Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math	Theobald et al. (2020)	Proceedings of the National Academy of Sciences of the United States of America	280
A novel integration of online and flipped classroom instructional models in public health higher education	Galway et al. (2014)	BMC Medical Education	165
Revisiting key skills: A practical framework for higher education	Washer (2007)	Quality in Higher Education	66
Didactic strategies to promote competencies in sustainability	Tejedor (2019)	Sustainability (Switzerland)	64
Flipped Classroom Implementation: A Case Report of Two Higher Education Institutions in the United States and Australia	McLaughlin et al. (2016)	Computers in the Schools	44
Students as scholars: evaluating student-led learning and teaching during fieldwork	Marvell et al. (2013)	Journal of Geography in Higher Education	40
Technical and didactic knowledge of the moodle LMS in higher education. Beyond functional use	Cabero-Almenara (2019)	Journal of New Approaches in Educational Research	35
Economics for a Higher Education	Becker (2004)	International Review of Economics Education	27
Diffusion of research-based instructional strategies: the case of SCALE-UP	Foote et al. (2014)	International Journal of STEM Education	26
Enabling and challenging factors in institutional reform: The case of SCALE-UP	Foote et al. (2016)	Physical Review Physics Education Research	23

Moreover, 178 authors are presented in this field of research. Figure 3 presents the most significant authors, given their number of papers. All the authors have two papers, but Blau, I & Shamir-Inbal, T. are the most cited authors, with 133 citations each.

Figure 3. Top of the most productive authors by the number of papers and citations
Source: Scopus (2022)



Higher Education, Active Learning, Co-Creation, and Innovation: Contribution by Country and by Affiliation

Figures 4 and 5 present the countries and affiliations that contributed the most during 1998 and 2022, debating the role of HEIs in using active learning methodologies and promoting co-creative and innovative environments. Such analysis considered two approaches: a) the number of papers published by country (Figure 4) and b) the number of papers published by affiliations (Figure 5). Figure 4 shows the most contributing countries based on the number of papers published. Spain leads as the country with the highest number of papers (41), followed by the United States (14), Mexico (11), and the United Kingdom (10). These countries are the most productive in higher education, active learning, and innovation. Similarly, the United Kingdom and the United States (and Israel) are the most productive in co-creation. On the other hand, and according to the number of papers by affiliation (Figure 5), the Universidad de Sevilla, Tecnologico de Monterrey, Universidad de Salamanca, and Universidad de Granada are the most contributive in the innovation field, with 7, 6, 4 and 4 papers, respectively. The Open University of Israel is the most productive in co-creation (2 papers).

Figure 4. Top of the most contributive country
Source: Scopus (2022)

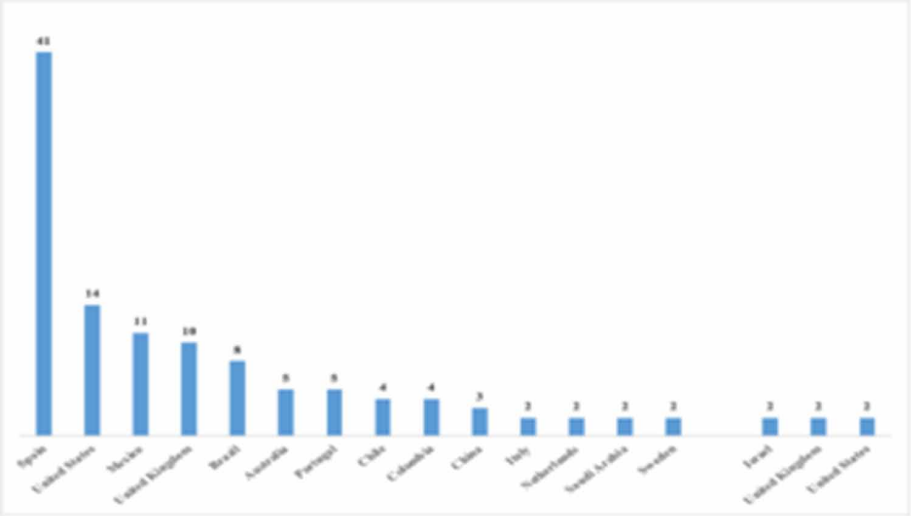
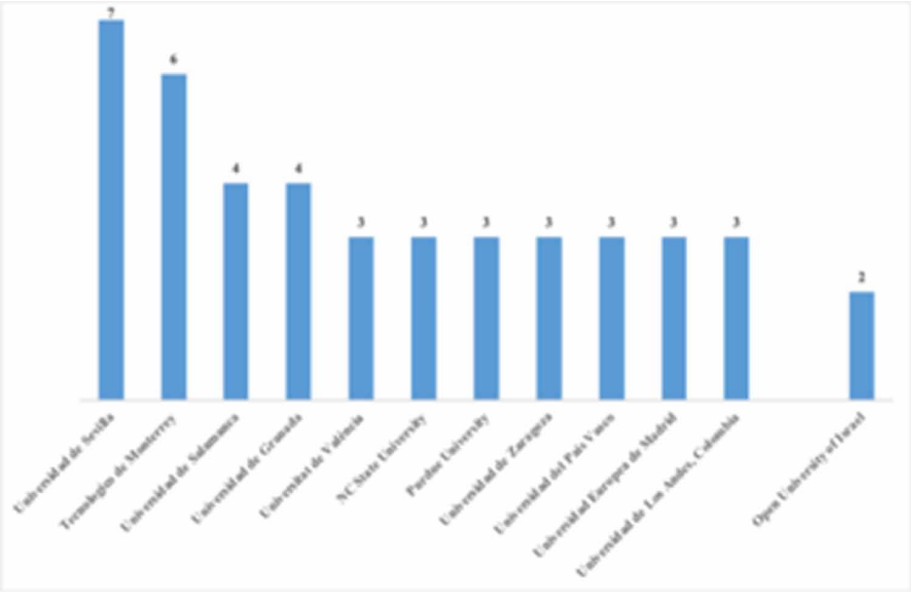


Figure 5. Top of the most contributive affiliation
Source: Scopus (2022)



Higher Education, Active Learning, Co-Creation, and Innovation: Network Visualization, Co-Occurrence Analysis of Keywords

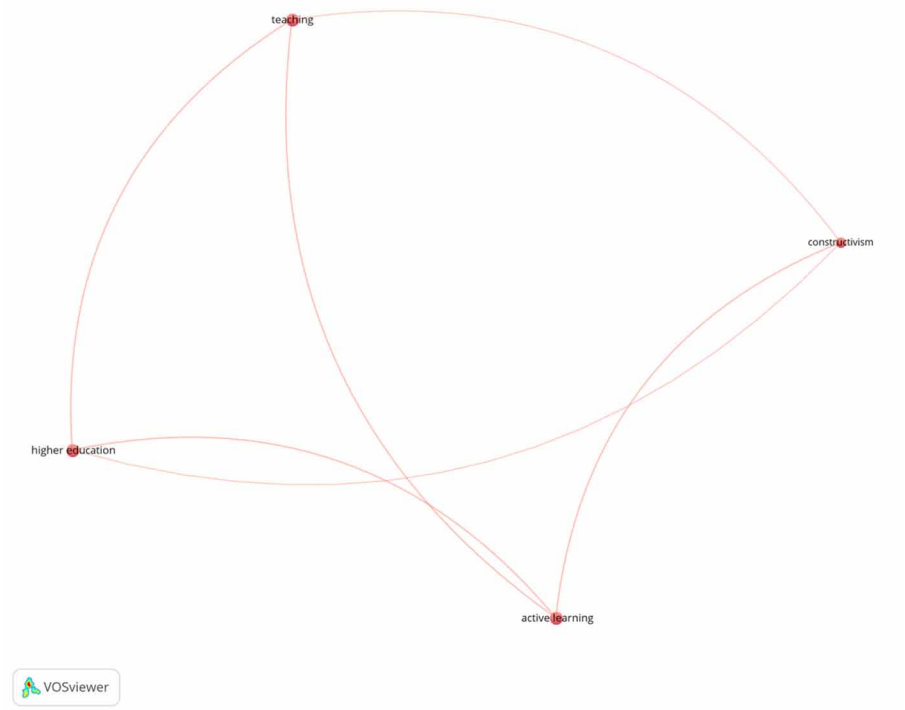
The bibliometric mapping of the two research topics is performed. It allows us to understand the conceptual evolution of the research theme established through clusters containing groups of related keywords (Figures 6, 7, and 8).

On the topic of co-creation (Figure 6), the results returned 69 keywords, from which the terms with at least two co-occurrences were selected, totaling a graph with four terms (higher education, active learning, teaching, and constructivism), which proved to be not very expressive for the analysis. This demonstrates the need for co-creation in promoting active learning practices in higher education again, even though the cluster focused on co-creation. In the theme, constructivism appears as a critical figure in co-creation because it is an approach in which the student learns through a constructive process based on active learning (Hedden et. al, 2017). These authors study the use of a constructivist approach to teaching sustainability in higher education, arguing that constructivism can be an effective pedagogical approach to teaching sustainability because of its emphasis on active learning, student-centered teaching and the development of critical thinking and problem-solving skills. They present several case studies of how the constructivist approach has been applied in different disciplines such as business, engineering, and environmental science. For example, in one business course, students were asked to develop a sustainability plan for a local company, in which they had to analyze the company's current practices, identify areas for improvement and develop a plan for implementing change. In the engineering course, students were asked to design and construct sustainable buildings using green building principles and technologies. These types of active learning projects and problem-solving exercises help students develop a deeper understanding of sustainability issues and the skills needed to address them. In addition, constructivist approaches can promote student engagement and motivation by putting students at the center of the learning process. According to them, constructivist approaches can be an effective way to teach sustainability in higher education and help students develop the skills and knowledge they will need to address sustainability challenges in their future careers. As Bozzi et al. (2021) point out, the traditional role of the teacher as someone who holds knowledge gives way to a role as a guide and directs the student to acquire knowledge autonomously (Bozzi et al., 2021).

Figure 7 highlights a different scenario on a research topic of innovation. In this case, the results returned 643 keywords, from which the terms with at least five co-occurrences were selected, totaling a graph with 21 terms spread to two main clusters and one more inconspicuous cluster. The most evident red cluster highlights the connection between higher education, active learning, educational innovation, education, students, and e-learning, among others. The green cluster emphasizes the connection between learning, teaching, human, and student. The blue cluster intercepts the two other clusters in higher education and learning. From observing the clusters, it is possible to draw two directions: one more focused on the use of new technologies and modernization of instruments and structures, and the other focused on the human aspect of teaching, fundamentally about developing new teaching techniques. It is noticeable that innovation in the context of higher education is most often understood as the creation and use of new technologies, as highlighted by Kraus et al. (2021), Saéz-Lopez et al. (2020), Bozzi et al. (2021), García-Galera et al. (2021), Pichardo et al. (2021), González-Zamar et al. (2022), Tudon-Martinez et al. (2020), Caratozzolo et al. (2022), Galway et al. (2014), Cabero-Almenara et al. (2019). However, it is also noted that the development of new teaching techniques is considered innovation by some authors, such as Melero-Aguilar et al. (2020), González-Zamar et al. (2022), McLaughlan, & Lodge (2019), Milohnic, & Licul (2018), Parada et al. (2022), Shi and Cai (2021), McLaughlin et al. (2016), e Forte-Celaya et al. (2021).

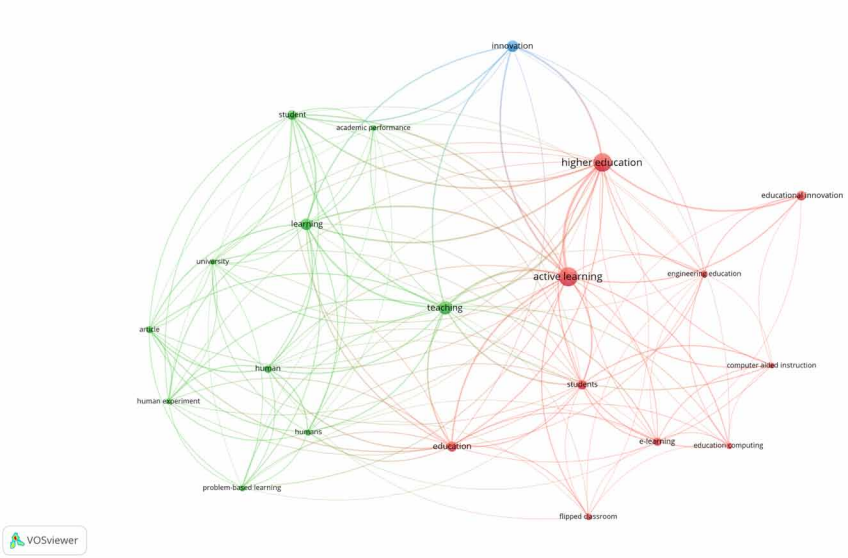
According to the first direction that innovation in the context of higher education is most often understood as the creation and use of new technologies, Kraus et al. (2021) and García-Galera et al. (2021) investigate the effectiveness of technology in higher education; Kraus et al. (2021) focus on the role of digital technology in Ukrainian higher education and García-Galera et al. (2021) examine the

Figure 6. Map of co-occurrences in the research topic of co-creation
Source: VOSviewer (2022)



effectiveness of peer learning in physics teaching. Tudon-Martinez et al. (2020) and Caratozzolo et al. (2022) investigate, respectively, the effectiveness of computer simulations and video essays/podcasts as teaching tools in engineering education. Galway et al. (2014) present a new teaching model that combines online and flipped classroom approaches in public health education. Saéz-Lopez et al. (2020) investigate the impact of visual block programming training on trainee teachers' pedagogical skills and attitudes and highlight the potential of visual block programming as a tool to improve trainee teachers' digital skills. Pichardo et al. (2021) present a systematic review of innovation in journalism training programs in Spanish universities, highlighting the importance of innovation in preparing future journalists for the changing demands of the profession. Finally, Cabero-Almenara et al. (2019) studied the technical and didactic knowledge of Moodle, a popular learning management system in HEIs, and found that teachers had basic technical knowledge but not didactic knowledge, suggesting that teachers' didactic knowledge needs to be improved to fully exploit Moodle's potential for effective teaching and learning. HEIs are constantly striving to improve the quality of education and prepare students for the challenges of the modern world. To achieve this, they are adopting new technologies and innovative teaching methods. Active learning approaches such as peer-to-peer learning flipped learning, and computer simulations are becoming increasingly popular. These approaches promote student participation, collaboration, and the acquisition of practical skills. New technologies, such as visual block programming, video essays, and podcasts, are being integrated into engineering and other fields to enhance creativity, critical thinking, and problem-solving skills. The use of online teaching models and flipped classrooms are also gaining momentum. These models allow students to learn at their own pace, interact with peers and instructors,

Figure 7. Map of co-occurrences in the research topic of innovation
Source: VOSviewer (2022)



and access learning materials and resources from anywhere. To ensure the effective use of these technologies and tools, it is crucial that HEIs provide instructors and students with technical and didactic knowledge. This knowledge helps maximize the benefits of these technologies and tools.

On the other side, the second direction focused on the human aspect of teaching, fundamentally about developing new teaching techniques, several authors explore the use of new teaching techniques that are also considered innovation. Shi and Cai (2021) found that active learning strategies, such as group discussions, role plays, and field trips, improved students' understanding of tourism and enhanced their critical thinking and problem-solving skills. Similarly, Forte-Celaya el al., (2021) found that using active learning strategies improved students' creative thinking skills, especially in the areas of fluency, flexibility, and originality. Flipped learning is another approach that has gained popularity in higher education. Gonzalez-Zamar et al. (2022) review global evidence on the use of flipped learning and conclude that it has the potential to improve student engagement, participation, and academic performance. McLaughlin et al. (2016) describe the benefits of the flipped classroom approach, such as increased student engagement and active learning, as well as the challenges in its implementation, such as the need for faculty training and the creation of effective preschool materials. Design thinking is another innovative approach that has been proposed to facilitate epistemic fluency in higher education. McLaughlan and Lodge (2019) found that design thinking improved student engagement and course satisfaction in a second-year marketing class. Business simulations were also suggested as a tool for teaching entrepreneurship and developing students' critical thinking, decision-making, and problem-solving skills. Milohnic and Licul (2018) highlighted the benefits of using active learning methods in teaching entrepreneurship and recommended the wider use of business simulations in HEIs. Finally, Parada et al. (2022) proposed a framework to promote socio-political learning in agroecology in Chile. The authors argue that such training is essential to promote sustainable agriculture and rural development in Chile and propose a series of itineraries designed to promote learning about local agroecological practices and the social and

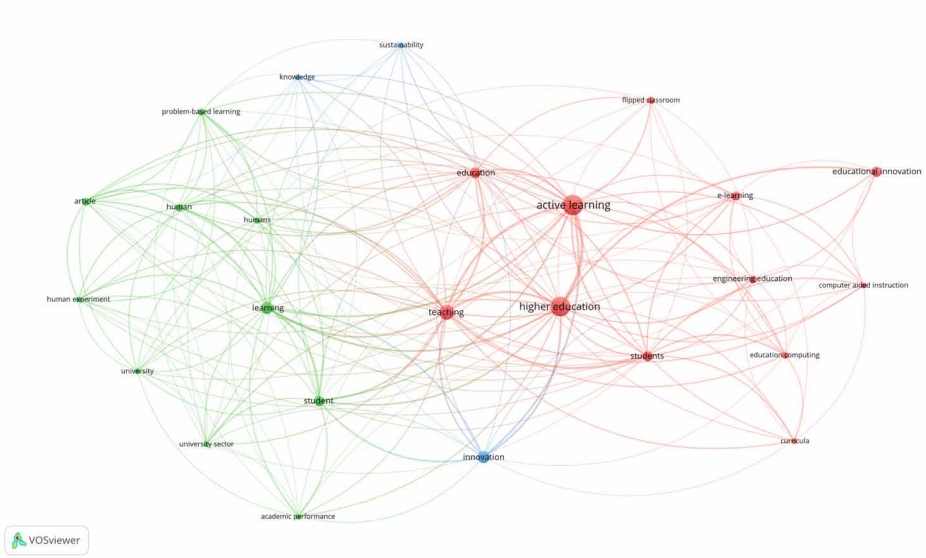
political context in which they take place. These papers present different approaches and methods used in higher education to improve the effectiveness of teaching and learning. What these methods have in common is an emphasis on active learning, creativity and innovation in teaching, and the human aspect of teaching. The authors suggest that incorporating active learning strategies such as the ECO method, flipped learning, design thinking, and business simulations can improve student engagement, participation, and critical thinking skills. In addition, these methods can facilitate the development of students' epistemic fluency and creative thinking skills, which are essential for success in today's world. The articles also highlight the challenges that educators face in implementing these methods, such as the need for training and support, as well as the creation of effective materials before class. Overall, the articles show that a person-centered approach to teaching and learning that emphasizes creativity, innovation, and active learning can improve the quality of education in HEIs.

Finally, and in a summarizing perspective, Figure 8 underlines the co-occurrences in research topics of co-creation and innovation together. The results returned 688 keywords, from which the terms with at least five co-occurrences were selected, totaling a graph with 25 terms spread to three clusters. Some words received greater attention and, therefore, have greater expressiveness, namely: active learning, higher education, teaching, innovation, and learning, corresponding to the central idea of the research. The constitution of three distinct clusters is evident, indicating that the papers have variations in their themes, given the diversity of the possibility of combining the key terms. Figure 8 shows a cluster (red) that associates the terms "active learning" and "higher education" with the engineering and computing sectors, a cluster (green) that associates the term "learning" with the internal context of HEI, and the innovation cluster (blue) that is associated with the issues of knowledge and sustainability. Innovation, while not being the most expressive co-occurrence, nevertheless occupies a central and equidistant position to the cluster of the HEI's internal context and that of the engineering and computing sector, suggesting that it is an issue present in both clusters. This denounces the idea that innovation is limited to the HEI internal context and focused on technological development (engineering and computing), which is, in the abstract and practice, a very reductive and wrong perception of the situation, even more so if we consider the contribution of regional development.

Higher Education, Active Learning, Co-Creation, Innovation, and Regional Development

Having arrived here it is easy to understand that there is still a long way to go in exploring and emphasizing the connection between HEIs, active learning, co-creation, and innovation. However, this path only makes sense if it incorporates the surrounding community, whether through private organizations such as SMEs or public organizations. Given the papers reviewed in this paper, unfortunately, only 6 make this connection (see Table 3). In their study, Hedden et al. (2017) took a constructivist approach to investigate the relationship between HEIs, active learning, co-creation, and regional development in the context of education for sustainability. They state that sustainability education requires moving away from traditional teaching methods to more innovative approaches involving active learning and co-creation with stakeholders. Case studies from US HEIs demonstrate how active learning and co-creation can be integrated into sustainability curricula. These case studies included courses in environmental studies, engineering, entrepreneurship, and other areas. The authors defined active learning as engaging students in hands-on activities and projects that encourage critical thinking, problem-solving, and collaboration. Co-creation, meanwhile, involves working with stakeholders outside the classroom, such as community

Figure 8. Map of co-occurrences in research topics of cocreation and innovation
Source: VOSviewer (2022)



members and industry partners, to co-design and implement sustainable solutions. The authors discovered that active learning and co-creation not only enhance students' learning experience but also contribute to regional development. By collaborating with stakeholders outside the classroom, students can apply their knowledge and skills to real-world challenges, leading to the design of sustainable solutions that benefit both the community and the economy. The authors also suggested that HEIs can play an important role in regional development by fostering partnerships with local organizations and businesses.

We noted that the constructivist approach to active learning described by Hedden et al. (2017) is consistent with the principles of co-creation and co-regulation discussed by Blau and Shamir-Inbal (2017, 2018) and Uskokovic (2018). It involves collaborative and participatory learning processes that allow students to take responsibility for their learning and contribute to the co-construction of knowledge. Furthermore, this approach is also consistent with the concept of entrepreneurial learning and the development of resilient graduates as discussed by Ilonen (2021) and McQuillan et al. (2021). By engaging students in real-world sustainability projects, this approach promotes entrepreneurial skills and resilience mindsets that are critical for success in the modern workforce.

In the same context of sustainability, Serra and Suárez-Collado (2021) explored the link between higher education, active learning, innovation, and regional development in the context of sustainability challenges in the Global South. HEIs can play a key role in promoting sustainable development in the region through active learning and innovation. HEIs can act as centers of innovation and knowledge creation by providing students and faculty with the tools and resources needed to develop and implement sustainable solutions to social, economic, and environmental challenges. The authors state that active learning approaches, such as problem-based learning, service learning, and experiential learning, can facilitate the development of critical thinking, problem-solving, and innovation skills among students and faculty. They also stress the importance of fostering partnerships between higher education institutions, industry, and local communities to promote regional development. Such cooperation can help bridge

the gap between academic research and practical application, leading to the development of innovative solutions to sustainability challenges that are tailored to local conditions. In addition, the authors point out that higher education institutions can play an important role in promoting entrepreneurship and innovation by providing students with the necessary skills and resources to start their own companies, which can contribute to economic development and job creation in the region.

Otherwise, Milohnic and Licul (2018) explored the link between higher education, active learning, innovation, and regional development in the context of entrepreneurship education using business simulations. The authors argued that entrepreneurship education also requires a shift from traditional teaching methods to more innovative approaches involving active learning and co-creation with stakeholders. They used their experience in using business simulations as a tool for teaching entrepreneurship management in HEIs in Croatia. Business simulations provide a realistic learning environment that engages students in problem-solving, decision making and teamwork, all essential skills for entrepreneurship. Active learning, as defined by the authors, involves students' participation in hands-on activities that promote critical thinking, problem-solving, and cooperation. Through innovation, HEIs can collaborate with stakeholders to identify and solve entrepreneurial challenges, leading to the creation of new business opportunities and jobs.

Considering the entrepreneurial context, Ilonen (2021) also suggests that creating an entrepreneurial learning environment in higher education can contribute to regional development. Entrepreneurship education can help promote economic growth and job creation by fostering a culture of innovation and entrepreneurship. By giving students the skills and knowledge necessary to start and grow successful businesses, higher education institutions can help create a pool of entrepreneurs who can stimulate economic development in their communities. Ilonen (2021) suggests that an entrepreneurial learning environment can help create a supportive ecosystem for entrepreneurship in the region. By encouraging collaboration and networking among students, academics, and industry partners, higher education institutions can help facilitate the exchange of ideas and resources that are essential to building successful businesses. The author also stresses the importance of providing students with access to resources and support, such as mentoring, funding, and incubation spaces, to help them turn their ideas into viable companies. Not only can this help create successful companies, but it can also help grow the local economy. Creating an entrepreneurial learning environment in higher education can have a positive impact on regional development by promoting entrepreneurship, innovation and economic growth.

Shi, Zhang and Cai (2021) explore the relationship between HEIs, active learning, innovation and regional development in the context of a tourism course. The authors highlight that active learning, which involves engaging students in hands-on, interactive activities, can improve student learning outcomes and promote innovation. They also state that innovation is a key factor in regional development and that higher education institutions have an important role to play in promoting innovation and entrepreneurship. The case study presented describes the implementation of active learning strategies in an introductory tourism course at a Chinese university. The authors used a variety of active learning methods, including role-playing, case studies, and field trips, to engage students and encourage them to think critically and creatively. The results showed that active learning had a positive impact on student engagement, motivation, and learning outcomes. Furthermore, the authors suggest that active learning can contribute to innovation and entrepreneurship by encouraging students to develop new ideas and solutions to real-world problems. In terms of regional development, HEIs can play an important role in promoting innovation and entrepreneurship by training students with the skills and knowledge they need

to succeed in today's economy. They also suggest that HEIs can act as incubators for new businesses and start-ups by providing resources and support to help students turn their ideas into reality.

Finally, Parada, Salas, and Burbi (2022) highlight the links between HEIs, active learning, innovation, and regional development in the context of agroecology in Chile. HEIs play a crucial role in promoting sustainable development and innovation in rural areas. They can support regional development by promoting active learning, which engages students directly with local communities and ecosystems. This type of learning can foster innovation by encouraging students to apply their knowledge and skills to real problems. The authors also emphasise the importance of regional development in promoting sustainable agriculture and agroecology. Sustainable agriculture requires a deep understanding of the local context, including the ecological, social, and political factors that influence farming practices. By engaging with local communities and ecosystems, higher education institutions can help develop this understanding and promote sustainable agriculture. Parada, Salas, and Burbi (2022) focus on the concept of "situated agroecologies," which refers to the unique ecological and social contexts in which agricultural practices are situated. HEIs can support the development of situated agroecologies by promoting socio-political learning, which involves understanding the social and political factors that shape agricultural practices and their impact on local communities.

In a nutshell, these papers explore the relationship between HEIs, active learning, co-creation, innovation, and regional development, with a focus on sustainability and entrepreneurship. The main argument is that traditional teaching methods should be replaced by innovative approaches that incorporate active learning and co-creation with stakeholders. It also stressed the importance of fostering partnerships between HEIs, industry, and local communities to promote regional development. HEIs can act as centers of innovation and knowledge creation by providing students and faculty with the necessary tools and resources to develop and implement sustainable solutions to social, economic, and environmental challenges. Furthermore, they emphasize that promoting entrepreneurship and innovation in higher education can contribute to economic growth and job creation in the region. Active learning, which involves engaging students in hands-on, interactive activities, is seen as a key component in promoting innovation and improving student learning outcomes.

Table 3. Papers connected with regional development

Papers	Does It Address the Issue of Regional Development?
Hedden, M. K., Worthy, R., Akins, E., Slinger-Friedman, V., & Paul, R. C. (2017). Teaching sustainability using an active learning constructivist approach: Discipline-specific case studies in higher education.	Yes, Sustainability.
Milohnic, I., & Licul, I. (2018). Entrepreneurial management and education: Experiences in the application of business simulations.	Yes, business simulations.
Shi, J., Zhang, J., & Cai, L. A. (2021). Active learning for an introductory tourism course—a case study.	Yes, the tourism sector.
Sierra, J., & Suárez-Collado, Á. (2021). Understanding economic, social, and environmental sustainability challenges in the global south.	Yes. Consideration of socioeconomic context and sustainability.
Ilonen, S. (2021). Creating an entrepreneurial learning environment for entrepreneurship education in HE: The educator's perspective.	Yes, Entrepreneurship.
Parada, S. P., Salas, C. B., & Burbi, S. (2022). Responding to the popular demand: Itinerary for the socio-political learning of situated agroecologies in chile.	Yes, Agroecology.

DISCUSSION AND CONCLUSION

This bibliometric analysis carried out on papers that specifically related higher education, to active learning, co-creation, and/or innovation, in journals indexed in the Scopus database, allowed us to assess the impact of authors, journals, countries/regions, and clusters, as well as their progressive development to systematize existing research and answer our research questions, highlighting current gaps and future research trends.

Attending our RQ1 "What is the growth pattern of publications whose focus is the relationship between higher education institutions, active learning, co-creation, and innovation?", the results show two different patterns: co-creation is content with no relevant expression with only eight publications, between 1998 and 2022, although with slight growth, and innovation field show exponential growth phase of publications (total of 114) with an expressive number of publications in the last five years.

In our RQ2 "What is the annual production pattern of published papers?" the results indicate the significant influence of the publications presented in the last years. In fact, until 2008 (more or less), the scientific production is inexpressive in both research topics. After that, the topic of innovation starts a progressive increase that becomes very evident from 2019 onwards; on the other hand, co-creation shows only a timid growth in the number of citations starting from 2019.

Considering the most cited papers and most productive authors (RQ3), "Re-designed flipped learning model in an academic course: The role of co-creation and co-regulation" is the most cited paper on the topic of co-creation, as well as "Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math" the most cited paper on the topic of innovation. We attest to the existence of many authors on this topic, so it is impossible to highlight the most influential authors. Through the number of citations, we can only highlight that Blau, I & Shamir-Inbal, T are the most cited (133 citations).

Another exciting result relates to our RQ4 "What country and affiliation have the most publications?". Spain is the most productive country regarding higher education, active learning, and innovation. The United Kingdom, the United States, and Israel are also the most productive in co-creation. Similarly, Universidad de Sevilla, Tecnologico de Monterrey, Universidad de Salamanca, and Universidad de Granada are the most contributing to innovation; and the Open University of Israel is the most productive University in the field of co-creation.

Concerning RQ5, "Which structural knowledge clusters underlying the network of co-citations among papers, authors, and journals can be identified?" suggest three distinct clusters. The red cluster associates the terms "active learning" and "higher education" with the engineering and computing sectors; a green cluster links the term "learning" with the internal context of HEIs; and the innovation cluster (blue) is associated with the issues of knowledge and sustainability. Innovation, while not being the most expressive co-occurrence, nevertheless occupies a central and equidistant position to the cluster of the higher education institution's internal context and that of the engineering and computing sector, suggesting that it is an issue present in both clusters. This denounces the idea that innovation is limited to the higher education institution context and focused on technological development, which is a very reductive and wrong perception of the situation, requiring the continuation of this study to overcome this limitation.

Finally, concerning the last RQ6 - How does this new attitude of HEIs address the issue of regional development? The answer to this question is enlightening on how pedagogical innovation and co-creation are disconnected from the issue of regional development. Only six studies establish this relationship, mainly focused on the tourism and sustainability sector. All the remaining studies (115) are essentially focused

on the pedagogical relationship between teachers and students (an internal issue to HEIs, we would say), the acquisition of hard and soft skills, and the development of students' creative and innovative potential, but always detached from the surrounding context, particularly the issues of regional development. This chapter is a first attempt to structure, bibliometrically, the importance of HEIs in using active learning methodologies and promoting co-creation and innovation environments. There is an urgent need for HEI to promote a shift of mindset in their educational practices. Moreover, the experience in these last years due to the pandemic showed us the necessity of a clear understanding of this change. In today's world, complex challenges are the true challenge for the future of higher education, and graduates capable of addressing these, are now the added value of the higher education system. Regarding the topic of this book, we highlight the urgent need to connect the issue of co-creation and innovation with the emerging needs of the natural world outside the walls of HEIs. Lastly, this chapter has some boundaries; the use of a single database, Scopus, and not considering other databases, for instance, the Web of Science; electing only one type of document, papers; putting aside books, book chapters, conferences papers, among others; and elected English as the official language of this analyzes. Naturally, future research must overcome such limitations and explore more profoundly the future of higher education institutions and their relationship with co-creation and innovation.

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