

INTERDISCIPLINARITY IN HIGHER EDUCATION: A CROSS-SECTIONAL ANALYSIS OF THE LITERATURE IN THE PERIOD 2014-2018

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ABSTRACT

Goal: The growing complexity of problems induces the use of multi- and interdisciplinary approaches in their solution. This situation occurs in a number of fields, including in the field of Education. The results of research from the interdisciplinary point of view in Education are presented in several journals, addressing different subjects, which prevents a holistic view on the development of this area. In order to fill this gap, this article aims to study interdisciplinarity in education in order to understand how the concept of interdisciplinarity has been applied in this area.

Design / Methodology / Approach: It consists of a bibliographical survey, with articles indexed in the SCOPUS database. The selection of articles was limited to a transversal research in the literature from 2014 to 2018, using the following keywords: interdisciplinarity and higher education.

Limitations of the investigation: Through the methodology used, 60 articles were selected.

Results: Few articles were related to interdisciplinary practices, demonstrating the need for research to cover this gap.

Practical implications: Although the subject began in the 1970s, there is still much to be researched regarding interdisciplinarity in education, to allow a better dissemination and practice thereof, so that students have a systemic view of current complexity.

Originality / Value: The study points out a gap in the literature, and the quantitative results suggest that there is a greater deficiency of works directed to the application of the interdisciplinary approach in the development of this aspect for the improvement of society.

Keywords: Interdisciplinarity; Education; Interdisciplinarity in Education; Interdisciplinary subjects.

1. INTRODUCTION

From the contemporaneity, complex problems that should be discussed in an unconventional, strictly disciplinary way arise. It is thus necessary that the different fields of knowledge dialogue and produce new forms of knowledge. According to Hannon et al. (2018), the focus on complex problems brings the need to have interdisciplinary curricula, beyond the limit of the subjects, to allow a better understanding.

According to Clark et Wallace (2015), knowledge is fragmented in its organization, classification, production and use in academia, professions, and society. A practical conceptualization of interdisciplinarity in the interests of integration is necessary to address the multiple perspectives, epistemologies and fragmentation inherent in these problems.

Interdisciplinarity, conceived in its etymological definition, is used in an overly broad sense. The definition of interdisciplinary implies in the relations between two or more disciplines or branches of knowledge, or something that is common to two or more disciplines (Houaiss, 2017).

Barth et Michelsen (2013) note that sustainability comprises a concept that not only influences educational practices, but also suggests disciplinary contributions to foster inter and transdisciplinary research in the discourse of sustainability. The question remains as to how and to what extent educational science in particular can contribute to the science of sustainability in terms of an "inside-out" approach.

In this context, the question that emerges from the research is "what is the frontier of knowledge within the Interdisciplinarity and Higher Education interface?" Thus, the aim of this study is to carry out a cross-sectional bibliographic study on interdisciplinarity in education in the period 2014-2018, in order to understand how the concept of interdisciplinarity has been applied in this field today. To achieve this goal, the following steps were taken: a) bibliographic research aiming to select the works in the last 5 years; b) analysis of selected articles, seeking to identify the subjects of the frontier of knowledge; and c) identification of the subjects cited by each of the authors.

2. CONTEXT OF INTERDISCIPLINARITY

Interdisciplinarity arises with the urgency of concern for the environment, and disciplinary issues are not enough to solve it. According to Weidner (1973), "interdisciplinarity and, in fact, all other forms of innovation, must be viewed from the standpoint of entire educational systems, thereby allowing the challenges to be faced."

Zverev (1975) believes that interdisciplinarity should be taken to the educational subject, reflecting its subordination to the structure of the study of school education, developed on the basis of an analysis of scientific knowledge.

In the analysis of the recent literature, interdisciplinarity is directly related to sustainability, and this can be studied at various educational levels. Annan-Diab et al. (2017) proposes that "interdisciplinarity should be applied to MBA students from graduate courses of different backgrounds," considering interdisciplinary education for sustainable development, where students should be encouraged to combine knowledge of different disciplines, in order to advance in understanding and sustainable development issues.

In the view of Klein et al. (2017), "interdisciplinarity and collaboration are key words for change in the 21st century. Both, however, face challenges across the academic system, from administrative policies and budget formulas to disciplinary research and education cultures."

With so much specialization of the disciplines, the search for interdisciplinarity falls in the complex field. Tarrant et Thiele (2016), believes that "interdisciplinarity needs a huge effort to be achieved" and there is little discussed in the literature regarding practices and the way it occurs. According to Choi et al. (2006), "interdisciplinarity analyzes, synthesizes and harmonizes the links between disciplines in a coordinated and coherent whole."

In the perspective of Morillo et al. (2003), "interdisciplinarity is considered the best way to tackle practical research topics, and studies on interdisciplinarity, from every possible perspective, are increasingly required," for a better understanding of the complex and what may be required for sustainable development. According to Steiner et Posch (2006), "traditional unidirectional educational processes are of very limited use for the education of sustainable development." The systemic view becomes important in this context, and the authors further corroborate that "mutual learning based on real-world cases requires an interdisciplinary point of view." The resolution of the complex sustainable development dilemma requires other attributes, such as creative ability, social skills, and specific communication skills to address dynamic transformation, and these lessons should occur in the classroom.

Universities play a key role in this process, and improving interdisciplinarity becomes a strategic goal at almost all levels of education according to Ferrer-Balas et al. (2008). According to Richter et Paretti (2009), "educators do not yet have rigorous research on learning barriers, outcomes, and concrete interventions to support this interdisciplinary development."

Fiore (2008) considers teamwork important to improve research in the interdisciplinary field and the practice of science. According to Rhoten et Pfirman (2007), “in the United States, funding agencies fund interdisciplinary research and universities promote the expansion of interdisciplinary research.” Interdisciplinarity is directly linked to sustainable issues, according to Yarime et al. (2012): “As sustainability issues span across multiple academic disciplines, from the natural sciences to the social and human sciences, interdisciplinarity has become a core idea for mastering the science of sustainability.” Gasevic et al. (2014) reinforce that the scarcity of the subject of educational technological innovation could be a worrying sign of the fragmentation of research and the need to increase efforts to promote interdisciplinarity.

According to Bromham et al. (2016), “interdisciplinary research is widely considered a greenhouse for innovation, and the only plausible approach to complex problems.” The problem of this subject is the issue of the financing of interdisciplinary studies.

Interdisciplinarity in Education

According to Klassen (2018), in order to design an interdisciplinary education, some variables are necessary, such as “the choice of the problem, the level of interaction between different disciplines, and the constructive alignment.” Leydesdorff et al. (2018), however, state it is difficult to operationalize interdisciplinarity in the absence of a definition of the disciplines.

Correia et Souza (2018) conceptualize interdisciplinarity as a guiding principle for theories and methodologies in several fields of knowledge. Notwithstanding, interdisciplinary research involves other aspects such as politics, pedagogy and epistemology.

Raynaut (2014) notes that interdisciplinarity arises in the context of understanding contemporary issues, beyond disciplinary boundaries, in order to understand the complexity of current problems, focusing on methodological issues.

According to Raynaut (2011), interdisciplinarity is a process of dialogue between disciplines that are established in their theoretical and methodological identity, but which respect the knowledge produced by others, acknowledging their own limits, thereby confronting disciplinary fields to feed a core problem without requiring distancing itself from its own questions. There should not be a hierarchy between the disciplines – there ought to be a mutual feeding to generate new questions, approaches, and results.

The university continues to be a merely expository environment, and it is necessary for educators to be aware of

the theoretical purposes that justify the need for interdisciplinary action. It is not possible to develop an understanding and complex thinking only with the juxtaposition of teachers in the classroom. It is necessary to rescue the importance of the “other” in the construction of knowledge without ignoring the social changes, understanding the current reality. Further, there should be redundancy in the sense of promoting the interaction of the individuals with the aim of exchanging information among the teachers to create an adequate and comprehensive curriculum (Kern et al., 2011).

3. METHODOLOGY

The bibliographic search was carried out in the Scopus indexed database, on October 20, 2018, using the following keywords: TITLE-ABS-KEY (“interdisciplinarity AND “higher education”) AND (LIMIT-TO (DOCTYPE, “ar”)) OR LIMIT-TO (DOCTYPE, “re”) OR LIMIT-TO (DOCTYPE, “ip”) AND (LIMIT-TO (SRCTYPE, “j”)) AND (LIMIT-TO (PUBYEAR, 2018)) OR LIMIT-TO (PUBYEAR, 2017) OR LIMIT-TO (PUBYEAR, 2016) OR LIMIT-TO (PUBYEAR, 2015) OR LIMIT-TO (PUBYEAR, 2014)), limited to a study that is characterized as cross-sectional, the period of time for the search in the portal database, in the last 5 years, being motivated by the aspect of the unpublished contribution of the identified studies. After the search, 108 articles were found. The selection considered articles, reviews, and press articles. In the filter, 108 articles were analyzed considering their adherence to the title and the abstract, with 60 remaining in the selection of articles for the composition of the “initial core,” based on the bibliometric model used by Freitas (2017). Thus, the steps of the Methodology are described in Figure 1 below:

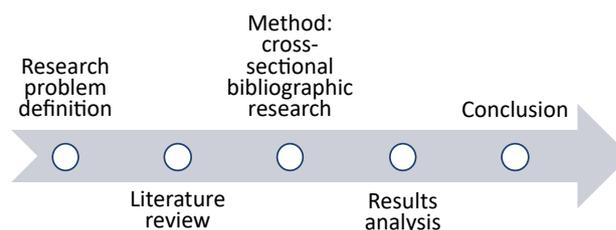


Figure 1. Research steps – Authors’ own work (2018).

Figure 1 represents the steps taken by the systematic research. The research problem was defined. Following that, we performed the literature review, defining the interdisciplinarity and its context, as well as Interdisciplinarity in Education. The method consisted of a bibliographic and cross-sectional research in the period 2014-2018. Following that, it was performed the analysis of the results, in which 10 subjects were addressed by the authors. Finally, the conclusion was developed.

4. CRITICAL ANALYSIS OF THE ARTICLES

With the articles selected as the “starting core,” an analysis of the abstracts was carried out to identify the articles that corresponded most to the initial idea of the search: to verify how interdisciplinarity is inserted in education and what the authors’ understanding is regarding the meaning of interdisciplinarity and its importance. Thus, the analysis of the most relevant abstracts is presented in Chart 1 below.

Based on the analysis of the abstracts, the 10 subjects most frequently addressed by the authors regarding the interface between interdisciplinarity and higher education are presented in Chart 2. The following were considered: S_1 = Study of Complex Problems (Related to studies of complex

problems); S_2 = Sustainable Issues (Relationship with sustainable development); S_3 = Interdisciplinarity as a Method (definition of applied Interdisciplinarity as a teaching method); S_4 = Interdisciplinary Practices (the authors approach interdisciplinarity as a teaching practice); S_5 = Curricular Questions (change in the curriculum aiming at achieving interdisciplinarity); S_6 = Contemporary Discourse (Modern Problems); S_7 = Interdisciplinarity for Innovation (Interdisciplinarity for technological advancement); S_8 = Interdisciplinarity in the Improvement of Skills and Competencies (Interdisciplinarity in the improvement of skills and competencies); S_9 = Interdisciplinary Approach (defining Interdisciplinarity as an approach); and S_{10} = Other (none of the criteria mentioned above were identified).

Chart 1. Concept of interdisciplinarity in Education – Authors’ own work (2018).

YEAR	AUTHORS	CONCEPTS
2018	Hannon et al.	2018 Hannon et al. It conceptualizes interdisciplinarity as a contemporary movement of curricular change, with the focus on breaking down the disciplinary boundaries, from the need to study the complex problems.
2018	Murray	It argues that student-led actions through multi-stakeholder collaboration, interdisciplinarity and collective action have an influence on sustainability in higher education, but that research has not made it possible to see to what extent this occurs in influencing institutional change, best practice, and intersections with social justice more broadly.
2018	Schäfer et al.	The interdisciplinary approach in law education has been advocated. Nevertheless, there is little evidence in terms of how this form of teaching can influence the relationship with other disciplines. Empirical evidence demonstrates that the adoption of interdisciplinary teaching is related to their previous higher education, socialization in research, and multidisciplinary environments.
2018	Longhurst et al.	For authors to critically reflect on the curriculum enhancement program led by them, they would have acted differently to increase students’ opportunities for interdisciplinarity in teaching and research. It is of the utmost importance that students be able to study issues based on interdisciplinary perspectives and to have maximum flexibility in their grades, thus ensuring that their choices are purposeful. In addition, it is important to facilitate the interactions of the deans, academic directors, and other college staff so that everyone has the same goal of collaboration and do not act independently.
2018	Pereira et al.	According to the authors, interdisciplinarity would collaborate in professional training, improvement to the teamwork, and greater ability to address subjects related to health.
2018	Khoo et al.	According to the authors, interdisciplinarity and transdisciplinarity are methodological approaches to address complex problems.
2018	Ülkü et al.	Interdisciplinarity acts in the solution of contemporary and complex problems, working in the integration of the disciplines, and collaborating in the exchange of new knowledge. With this, it would act in the retention of the undergraduate student, through improved curricula.
2018	Vienni et al.	The authors emphasize that universities are conducive environments for interdisciplinary action, as they have tradition and spaces for experimentation.
2018	Sparke, M.	The author reflects on the challenge faced in interdisciplinary writing, to appeal to a disciplinary audience.
2018	Sclater and Lally	The authors cite interdisciplinarity as an interlacing of the disciplines and, with that, view higher education under a new approach.
2018	Milić et al.	Based on an interdisciplinary knowledge, there is an opportunity to improve skills and knowledge.
2018	Molderez and Fonseca	Interdisciplinary education, combined with diverse activities, appears as an opportunity to overcome the barrier for the acquisition of sustainable skills.
2018	Haapakorpi	Higher education is disciplinary, but the student, upon reaching the labor market, encounters multi- or interdisciplinary issues.

2018	Mossman	Disciplinary educational centers should encourage interdisciplinarity as the challenge of addressing complex issues with sustainable issues.
2018	Chernetsova et al.	The author notes that, in modern universities in Russia, interdisciplinarity and complexity are the main principles that underlie the proposed integrative approach used in higher education.
2018	Ouellet et al.	According to the authors, the interdisciplinary dialogue is promoted based on the need to understand the study of sustainability.
2018	Nanni et al.	The authors analyze the changes in interdisciplinary practices, with the adoption of computational approaches.
2018	Grierson and Munro	The authors discuss the relationship between sustainable development and interdisciplinarity in distance Higher Education.
2017	Donina et al.	Interdisciplinary research is critical to meeting contemporary challenges. In this sense, interdisciplinarity has become prominent in political discourse for science and Higher Education.
2017	Power and Handley	The complex problems created by global society require moving beyond disciplinary boundaries, and interdisciplinary practices emerge as facilitators for solving these problems.
2017	Self and Baek	Interdisciplinarity arises to offer skills and competencies, thereby reinforcing the need to provide an interdisciplinary curriculum with interdisciplinary experiences.
2017	Tarrant and Thiele	Interdisciplinarity is a challenge for achieving integrative knowledge in order to solve complex problems in the field of sustainability studies.
2017	Knewstubb and Nicholas	According to the authors, the interdisciplinary conceptual model contributes to exploring the relationship between teaching and learning as a methodological approach.
2017	Brooks	Contemporary problems can best be approached with broadly trained specialists who can think, imagine and solve problems beyond academic disciplinary boundaries.
2017	Buekers	Interdisciplinarity as an approach can be used to explain how elite athletes deal with the complex nature of sport skills.
2017	Macuch and Dal	The authors address interdisciplinarity as an important methodology, being a facilitator in understanding concepts related to learning.
2017	Brudermann et al.	According to the authors, the interdisciplinary approach arises for a better understanding of environmental and social issues, with the aim of promoting sustainable development.
2017	Holt et al.	There is a growing need for interdisciplinary education, based on socio-environmental issues that go beyond disciplinary boundaries.
2017	Pinto et al.	The authors believe that the interdisciplinary approach broadens the possibility of complementing the gaps left by disciplinary and multidisciplinary approaches.
2016	Ribeiro	The author notes that having a network of researchers and strong links are positively related to interdisciplinarity.
2016	Shandas and Brown	Interdisciplinarity is an educational and research paradigm that emerges to address complex problems beyond disciplinary boundaries. Interdisciplinarity presents a practical approach to dealing with contemporary challenges.
2016	Kaittani et al.	The authors analyze interdisciplinarity as a method used in teaching and learning.
2016	Toassi and Lewgoy	They cite interdisciplinarity as an innovative teaching-learning practice, encouraging curricular change.
2016	Causgrove et al.	Complex problems require a combination of disciplines for the best understanding, and for this to occur, researchers must be open to listening to one another.
2016	Szostak	It addresses interdisciplinarity as a methodology.
2016	Wood et al.	Interdisciplinarity was established with a key principle and the challenge of understanding sustainability.
2016	Widener et al.	The authors consider curricular change and build new interdisciplinary links to teach the concepts of sustainability.
2015	Peterson	Higher education is improved based on interdisciplinary thinking.
2015	Cárdenas-Rodríguez et al.	The authors cite innovative educational changes based on the principles of interdisciplinarity.
2015	Alexei	The author cites interdisciplinarity and curricular customization as an interactive teaching strategy aimed at developing learning skills and abilities.
2015	Monk et al.	The authors cite that technology and curriculums allow the creation of research that is not limited by disciplines, but rather by interdisciplinary interactions.

2015	Holley	It emphasizes the challenge of creating innovative, collaborative and interdisciplinary knowledge in response to enormous social demands.
2015	Miles	Collaborative teaching and learning, with the technological tools, helps to foster innovation and interdisciplinary work.
2015	Scimeca and Labaree	According to the authors, going beyond disciplinary boundaries may be an effective way to understand complex problems, but little is known about interdisciplinary practices.
2015	Engerman	Academically interdisciplinarity is highlighted for its ability to deliver important results in research and contribute to innovation.
2015	Lygo-Baker et al.	Interdisciplinarity is inserted as a dynamic that can serve as the basis for a new program of support for clinical teaching.
2015	Vasconcelos	The author indicates that the graduate program in nutrition in Brazil, due to its complexity, breadth, epistemology and heterogeneous methodology, requires the search for interdisciplinarity.
2014	Ventura and Lins	They consider that interdisciplinarity, as well as multidisciplinary and transdisciplinarity, have become criteria for institutional evaluation in various countries.
2014	McCulloch	Research is addressed in an interdisciplinary way regarding teaching and social practices, overlapping the research model studied in a multidisciplinary way.
2014	Bursztyń and Drummond	The authors consider that interdisciplinarity should be treated in an integrated way with disciplinarity, without considered opposites.
2014	Bossio et al.	The authors provide a map for successful interdisciplinary collaboration.
2014	Fonsêca et al.	The authors consider that education through work is capable of assisting in the training process, and that one of its advantages is the establishment of interdisciplinarity in the education process.
2014	Cesco et al.	Interdisciplinarity is especially important in graduate education. The authors examine their construction and institutionalization in addition to the intended and/or unforeseen outcomes in a graduate program.
2014	Strengers	The authors stress that tensions in the doctoral course may overwhelm the doctoral students. They emphasize that there is not always a need for interdisciplinarity to solve real world problems.
2014	Oliva-Figueroa et al.	The scarcity and practical constraints of a flexible curriculum restrict the denser interdisciplinary and transdisciplinary discourses in higher education.
2014	Macdonnell	The author addresses interdisciplinarity as a dimension of emancipatory nursing.
2014	Lee	The author notes that interdisciplinarity has been used in higher education as a response to the need for training of generalists and non-specialists.
2014	Mobley et al.	The authors address the teaching of sustainability and biocomplexity in the interdisciplinary perspective. The innovative format and pedagogical approach can be employed in other disciplines to promote an understanding of complex environmental issues.
2014	Balon	The author addresses the disappearance of postmodernism based on debates and perspectives for interdisciplinarity.
2014	Duda	Interdisciplinarity is guided by a methodology.

Chart 2. Analysis of the subjects covered – Authors' own work (2018).

Authors / Subjects	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Hannon et al. (2018)	X				X	X				
Murray (2018)		X		X						
Schäfer et al. (2018)									X	
Longhurst et al. (2018)					X					
Pereira et al. (2018)								X		
Khoo et al. (2018)	X		X							
Ülkü et al. (2018)	X				X	X				
Vienni et al. (2018)				X						
Sparke, M. (2018)										X
Sclater and Lally (2018)									X	
Milić et al. (2018)								X		
Molderez and Fonseca (2018)		X		X				X		



Haapakorpi (2018)										X
Mossman (2018)	X	X								
Chernetsova et al. (2018)	X									
Ouellet et al. (2018)		X								
Nanni et al. (2018)				X						
Grierson and Munro (2018)		X								
Donina et al. (2017)						X				
Power and Handley (2017)	X			X						
Self and Baek (2017)					X			X		
Tarrant and Thiele (2017)	X	X								
Knewstubb and Nicholas (2017)				X						
Brooks (2017)						X				
Buekers (2017)	X							X	X	
Macuch and Dal (2017)				X						
Brudermann et al. (2017)		X							X	
Holt et al. (2017)		X								
Pinto et al. (2017)									X	
Ribeiro (2016)										X
Shandas and Brown (2016)	X			X		X			X	
Kaittäni et al. (2016)				X						
Toassi and Lewgoy (2016)				X	X					
Causgrove (2016)	X									
Szostak (2016)				X						
Wood et al. (2016)		X								
Widener et al. (2016)		X				X				
Peterson (2015)										X
Cárdenas-Rodríguez et al. (2015)										X
Alexei (2015)						X		X		
Monk et al. (2015)						X				
Holley (2015)								X		
Miles (2015)								X		
Scimeca and Labaree (2015)	X			X						
Engerman (2015)								X		
Lygo-Baker et al. (2015)										X
Vasconcelos (2015)	X			X						
Ventura and Lins (2014)										X
McCulloch (2014)					X				X	
Bursztyn and Drummond (2014)										X
Bossio et al. (2014)				X	X					
Fonsêca et al. (2014)										X
Cesco et al. (2014)										X
Strengers (2014)	X									
Oliva-Figueroa et al. (2014)				X	X					
MacDonnell (2014)										X
Lee (2014)								X		
Mobley et al. (2014)	X	X						X	X	
Balon (2014)	X						X			
Duda (2014)				X						
Total	15	11	8	11	9	6	4	7	8	11

Figure 2, which shows the frequency of subjects addressed by the selected authors, is presented below.

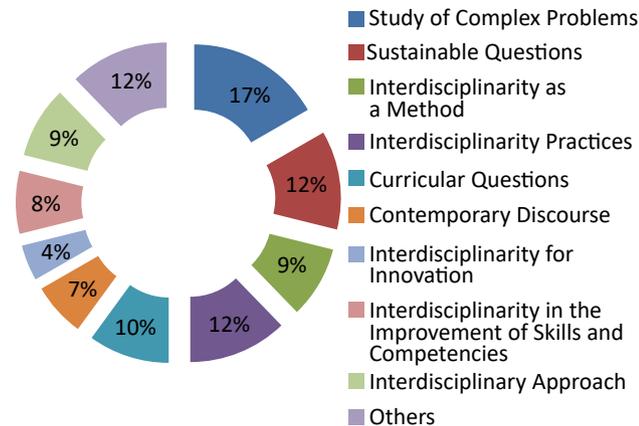


Figure 2. Frequency of subjects – Authors' own work (2018).

After analyzing the graph, the topic most frequently addressed by the authors about the importance of the study of Interdisciplinarity is the "Study of Complex Problems," with 16.7%, followed by "Interdisciplinary Practices," "Sustainable Issues" and "Other," with 12.2% each. The first three subjects are closely linked to the need for a behavioral change in the educational approach of interdisciplinarity, as a field of complexity that can be internalized through practical experiences provided by a contemporary education, aiming at sustainability. The subjects of "Curricular Questions," "Interdisciplinarity as a Method", and "Interdisciplinary Approach" are factors that support the possible changes in formal curricula. A larger gap of study is found in the following subjects with "Interdisciplinarity in the Improvement of Skills and Competencies", with "Contemporary Discourse", with "Interdisciplinarity for Innovation" being the least frequently cited. These last items are presented as the consequences that may arise from interdisciplinarity as a science of training of a new reality of competencies and their applications in the impetus of innovations that are necessary for the survival of organizations in this society of knowledge and that must be sustainable.

5. CONCLUSION

This article reached the objective of performing a cross-sectional bibliographical analysis in order to identify the frontier of knowledge in the interface of Interdisciplinarity and Higher Education. To do so, the abstracts of articles found in the SCOPUS database were used with the keywords "Interdisciplinarity" and "higher education" in the titles, abstracts and keywords "articles", "review" and "article in press". The timeframe from 2014 to 2018 aimed to find what is new in this context.

Furthermore, through the analysis of the abstracts, the following subjects were identified: Study of Complex Problems; Sustainable Issues; Interdisciplinarity as a Method; Interdisciplinary Practices; Curricular Questions; Contemporary Discourse; Interdisciplinarity for Innovation; Interdisciplinarity in the Improvement of Skills and Competencies; Interdisciplinary Approach; and Others, which were later used to quantify the subjects cited by each of the authors.

Thus, it was verified that 12.2% of the authors report the practices to promote interdisciplinarity in higher education. Many authors seek to define what comprises interdisciplinarity and note the importance of practicing it at all levels of education. The studies point to the use of interdisciplinarity for a better sustainable development and in terms of how acting in an interdisciplinary way is intrinsic to the proposal of sustainability. The quantitative results show that there is a greater deficiency of studies aimed at the application of the interdisciplinary approach in the development of this aspect for the improvement of society. This is a challenge for contemporary researchers in all fields of knowledge.

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