Review

Bibliometric Systematic Literature Review of Problem-Based Learning Entrepreneurship

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Abstract: The augmenting commitment in the entrepreneurial learning process, both at academic and industry level, has led to new mechanisms and methodologies. Entrepreneurship literature has shown evidence of raising interest in the problem-based learning (PBL) methodology with regard to upcoming events from the surrounding learning context. This paper presents a Systematic Bibliographic Literature Review (SBLR) with respect to the application of PBL throughout distinct entrepreneurial processes either in higher education, or in industry. It aimed to identify relevant entrepreneurial opportunities for PBL. Bibliographic databases were searched for documents published between 2002 and May 2024 to categorize key topics discussed in the literature on PBL and entrepreneurship. The review process identified 142 empirical and non-empirical papers on entrepreneurship related PBL. Data analysis revealed diverse subthemes for PBL uses in entrepreneurship in both higher education institutions and industry. The research questions "What is the interplay of problem-based learning methodology with entrepreneurship?" guided the study. The central output of the research is the discovery of the varying uses of PBL to cope with diverse events arising within entrepreneurship context. Future research directions are suggested.

Keywords: problem-based learning; entrepreneurship

1. Introduction

The principal objective of this paper was to identify contributions of problem-based learning methodology to entrepreneurship. In this vein, the research questions "What is the interplay of problem-based learning methodology with entrepreneurship?" guided this piece of literature. It was adopted a SBLR to ascertain key contributions related to the countless application of PBL methodology in entrepreneurship. PBL revealed to be worthwhile in varying situations to build new knowledge and find the suitable solutions. It thus delivers new insights when it comes to unveil new entrepreneurial skills, potential challenges in transferring it to the educational domain and appropriate strategies to fuel entrepreneurial mindset and innovation [1].

This piece of literature intends to shed light over the vast array of inputs from PBL to the entrepreneurship domain. In particular, the extent to which it influences entrepreneurial attitudes amongst students, [1] its effects on entrepreneurial mindset and skills such as teamwork and communication, which are essential for entrepreneurship education and long-term entrepreneurial success [2]. Likewise, the development of student entrepreneurship abilities [3] for instance in terms of analyzing the implementation objectives [4], or the building of critical thinking ability in entrepreneurship courses [5] improving thus student learning activities [6] and ensuing sustainable business ideas aimed at solving conjointly local, national, and global problems [4] and solutions to real-world problems [5].

PBL has therefore, on one hand, unveiled to have an influence on entrepreneurial attitudes, learning motivation, and entrepreneurial skills among students [1], such as through learner-led

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methodologies, in which the focus turned from teacher to student as a learner itself [7]. On the other hand, mainly by challenge-based learning programs, PBL have proved to have a key effect on students' entrepreneurial skills, such as creativity and financial literacy, triggering the development of multidisciplinary solutions [2]. Some posit that by exposing students to the challenges of entrepreneurship in problem-based courses will significantly increase the intention to become an entrepreneur [2]. Problem-Based Learning (PBL), combined with other methodologies – e.g. action learning - has been suggested as proven social entrepreneurship learning approaches to uphold social entrepreneurial mindsets, whilst fostering entrepreneurial mindset and innovation [7].

To summarize, this paper aims to categorize the learning events linked to PBL theory, contributing thus to problem-based learning framework in terms of defining the best active learning strategies for entrepreneurship and the subsequent path to the best solutions to organizational issues. This research is based on a SBLR methodology and intends to deliver its key conclusions for the betterment of entrepreneurship both at academic and industry levels. This article is structured as follows. First, we briefly discuss problem-based learning theoretical background, second, we present the chosen methods and data, third, its discussion is carried out in the light of the main subthemes and finally, conclusions are drawn.

2. Theoretical Background: Entrepreneurship Education and Problem-Based Learning

Entrepreneurship is learning in context, which varies with distinct environs [1]. Notwithstanding, in spite of the ontological and epistemological assumptions underlying that experiential learning, one can emulate those 'real problems', in order to develop the best entrepreneurial competences through different pedagogical methodologies, noteworthy problem-based learning.

Hence, to embrace entrepreneurship fundamentals in the curricula demands a new paradigm is opportune. It is worthwhile to reflect the way the education system interplays with the increasingly turbulent industry contexts. It is advisable to learn how to learn in more realistic, proactive and innovative ways, within the education system, in order to better cope with the nowadays critical events, instead of learning through memorization. The argument upon the best ways to include entrepreneurship fundamentals curricula is a current debate in how to combine traditional education with the augmenting business demands. The efficacy of process-based learning, courses cantered for example on developing business plans, has been compared with other active methodologies, such as PBL, suggesting potential challenges in conventional entrepreneurship education approaches [2].

It's been some attempts at structuring the education system in the light of entrepreneurship education in the European Union, as a way to foster economic growth, in which the entrepreneurship dimensions are depicted in the curricula, apparently able to develop entrepreneurial competences. The importance of entrepreneurship is deemed as a central feature of life and should be taught accordingly, leading to collaborative pedagogical models that ease the knowledge processing between academic and business actors [8].

Problem Based Learning, a method intended to boost critical thinking, innovation and opportunity recognition, comes up amidst those efforts in promoting entrepreneurship education, which have been giving strategic interest, because of the weight the educational system represents in promoting economical behavioural attitudes and ensuing job creation and economic development [9].

PBL in entrepreneurship education includes varying elements that concur to the improvement of entrepreneurial competencies. On the one hand, it challenges students to learn by commitment to real issues, emphasizing active learning and critical thinking [1]. On the other hand, it embraces learning by the application of existent knowledge to cope with real issues, promoting an entrepreneurial mindset and behaviour [10]. In sum, it combines interdisciplinary knowledge and skills into a pedagogy, fostering an entrepreneurial attitude in daily life [10] and, therefore, implying innovation, enabling students to develop innovative products to unravel troubles amidst environs such as for instance the agri-food sector [11].

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Problem-based learning is an original didactic methodology, aiming at helping learners with their learning process, whilst finding solutions to practical problems by constant commitment [5]. In a shared environment, learners work together to find a best solution to a problem [12] based on their knowledge and ongoing learning in the process. Such learning processes lead to the building of theoretical constructs while emphasizing learning routines both by reflection and discussion [13]. Problem-Based Learning enhances learning by engagement in real problems, promoting active learning and combination of theory and practice [3], leading to ensuing entrepreneurial skills, that can be categorize as: creativity, planning and financial literacy [1]; and interpersonal skills of students, such as teamwork and self-employment, fostering thus interaction between university and industry [14].

Entrepreneurship should be therefore taught, through collaborative models that ease the exchange and co-creation of knowledge between, entrepreneurs, businesses and communities and by problem-based learning [8]. By using a combination of elements including entrepreneurially minded learning, problem based learning and active collaborative learning, the entrepreneurial impact of pedagogical programs increases [15]. The combination of active pedagogies with PBL triggers self-directed and collaborative learning and improved the aforementioned learner's problem-solving skills [16].

It creates situations that imitate distinct environments, in where participants are confronted with 'real world' problems, allowing the development of entrepreneurial capabilities [17]. Arisen hurdles that simulate entrepreneurial situations within a given learning environment promote students' capacity for entrepreneurship. In this way, PBL, as an active learning and multi-solution approach, resembles thus “learning-by-doing” approach of entrepreneurship education [18]. PBL stimulates therefore entrepreneurial awareness among students [5], whilst lecturers act as facilitators, to develop entrepreneurial competences and innovation [19].

PBL methodology is embedded in a context that simulates enterprise activities, within an immersive approach, also encapsulated by ‘learning by doing’ framework [20]. Throughout the process, ill-structured problems arise, which demand autonomous thinking and ongoing problem solving with students taking responsibility for their own learning [21]. PBL, combined with other active methodological strategies (e.g. *gamification*) promotes an improvement in academic results, in terms of acquisition of skills such as the development of entrepreneurship and problem-solving capacity [22]. It takes advantage of active learning environments in that educators construct active learning curricula that ultimately create ensuing entrepreneurs with broader meta-cognitive scope [23].

PBL has also the potential to feed the development of transversal attitudinal skills, such as teamwork and communication, which are essential for long-term entrepreneurial success [24]. In short, PBL is paramount regarding emphasizing entrepreneurial capabilities and mindset. It over-enhances varying types and forms of experiential learning, in the vein of active learning, critical thinking, and learning by searching, promoting the development of a wider and more multidisciplinary entrepreneurial mindset.

PBL has revealed a central influence on entrepreneurial attitude, building on experience and long-term development of entrepreneurial skills. Nonetheless, it poses some constraints such as lack of resources for students in sparsely populated contexts [25], the need for early group formation and formative feedback as resistance is apparent in integrating PBL principles before traditional learning [26]. Also, the inherent complexity in combining PBL with more traditional process-based learning akin business plans, tend to lessen collaborative intentions among students [2].

3. Materials and Methods

Systematic reviews are essential tools that provide comprehensive insights into topics that individual studies might not fully address. For these reviews to be beneficial to readers, authors need to offer a detailed, accurate, and transparent explanation of the research rationale, methodologies, and results [27]. To meet these standards, the researcher employed a systematic bibliometric literature review (SBLR) methodology. This method involves a structured approach to the literature review,

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allowing for an in-depth exploration of existing studies, theories, and trends within the field of problem-based learning entrepreneurship. The use of standardized methodologies and guidelines facilitates the search, review, critique, interpretation, and synthesis of findings related to the study topic. Furthermore, SBLR's rigorous and replicable process for literature selection and analysis minimizes bias by ensuring comprehensive consideration of all relevant literature, regardless of its source or the author's affiliations.

In contrast to traditional literature reviews, SBLR follows a replicable, scientific, and transparent process that aims to minimize bias by exhaustively searching both published and unpublished literature related to the study topic [28–30]. The researcher also provides an audit trail, enabling readers to evaluate the quality of the studies included in the review, as well as the research procedures and conclusions.

Thus, SBLR involves a thorough screening and selection of information sources across three phases and six steps [28–30], as outlined in Table 1, to ensure the validity and accuracy of the data presented.

Table 1. Process of systematic SBLR.

Fase	Step	Description
Exploration	Step 1	formulating the research problem
	Step 2	searching for appropriate literature
	Step 3	critical appraisal of the selected studies
	Step 4	data synthesis from individual sources
Interpretation	Step 5	reporting findings and recommendations
Communication	Step 6	Presentation of the SBLR report

Source: adapted Rosário and Dias (2023a;b;c).

The researchers conducted their literature search using the Scopus database, which is well-respected in the scientific and academic communities. However, it is important to note that this study has limitations due to its exclusive reliance on the Scopus database, omitting other scientific and academic databases. Ideally, the literature search should include peer-reviewed scientific and/or academic publications up until May 2024.

The process began with the selection of the Scopus database for sourcing and identifying relevant literature. Systematic searches were conducted using predefined keywords and phrases, with the phrase "problem-based learning entrepreneurship" yielding documents. Initial steps included removing duplicates and applying inclusion criteria to ensure the relevance of the studies to the topic. Documents were screened and excluded based on their relevance to problem-based learning entrepreneurship and the rigor of their methodology. Only peer-reviewed journal articles, conference papers, books, and reports published in English were considered (Figure 1).

For data analysis, we employed content and thematic analysis methods to categorize and discuss the varied documents as recommended by Rosário and Dias [28–30]. The 142 documents indexed in Scopus were analyzed both interpretatively and bibliometrically to enhance understanding of the content and to derive common themes that address the research question directly [28–30]. Among the selected documents, 70 are articles; 56 are conference papers; 10 are part of a book series, and 6 are book

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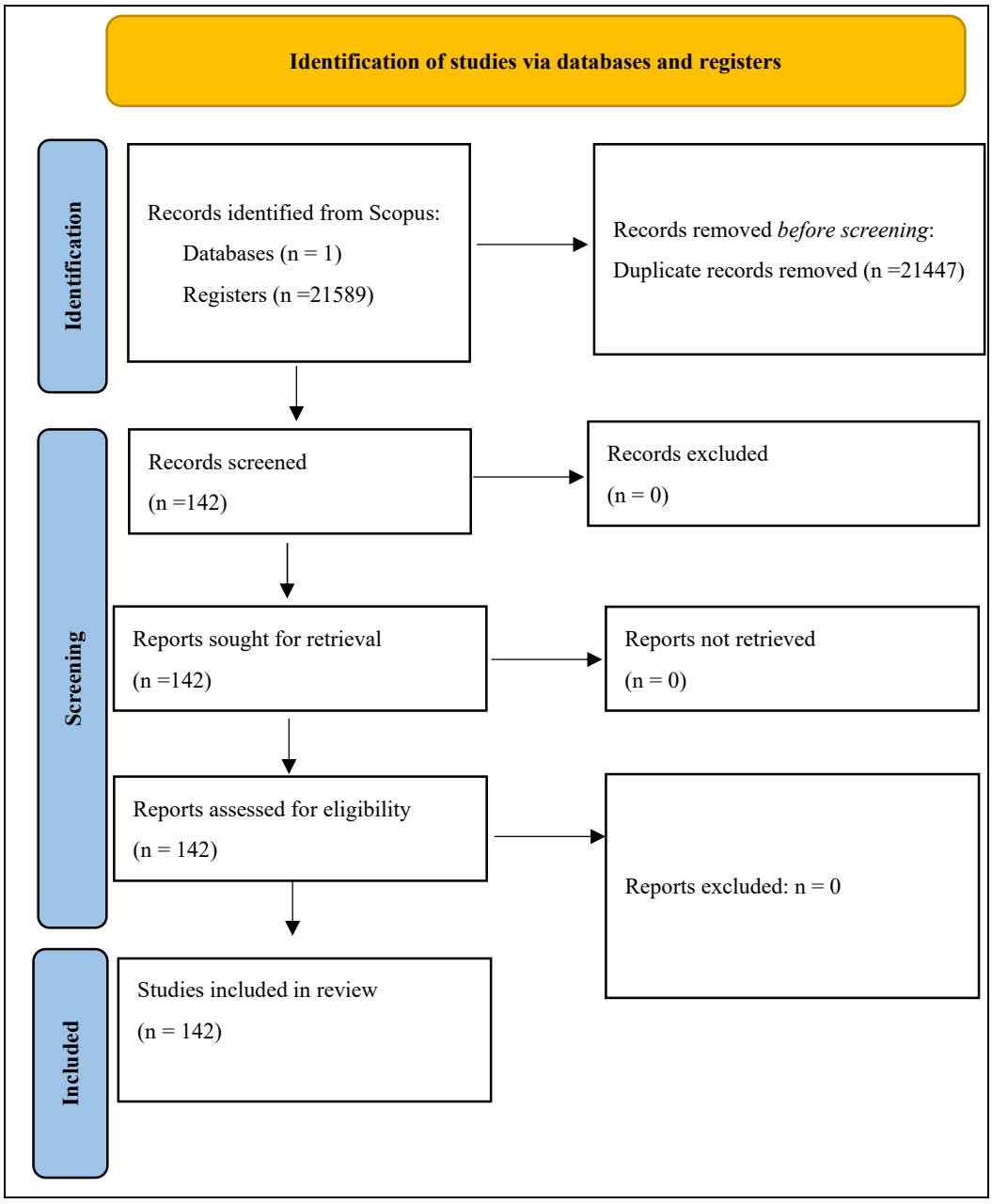

Figure 1. PRISMA flow diagram for literature search.

3.1. Publication Distribution

Peer-reviewed articles Importance of problem-based learning in entrepreneurship until May 2024. The year 2020 had the highest number of peer-reviewed publications on the subject, reaching 21. Figure 2 summarizes the peer-reviewed literature published until May 2024.

The publications were sorted out as follows: ASEE Annual Conference And Exposition Conference Proceedings (8); Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial; and with 3 (Intelligence And Lecture Notes In Bioinformatics; Journal Of Physics Conference Series; International Research Symposium On Pbl; International Journal Of Management Education; International Journal Of Engineering Education; Education Sciences; ASEE Annual Conference Proceedings); and with 2 (Proceedings Of The International Conference On E Learning Icel; Proceedings Of The European Conference On E Learning Ecel; Mechanical Engineering Education Handbook; Journal Of Entrepreneurship Education; Journal Of Commercial Biotechnology; International Symposium On Project Approaches In Engineering Education; International Journal Of Innovation And Learning; IEEE Global Engineering Education Conference

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Educon; European Journal Of Education; Education Training; Communications In Computer And Information Science; Advances In Intelligent Systems And Computing; ACM International Conference Proceeding Series); and the remaining publications with 1 document.

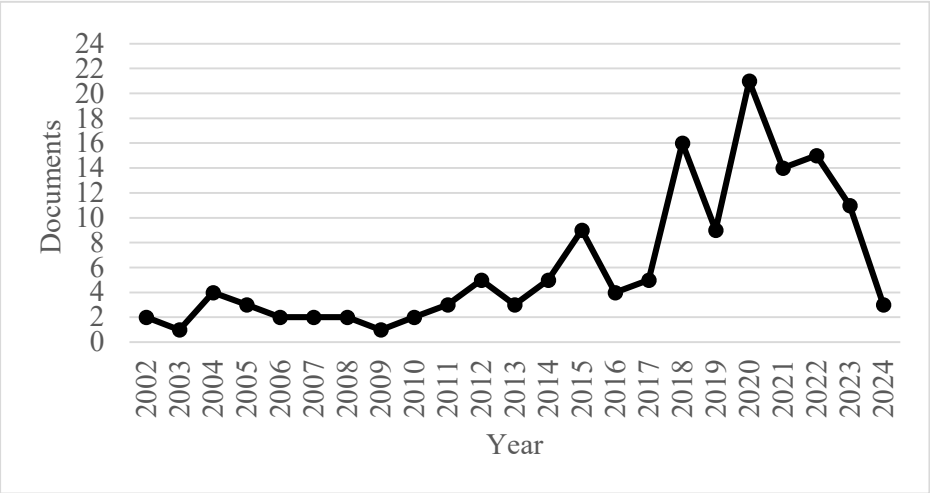

Figure 2. Documents by year.

Similarly, Figure 3 illustrates the regions with the most abundant literature contributions on the topic. The USA stands out with the highest levels of scientific output in related fields, trailed by Indonesia and Brazil, among others publishing on the subject.

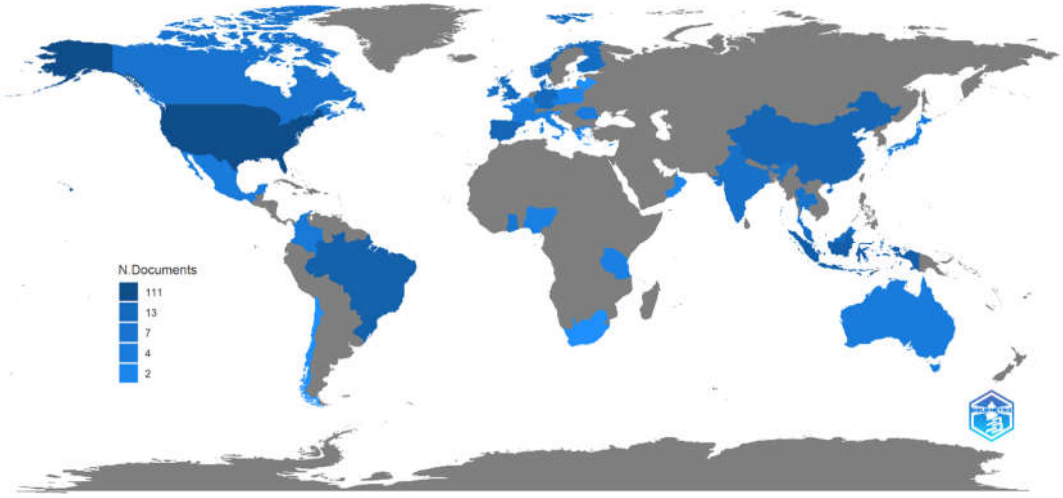

Figure 3. Documents by Geographical Area.

Table 2 and Figure 3 present the leading 10 nations that have made significant scientific contributions in the studied fields. The analysis seeks to ascertain whether these countries prioritize employing artificial intelligence in consumer behavior processes within businesses, or if their focus is primarily on enhancing productivity.

Table 2. Top 10 countries by number of publications.

Country	Number of Publications
USA	111
INDONÉSIA	31
BRASIL	27
PORTUGAL	21

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DENMARK	20
CHINA	18
SPAIN	17
GERMANY	13
UK	13
NORWAY	12

Source: own elaboration.

The publications were sorted out as follows: Social Sciences (87); Engineering (49); Computer Science (39); Business, Management and Accounting (26); Mathematics (10); Economics, Econometrics and Finance (7); Psychology (6); Medicine (6); Health Professions (5); Decision Sciences (5); Biochemistry, Genetics and Molecular Biology (5); Arts and Humanities (5); Chemical Engineering (4); Physics and Astronomy (3); Energy (2); Pharmacology, Toxicology and Pharmaceutics (1); Nursing (1); Materials Science (1); Immunology and Microbiology (1); Environmental Science (1); Earth and Planetary Sciences (1); Chemistry (1); Agricultural and Biological Sciences (1).

In Table 3 we analyze the Scimago Journal & Country Rank (SJR), the best quartile and the H index by Computers In Education Journal with 3,650 (SJR), Q1, and H index 232.

Table 3. Process of systematic SBLR.

Title	SJR	Best Quartile	H Index
Computers In Education Journal	3,650	Q1	232
Innovation Technology And Knowledge Management	3,370	Q1	54
Nature Biotechnology	18,12	Q1	511
International Journal Of Management Education	1,260	Q1	53
Thinking Skills And Creativity	1,160	Q1	66
Interactive Technology And Smart Education	1,150	Q1	34
American Journal Of Pharmaceutical Education	1,110	Q1	78
Medical Education Online	1,010	Q1	50
European Journal Of Education	0,970	Q1	59
Journal Of Surgical Education	0,900	Q1	72
International Journal Of Technology And Design Education	0,810	Q1	56
Frontiers In Psychology	0,800	Q2	184
Journal Of Small Business And Enterprise Development	0,790	Q1	86
IEEE Transactions On Education	0,790	Q1	76
Journal Of Computer Information Systems	0,780	Q1	77
European Journal Of Engineering Education	0,770	Q1	59
Education Training	0,760	Q1	85
Educational Action Research	0,760	Q1	46
Education And Training	0,760	Q1	85
Innovations In Education And Teaching International	0,730	Q1	62
Social Work Education	0,710	Q1	50
Education Sciences	0,67	Q2	53
Administrative Sciences	0,630	Q2	35
Journal Of Management Education	0,580	Q2	59
Journal Of Applied Research In Higher Education	0,560	Q2	25
Nursing Administration Quarterly	0,530	Q2	44
Entrepreneurship Education And Pedagogy	0,530	Q2	19
Procedia Computer Science	0,510	-*	132

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International Journal Of Engineering Pedagogy	0,510	Q2	19
Higher Education Skills And Work Based Learning	0,510	Q2	26
Journal Of Biomechanical Engineering	0,460	Q3	139
New England Journal Of Entrepreneurship	0,440	Q2	19
Eurasia Journal Of Mathematics Science And Technology Education	0,420	Q2	56
Journal Of Education And E Learning Research	0,410	Q2	12
Estudios Sobre El Mensaje Periodistico	0,390	Q1	17
Computing In Science And Engineering	0,380	Q2	79
International Journal Of Technology Management	0,360	Q2	66
Education Research International	0,360	Q3	18
Quarterly Journal Of Speech	0,350	Q1	45
International Journal Of Engineering Education	0,35	Q2	61
Lecture Notes In Business Information Processing	0,340	Q3	63
Journal Of Emergencies Trauma And Shock	0,340	Q2	39
Journal Of Teaching English For Specific And Academic Purposes	0,310	Q3	5
International Journal Of Learning Teaching And Educational Research	0,290	Q3	18
Management Teaching Review	0,280	Q3	5
Science Education International	0,260	Q3	8
Proceedings Frontiers In Education Conference Fie	0,260	-*	46
ACM International Conference Proceeding Series	0,250	-*	151
International Journal Of Innovation And Learning	0,240	Q3	29
Journal Of Allied Health	0,240	Q3	43
Journal Of Commercial Biotechnology	0,200	Q4	19
Communications In Computer And Information Science	0,200	Q4	69
Journal Of Engineering Education Transformations	0,190	Q4	11
Journal Of Physics Conference Series	0,180	-*	99
Lecture Notes In Mechanical Engineering	0,170	Q4	29
Journal Of Food Science Education	0,170	Q4	18
International Multidisciplinary Scientific Geoconference Surveying Geology And Mining Ecology Management Sgem	0,170	-*	27
Ifmbe Proceedings	0,140	-*	37
International Research Symposium On Pbl	0,120	-*	4
Proceedings Of The Laccei International Multi Conference For Engineering Education And Technology	0,120	-*	9
Biomedical Sciences Instrumentation	0,120	Q4	37
ASEE Annual Conference And Exposition Conference Proceedings	0	-*	28
ASEE Annual Conference Proceedings	0	-*	28
Proceedings Of The International Conference On E Learning Icel	0	-*	13
Proceedings Of The European Conference On E Learning Ecel	0	-*	12
Journal Of Entrepreneurship Education	0	-*	28
International Symposium On Project Approaches In Engineering Education	0	-*	7
IEEE Global Engineering Education Conference Educon	0	-*	35
Advances In Intelligent Systems And Computing	0	-*	69
Turkish Online Journal Of Educational Technology	0	-*	47
Review Of International Geographical Education Online	0	-*	11
Proceedings Of The European Conference On Innovation And Entrepreneurship Ecie	0	-*	9
Proceedings Of The ASME Design Engineering Technical Conference	0	-*	54

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Proceedings Of The 46th Sefi Annual Conference 2018 Creativity Innovation And Entrepreneurship For Engineering Education Excellence	0	-*	4
Proceedings Of The 32nd International Business Information Management Association Conference Ibima 2018 Vision 2020 Sustainable Economic Development And Application Of Innovation Management From Regional Expansion To Global Growth	0	-*	11
Proceedings Of The 2019 Pacific Neighborhood Consortium Annual Conference And Joint Meetings Regionality And Digital Humanities South South Connections Pnc 2019	0	-*	0
Proceedings Of 2015 International Conference On Interactive Mobile Communication Technologies And Learning Imcl 2015	0	-*	11
Procedia Social And Behavioral Sciences	0	-*	73
Iop Conference Series Materials Science And Engineering	0	-*	62
International Journal Of Instruction	0	-*	39
International Journal Of Innovation Creativity And Change	0	-*	21
Iberian Conference On Information Systems And Technologies Cisti	0	-*	24
Iadis International Conference On Cognition And Exploratory Learning In Digital Age Celda 2012	0	-*	6
Csedu 2010 2nd International Conference On Computer Supported Education Proceedings	0	-*	6
Chemical Engineering Education	0	-*	28
Asian Social Science	0	-*	41
Advanced Science Letters	0	-*	32
Administration In Social Work	0	-*	43
Academy Of Management 2005 Annual Meeting A New Vision Of Management In The 21st Century Aom 2005	0	-*	11
29th Annual Conference Of The European Association For Education In Electrical And Information Engineering Eaeeie 2019 Proceedings	0	-*	4
Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics	-*	-*	-*
Mechanical Engineering Education Handbook	-*	-*	-*
Sefi 47th Annual Conference Varietas Delectat Complexity Is The New Normality Proceedings	-*	-*	-*
Sefi 2022 50th Annual Conference Of The European Society For Engineering Education Proceedings	-*	-*	-*
Research Handbook On The Student Experience In Higher Education	-*	-*	-*
Proceedings Of The 16th International Conference On Engineering And Product Design Education Design Education And Human Technology Relations E And Pde 2014	-*	-*	-*
Proceedings Of 2021 World Engineering Education Forum Global Engineering Deans Council Weef Gedc 2021	-*	-*	-*
Proceedings Of 2014 International Conference On Interactive Collaborative Learning Icl 2014	-*	-*	-*
Proceedings Of 2013 6th International Conference On Information Management Innovation Management And Industrial Engineering Iciii 2013	-*	-*	-*
Proceedings Frontiers In Education Conference	-*	-*	-*

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Proceedings 2022 IEEE International Conference On Teaching Assessment And Learning For Engineering Tale 2022	-*	-*	-*
Populism And Higher Education Curriculum Development Problem Based Learning As A Mitigating Response	-*	-*	-*
Novel Innovation Design For The Future Of Health Entrepreneurial Concepts For Patient Empowerment And Health Democratization	-*	-*	-*
Entrepreneurship Education Opportunities Challenges And Future Directions	-*	-*	-*
EPE 2020 Proceedings Of The 2020 11th International Conference And Exposition On Electrical And Power Engineering	-*	-*	-*
Balkan Region Conference On Engineering And Business Education	-*	-*	-*
Archives Of Otolaryngology Head And Neck Surgery	-*	-*	-*
2021 Joint 6th International Conference On Digital Arts Media And Technology With 4th Ecti Northern Section Conference On Electrical Electronics Computer And Telecommunication Engineering Ecti Damt And Ncon 2021	-*	-*	-*

*data not available. Source: own elaboration.

There is a total of 22 publications in Q1, 16 publications in Q2, 9 publications Q3, and 6 publications in Q4. Publications from best quartile Q1 represent 20% of the 198 publications titles; best quartile Q2 represents 14%, best Q3 represents 8% and best Q4 represents 5% of each of the titles of 108 publications. Finally, 55 publications without indexing data represent 50% of publications. As shown in Table 2, the significant majority of publications do have quartile Q1.

The subject areas covered by the 142 scientific and/or academic documents were: Social Sciences (87); Engineering (49); Computer Science (39); Business, Management and Accounting (26); Mathematics (10); Economics, Econometrics and Finance (7); Psychology (6); Medicine (6); Health Professions (5); Decision Sciences (5); Biochemistry, Genetics and Molecular Biology (5); Arts and Humanities (5); Chemical Engineering (4); Physics and Astronomy (3); Energy (2); Pharmacology, Toxicology and Pharmaceutics (1); Nursing (1); Materials Science (1); Immunology and Microbiology (1); Environmental Science (1); Earth and Planetary Sciences (1); Chemistry (1); Agricultural and Biological Sciences (1).

The most quoted article was "A problem-based learning approach to entrepreneurship education" by Siok and Frank (2006), with 133 quotes published Education and Training 0,760 (SJR), the best quartile (Q1) and with H index (85), this paper presents a case to suggest that a problem-based learning approach practised at the Republic Polytechnic in Singapore could be an effective pedagogical approach for entrepreneurship education.

In Figure 4 we can analyze citation changes for documents published until May 2024. The period 2014-2024 shows a positive net growth in citations with an R2 of 25%, reaching 990 citations in May 2024.

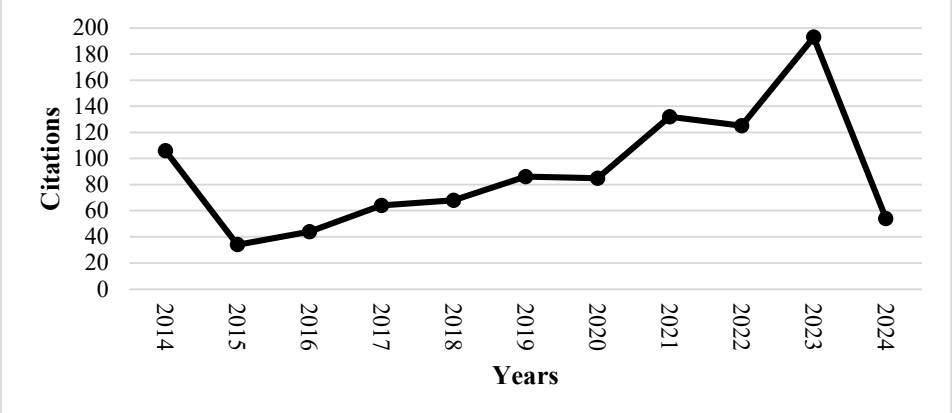

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Figure 4. Evolution of citations between 2014 and 2024. Source: own elaboration.

The h-index is used to determine the productivity and impact of a published work based on the maximum number of included articles with at least the same number of citations. Of the documents considered for h-index, 17 were cited at least 17 times.

Citations of all scientific and/or academic documents from the period ≤2014 to until May 2024, with a total of 990 citations, of the 142 documents 48 were not cited. The self-citation of documents in the period ≤2014 to May 2024 was self-cited 869 times.

The bibliometric analysis was conducted to explore and pinpoint metrics that reveal the patterns and development of scientific or academic content within documents, using principal keywords (Figure 5). In this visualization, we can observe most of the network nodes. The size of each node indicates the frequency of the associated keyword—that is, how often the keyword appears. Furthermore, the connections between the nodes signify keyword co-occurrences, where keywords appear together. The thickness of these links, meanwhile, highlights the frequency of these co-occurrences—essentially, how frequently the keywords are found together. In the case, the following two figures illustrate the interplay between PBL and entrepreneurship along key subthemes such as entrepreneurial mindset, critical thinking, skills, capabilities and pedagogy.

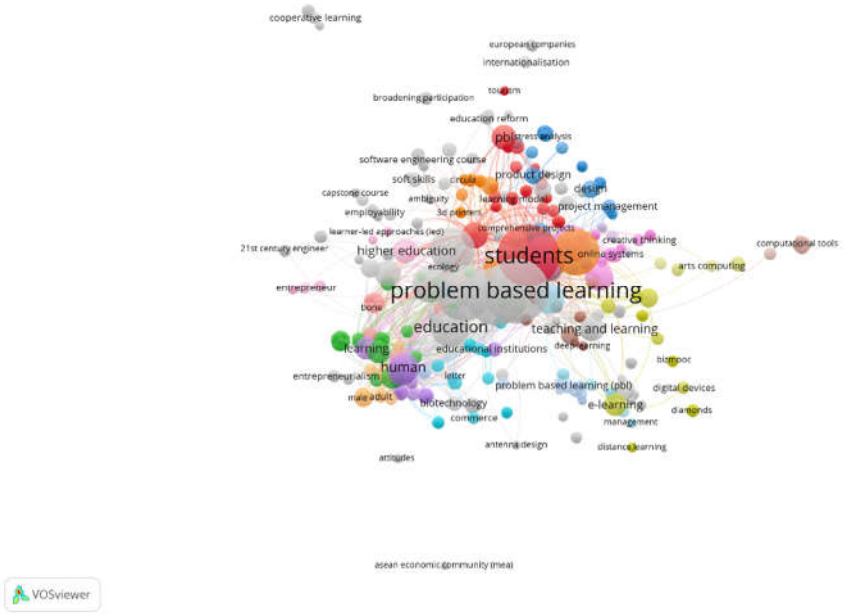

Figure 5. A network of all keywords.

In these diagrams, the size of a node corresponds to the frequency of its keyword, while the thickness of the links between nodes indicates the frequency of keyword co-occurrences. Each color represents a different thematic cluster, with the nodes illustrating the scope of topics within a theme, and the links showing the relationships among these topics under the same thematic umbrella.

The results were derived using the scientific software VOSviewer, specifically designed to target the key search term "problem-based learning entrepreneurship." The study utilized scientific and academic documents focusing on this area.

In Figure 6, from a different perspective, we can analyze the connected keywords, which allows us to illustrate the network of keywords that co-occur in each scientific article. This analysis helps in identifying the subjects investigated by researchers and pinpointing emerging trends in future studies.

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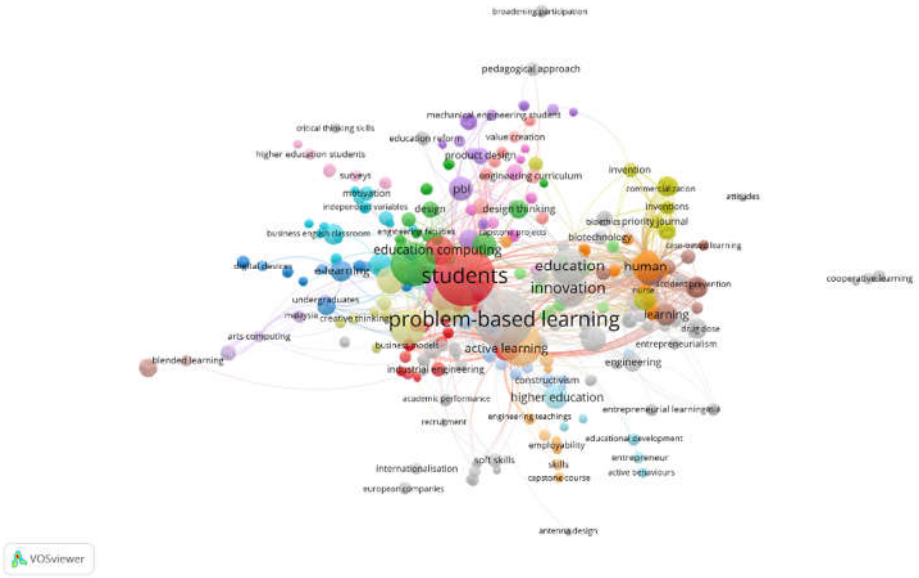

Figure 6. A network of Linked Keywords.

In summary, the methodology selected for this study provided precision and ensured the availability of comprehensive data for other researchers interested in building upon this review. Moreover, by addressing key issues, the methodology enhanced coherence and improved the overall validity and reliability of the findings. Therefore, we assess that the established guidelines for systematic reviews and meta-analyses were adhered to, achieving a high methodological standard. We will discuss these aspects in further detail below.

4. Discussion

4.1. Entrepreneurial Skills and Mindset

PBL enhances entrepreneurial skills and mindset, in contrast with traditional learning methods, leading to a more multidisciplinary and interactive solutions upon the student community [31]. It feeds critical thinking skills that are essential for dealing with the challenges of the nowadays context, while developing an entrepreneurial mindset by emphasizing real-world experience, motivation, teamwork and knowledge retention [6]. Furthermore, it is paramount to ameliorate critical thinking skills and student learning as it over enhances the entrepreneurship activities of opportunity discovery and value creation, often resorting to challenge based learning, in which it is encouraged critical thinking, a key characteristic of entrepreneurial mindset [14]. Overall, PBL has proven to increase entrepreneurial learning outcomes, highlighting its long-term impact on the reinforcement of business capabilities [32].

The aforementioned capabilities and mindset attained by PBL methodologies rely upon varying pedagogical resources and didactic strategies that worth mentioning. First, some literature strings, posit that scaffolds used in the PBL positively impacted the learning outcome, in terms of helping students to develop their entrepreneurial attitudes, in particular with respect to engineering and related technical fields [33]. It emphasizes the fostering of enterprising graduates in engineering by combining entrepreneurial learning behavior along the curricula enable them to build new value through action [34]. The intention relies on overwhelming traditional entrepreneurship pedagogies through for instance a ‘hackathon’ approach, an effective entrepreneurial learning methodology to attain entrepreneurial skills and self-confidence [35]. The vast array of PBL didactic resources allows for collaborative pedagogical models that facilitate the exchange and co-creation of knowledge while developing entrepreneurial skills, often in conjunction with other disciplines as for example design thinking [8].

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Second, PBL often resort to new, current tools such as digital technologies to innovate socially and promote social change through digital social innovations and ensuing entrepreneurial skills in all sectors of education and training [36]. Such entrepreneurial capabilities could, on one hand, emerge by active learning, under the form of communication and collaboration and knowledge-sharing in class that ultimately result in a new way of thinking [12]. On the other hand, it could come out through the ability to market a product by means of a sales poster for example, resorting to PBL, which is feasible in different contexts. It stimulates, as well, entrepreneurial awareness in whatever geography [5]. PBL enables innovation to be promoted irrespective the context and technology, providing the curricula (e.g. engineering and business) and underscoring the development of entrepreneurial and intrapreneurial skills [37].

Third, on this vein, PBL could be implemented in diverse milieus. As it emulates the entrepreneurial learning based on experimental learning by doing, it relies upon a multi-solution approach that fits varying trigger events [18]. In so, it could be applied with regard either to social work, or to international courses (e.g. Erasmus), in which explores the potential of using active experiential learning methods in an international environ, whilst building responses to critical 'real world' events, and ensuing entrepreneurial capabilities [17]. Likewise, PBL could be implemented on-line, shifting from a passive learning mode to an active experiential mode [38].

Fourth, behind the already mentioned set of entrepreneurial skills relies the inherent entrepreneurial mindset that triggers the appropriate business responses. The purpose of PBL is the development of such entrepreneurial mind and subsequent responses in students [13] for effective entrepreneurship education [39]. It may come up as a digital entrepreneurial mindset and digital competences, for a digitized world, by dealing with problems from their working environ [40], within an entrepreneurial digital learning environment of active users throughout web platforms, e-Testing, webinars, e-books, video sequences, podcasts, social networks [10] and Google Hangouts [41]. Entrepreneurial mind could, as well, be addressed by PBL through the engagement of entrepreneurial orientation (innovativeness, risk-taking, and proactiveness), throughout varied didactics of active entrepreneurial learning (e.g. games) [42] that, along the relevant teaching innovation, goes well beyond the academic grades [43].

Fifth, those innovative didactics should put the tonic more on customer related problems than on technical related issues [44], while imitating the industrial work environment [45], with open-ended questions, applied to different institutions, student demographics [46] and a wide scope of fields (e.g. biomedicine) [47,48]. Additionally, such innovative didactics could even go further in terms of creating a smart learning ecosystem, both indoor and outdoor, underscoring participatory learning, networking and capacity building [49].

Finally, PBL, combined with related active pedagogy, can also be modified to fit either a specific course, such as the traditional engineering curriculum [50,51]; or a distinct sector, by settling the course according to the characteristics of the students and demanded contents/skills [52], for instance the peculiar tourism sector [32]. In sum, PBL promotes entrepreneurial intention and attitude by creating innovative learners, with precise learning strategies and entrepreneurial self-efficacy along business planning [9,21], often supported by creative teachers, as well [2,53].

4.2. Challenges and Critical Thinking

Problem-based learning (PBL) is an active hands-on pedagogical approach that holistically engages participants in realistic challenges (e.g. small business constraints, legal issues) related to their context that demands a solution for a challenge. It improves thus the critical thinking skills behind the entrepreneurial attitude of risk assumption, proactive attitude and innovation [6]. Likewise, it positively impacts entrepreneurs by over enhancing their problem-solving capabilities [3], as emphasis their critical thinking, which is key for decision-making upon entrepreneurial action [39]. Such experiential learning methodology can assume varying forms according to similarly different environments. It could be applied to bioengineering education and training [54,55], both at graduate and postgraduate level, as for example food studies innovative programs [11], distant geographies, as employment agencies in Nigeria [56] and East Java Indonesia [1]. And yet, it was

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evidenced the improvement of critical thinking student learning activities [6], a higher retention rate, augmented motivation, and the growth of high quality work worldwide [57], along diversified curricula.

First, intensive entrepreneurship learning methods (e.g. hackathons) may be more effective in developing entrepreneurial self-efficacy than conventional courses [35]. These types of curricula use a constructivist approach allowing students to build their understandings towards their own tech innovations [58], either through experiences from Entrepreneurship live-in program studies [59], or by blended learning models, employing integrated-modular course framework [60] and new developments in digital devices along the learning process [61]. It is all about new pedagogical approaches to how we teach entrepreneurship by facilitating entrepreneurial projects in a problem-based learning environment [62]. The projects carried out are often based on team members with common interests in entrepreneurship from universities aiming at start-up business plans [63], which improve student learning activities as well as student learning outcomes [64] among entrepreneurs [65]. These projects may assume different forms, such as the STEAMpunk Girls Program, funded by the Australian Government, that uses project-learning and design thinking strategies to enable the girls to be change-makers [66], the Teaching factory (TEFA) that is a combination of production-based learning and competency learning [67], relying often upon innovation [68] throughout a new “way of teaching”[69].

Second, the PBL pedagogy is intended to shape a business oriented curriculum designed to help students learn about creativity techniques [70], by promoting entrepreneurship in the classroom for a given company [71]. It is suggested to merge work-life experience with studio training in a multidisciplinary and multi-professional environment [72], combining varying pedagogical models and methods pursued in entrepreneurship education, aiming at encouraging students to be self-directed [73] and committed [74], often through case studies [75] and integrated in distinct academic courses [76]. Such pedagogy offers a "scalable" model to reduce teacher load, whilst promoting student interaction [77] and lecturers' facilitative skills [19]. Ill-structured problems are posed and demand autonomous thinking with students taking responsibility for their own learning [21] in different ventures [78], educational portfolio [22] and geographies [79,80], inclusive at master level work [81]. PBL also relies on computer-aided activities [20], e-learning in sparsely populated areas [25], reverse online classes [82] and online learning methods during the lockdown period due to COVID-pandemic [83].

Third, PBL turn out to be an extremely useful method with respect to motivating students and entrepreneurs. This is particularly true to Z generation students, who, in average, are entrepreneurial, have shorter attention capacity and a huge desire for customized curricula and hands-on approaches [84]. Also, PBL enhances motivation toward students’ achievement [1], experienced meaningfulness [7] and student-cantered learning models [31]. It emphasizes positive learning among students and potential entrepreneurs [85], partly through cooperative efforts within the community, for instance, by municipality and industry cooperation [86,87] or between the university, industry and government [88], in where the integration of PBL fosters self-directed and collaborative learning and improves problem-solving skills [16]. Moreover, interdisciplinary learning is inherent to PBL, for instance in the full-day ‘Start-Up Sprint’ to emulates a start-up event [89], and singular case studies that enable students to approach real world problems [90,91].

Fourth, those experiential, collaborative and motivating tools of PBL aim at building entrepreneurial capabilities and ensuing innovation. Innovation may arise by spreading entrepreneurial culture and innovative ideas amongst stakeholders [92], through start-up companies and patent disclosures [93] and amidst varying participants [94]. It may occur through the creation of accessible products and services under universal design [95] and prototype-based experiences aiming at value-creation [96], within real contexts [97].

Fifth, such innovation is intended to come out all over varied sectors [98]. PBL introduces entrepreneurship in terms of learning engagement and innovation, to biotech sector [99], undergraduate nursing education [100], entrepreneurship education for both secondary and tertiary-level students [101], foundations for entrepreneurship education [102] and medical education

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[103,104]. Furthermore, it is key in empowering students to become more entrepreneurial and innovative irrespective their age [105], emphasizing their active learning tools to, along with conventional curricula, make them set for industry [106], whilst over enhancing their response skills to challenges [107]. This is particularly true with regard to Biomedical engineering applications that are very valuable and engaging to the students in terms of combining medical device design [108] with economic competencies [109].

Sixth, in PBL the tonic is posed upon achieving new entrepreneurial capabilities [110] through active learning and methodologies [111], fitted for different disciplines [23]. To attain this goal, varying tools are employed, such as Rapid Prototyping devices [112,113], computer simulation [114] and learning by doing [115,116] to achieve transversal capabilities [14] and entrepreneurship abilities [4], in cooperation with industry [117]. The goal is to blend theory with real world practices beyond technical knowledge [118], enhancing on honing students' capacity for criticism [119], which results in increasing learning and ameliorated design and communication competences, together with augmented observance towards team work [120]. Moreover, the teaching styles heavily influence the interplay between hands on job learning approaches and attitudes [121].

Seventh, regional level of development is paramount regarding entrepreneurial education. In this way, PBL has been applied throughout varying environs, of equally distinct level of development. In fact, literature reveals an increasing concern with sustainable issues mainly in developing regions, with respect to circular economy in terms of entrepreneurial learning and sustainable value creation [122], namely how courses could be designed combining teaching and real life projects into new sustainable business ideas [123]. Overall, in light of PBL, there is a positive impact of entrepreneurial learning on entrepreneurial intentions, within distinct milieus [124]. Nevertheless, some constraints could emerge in developed regions while implementing PBL methodology, for instance in terms of group arrangement and problem analysis stages [26], appropriate curricula creation to social and economic needs of Africa [125], as well as, the carrying out of relevant PBL sustainable entrepreneurship approaches in Africa [126], Indonesia [127] and India [128].

Ninth, entrepreneurial education has risen substantially in the technical related fields, aiming at promoting entrepreneurial learning activities among existing curricula in engineering courses to developing new capabilities [34], either to provide opportunities for students to try out new skills [129], or to foster collaboration in entrepreneurship initiatives between engineering and other relevant business schools [130]. Those initiatives allow to acquiring relevant entrepreneurship competences to be applied on product design [131], innovation networking within diverse contexts [132,133] experiential learning on a daily basis, cantered in entrepreneurial problems [134]. Furthermore, it focused on creativity and customer-oriented design along varied engineering disciplines [135], to institutionalize the engineering entrepreneurship [136] always based on committing students in common PBL opportunities in context [137].

Lastly, PBL has been applied in the context of social entrepreneurship [138], relying on the productive learning principle of teaching social entrepreneurship upon a student project work [139], based for instance on a social company innovation [140,141], towards authentic creation of entrepreneurial learning and real-world value [142,143]. In sum, problem-based learning plays a key role in enhancing critical thinking skills [144,145] for entrepreneurs by delivering a stage for active engagement [146], proper mindset and real problem-solving, which are essential for entrepreneurial and business success.

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5. Conclusions

Problem-based learning (PBL) is an educational approach that uses complex and authentic problems as a starting point for the acquisition of new knowledge. This method is particularly effective in entrepreneurship education, as it motivates students by mirroring the real-world challenges that entrepreneurs often face, while emphasizing the basic entrepreneurship principles of risk assumption, innovation and proactivity. As aforementioned, problem-based learning and entrepreneurship are linked in the field of innovative education. In so, it allows identifying constructively real world challenges and ensuing solutions by critical thinking. The PBL framework provide a vast array of tools that trigger varying learning modes and types, either more experiential such as learning by doing, trial and error and improvisation, or more deliberate, such as planning and networking. Likewise, it builds on different contexts and sectors of diverse level of development, technology and knowledge absorption towards value creation and innovative outputs, while enduring potential setbacks over the learning process. Furthermore, PBL considers the issues of sustainability and social responsibility along its decision process. On can conclude that this pedagogical method effectively prepare for entrepreneurial challenges, while underscoring the foundations of entrepreneurship.

Nonetheless, PBL cope with several issues that need further research. In particular, it would be worth to ascertain longitudinally, how an effective long lasting networking with both academic and non academic learners could ameliorate high demanding entrepreneurship programs in terms, for instance of business knowledge and capabilities at a broader regional scope. Also noteworthy, some key areas where future investigations could prove fruitful: (i) how can emerging technologies like artificial intelligence (AI), virtual reality (VR), and augmented reality (AR) be integrated into PBL to enhance entrepreneurial education? This research could lead to the development of more immersive and interactive learning environments that simulate real-world entrepreneurial challenges more effectively; (ii) what are effective assessment strategies for gauging competence and skill development in PBL settings specific to entrepreneurship? Identifying robust assessment methods could help educators measure learning outcomes more accurately and tailor educational interventions to enhance student learning. Each of these research directions not only broadens the academic understanding of PBL in entrepreneurship but also has the potential to significantly enhance practical applications in educational settings, ultimately preparing more effective, innovative, and adaptable entrepreneurs.

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Appendix A

Table A1. Overview of document citations period ≤2014 to 2024.

Documents		≤2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Teaching entrepreneurship in higher education: The applicati...	2024	-	-	-	-	-	-	-	-	-	-	-	-
Best Social Entrepreneurship Teaching and Learning Strategie...	2024	-	-	-	-	-	-	-	-	-	-	-	-
Scaffolded cooperative problem-based approach in entrepreneu...	2024	-	-	-	-	-	-	-	-	-	-	-	-
A Qualitative Exploration of ACPE Standard 4 Key Elements Fr... 1 1 1	2023	-	-	-	-	-	-	-	-	-	-	1	1
Learner-led approaches in higher education	2023	-	-	-	-	-	-	-	-	-	-	-	-
Empowering Technical Skills and Soft Skills in Software Engi...	2023	-	-	-	-	-	-	-	-	-	-	-	-
Entrepreneurship Education Pedagogical Approaches in Higher ...	2023	-	-	-	-	-	-	-	-	-	-	-	-
Development of biology learning programs for entrepreneurshi...	2023	-	-	-	-	-	-	-	-	-	-	-	-
Enhancing Student Interest in Biotechnology Entrepreneurship...	2023	-	-	-	-	-	-	-	-	-	-	-	-
Students' Satisfaction of Blended Problem-Based Learning: An...	2023	-	-	-	-	-	-	-	-	-	-	-	-
Soft skills development in bioengineering students through p...	2023	-	-	-	-	-	-	-	-	-	-	-	-
A design and effectiveness evaluation of the Maker spirit–PB...	2023	-	-	-	-	-	-	-	-	-	-	-	-
Problem-based learning in the online flipped classroom: Its ...	2023	-	-	-	-	-	-	-	-	-	-	-	-
Entrepreneurship education through sustainable value creatio...	2023	-	-	-	-	-	-	-	-	1	1	-	2
Universal Design: A Problem-Based Exercise in a Fast-Paced C...	2022	-	-	-	-	-	-	-	-	-	-	-	-
Teaching entrepreneurship to life-science students through P...	2022	-	-	-	-	-	-	-	-	1	2	3	6
Problem-Based Effectual Action fuels Digital Mindsets	2022	-	-	-	-	-	-	-	-	-	1	-	1
The Effect of E-Problem Based Learning on Students' Interest...	2022	-	-	-	-	-	-	-	-	-	4	2	6
INNOVATE	2022	-	-	-	-	-	-	-	-	-	6	1	7
Teaching Strategies and Psychological Effects of Entrepreneu...	2022	-	-	-	-	-	-	-	-	-	1	1	2
Discovering Entrepreneurship Competencies through ProblBa...21	2022	-	-	-	-	-	-	-	-	1	4	1	6
Using the EntreComp framework to evaluate two entrepreneursh ...	2022	-	-	-	-	-	-	-	-	1	7	1	10
Lenses on the post-oil economy: integrating entrepreneurship ...	2022	-	-	-	-	-	-	-	3	1	1	-	5
A project-based learning approach to promete innovation and ...	2021	-	-	-	-	-	-	-		1	3	2	6
Success Through Failure: Towards a Problem-Based Approach to ...	2021	-	-	-	-	-	-	-	1	3	1	1	6

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lmplementing studio-based learning for design education: as ...	2021	-	-	-	-	-	-	-	1	2	2	1	6
Start-Up Sprint: Providing a Small Group Learning Experience ...	2021	-	-	-	-	-	-	-	1	-	2	-	3
POPBL-Blended Learning Model to Enhance Student Performance ...	2021	-	-	-	-	-	-	-	-	1	-	-	1
Towards a responsible entrepreneurship education and the fut. ..	2021	-	-	-	-	-	-	3	6	8	11	3	31
lmproving activities and learning outcomes of biology educat...	2021	-	-	-	-	-	-	-	1	-	-	-	1
A Capstone Course Linking Geography Knowledge and Entreprene ...	2021	-	-	-	-	-	-	-	-	1	-	-	1
Teaching Z Generation Engineers. Using Entrepreneurship Educ ...	2020	-	-	-	-	-	-	-	-	1	1	1	3
The effects of hackathons on lhe entrepreneurial skillset an ...	2020	-	-	-	-	-	-	-	2	1	11	2	16
Understanding How to Engage Black HS Boys in Computer Scienc ...	2020	-	-	-	-	-	-	-	4	1	3	1	9
[ICT Methodologies in Entrepreneurship: Business Models and ...	2020	-	-	-	-	-	-	-	-	-	1	-	1
The lnfluence of Entrepreneurial Mindsets on Student Design ...	2020	-	-	-	-	-	-	-	5	4	4	4	17
Entrepreneurship education through sustainable value creatio ...	2020	-	-	-	-	-	-	-	1	-	1	1	3
The effect of problem based learning (pbl) model on student ...	2020	-	-	-	-	-	-	-	-	1	1	-	2
Engaging High School Girls in lnterdisciplinary STEAM	2020	-	-	-	-	-	-	-	3	3	7	-	13
Teaching social entrepreneurship through problem-based learn ...	2020	-	-	-	-	-	-	-	1	1	2	1	5
Master StudentTeaching and Training in an lnternational Con ...	2020	-	-	-	-	-	-	-	-	1	-	-	1
Engineering Design Entrepreneurship and lnnovation: Transdis ...	2020	-	-	-	-	-	-	-	2	3	4	1	10
Developing professional and entrepreneurship skills of engin ...	2020	-	-	-	-	-	-	2	4	6	7	1	20
A criticai review of learning approaches for entrepreneurshi ...	2019	-	-	-	-	-	-	2	3	5	9	5	24
The Curriculum Development for Global AGILE Problem-Based Le ...	2019	-	-	-	-	-	-	-	1	-	-	-	1
STEAM for STEM-lnclude 'Art' in STEM (Science, Technology, E ...	2019	-	-	-	-	-	-	-	1	-	-	-	1
Creative entrepreneurship -A proposal to 2030's education	2019	-	-	-	-	-	-	-	1	-	-	-	1
Application of digital toais for the development of entrepre ...	2019	-	-	-	-	-	-	-	1	-	3	-	4
The role of engineering education for innovation in the 2lst...	2019	-	-	-	-	-	-	-	-	-	-	1	1
Bad to the Bane: Multifaceted Enrichment of Open-Ended Biorne ...	2018	-	-	-	-	-	-	1	-	-	1	-	2

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BFab for Faculty: Using Making to Empower Entrepreneurially- ...	2018	-	-	-	-	-	-	2	-	-	1	-	3
The Surgery lnnovation and Entrepreneurship Development Prog ...	2018	-	-	-	-	2	2	2	4	2	3	-	15
Preparation of the professional engineer: Outcomes from 20 y ...	2018	-	-	-	-	-	1	-	-	-	2	-	3
The implementation of interest-based entrepreneurship curric. ..	2018	-	-	-	-	5	1	1	-	1	-	-	8
Can TEFA (teaching factory) be realized with a creative econ ...	2018	-	-	-	-	-	-	-	-	-	-	1	1
Promoting PBL through an aclive learning model and the use o ...	2018	-	-	-	-	-	4	2	-	-	3	-	9
One design issue - many solutions. Different perspectives of...	2018	-	-	-	-	1	10	3	1	4	3	-	22
Effective learning of innovation by engineering students in ...	2018	-	-	-	-	-	-	1	1	1	-	-	3
The effect of problem-based learning (PBL) method on student...	2018	-	-	-	-	-	2	1	-	-	-	-	3
The 'case-based learning conference' model at EMINDIA2017: A ...	2018	-	-	-	-	-	-	-	-	-	1	-	1
Promoting interdisciplinarity through an intensive entrepren ...	2018	-	-	-	-	-	-	1	1	1	1	1	5
Using PBL and Rapid Prototyping Resources to Improve Learnin ...	2018	-	-	-	-	-	1	-	-	-	-	-	1
Fostering skills for digital social innovations in entrepren ...	2017	-	-	-	-	-	-	2	-	-	1	-	3
More than justa game: the role of simulation in the teachin ...	2017	-	-	-	-		3	3	4	2	2	-	14
lnnovation and entrepreneurship programs in US medical educa ...	2017	-	-	-	-	1	6	7	8	7	23	3	55
Creativity and problem-solving: Closing the skills gap	2017		-	-	-		3	3	5	3	6	3	23
The Relevance of Problem-based Learning for Policy Developme ...	2016	-	-	1	4	2	7	3	4	7	3	-	31
Fostering Entrepreneurship in Higher Education, by Problem-B ...	2016	-	-	-	-	1	-	-	1	-	1	-	3
The LAB studio model: Enhancing entrepreneurship skills in h ...	2016	-	-	-	1	1	3	-	1	-	3	1	10
Creative thinking experimentations for entrepreneurship with ...	2015	-	-	1	-	-	1	-	1	1	1	1	6
A creative and entrepreneurship project promotion of primary ...	2015	-	-	-	2	1	-	-	1	-	-	-	4
How do finnish teacher educators implement entrepreneurship ...	2015	-	-	1	2	12	4	2	12	5	6	-	44
Analyzing tourism student's managerial skills by applying PB ...	2015	-	-	-	2	-	-	-	-	-	-	-	2
Replica of a shaking table from the XIX century: A workshop ...	2015	-	2	2	-	-	-	-	1	-	-	-	5
Fostering the entrepreneurial mindset through the developmen ...	2015	-	5	3	1	1	-	-	-	1	-	-	11
lnnovation to entrepreneurship in the first year engineering ...	2015	-	4	6	1	1	-	-	1	2	2	-	17
Challenges and potential of teaching engineering students in ...	2015	-	1	-	1	-	-	-	-	-	-	-	2

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Evaluating the effects of a problem-based learning business ...	2014	-	1		1	1	-	-	-	1	-	-	4
Needs assessment for the development of entrepreneurship cur ...	2014	-	-	-	-	-	-	-	1	-	-	-	1
Using problem-based learning to stimulate entrepreneurial aw ...	2014	1	5	3	4	8	2	2	-	-	1	-	26
An assessment of educational benefits from the openorbiter s ...	2012	8	7	2	5	1	1	2	-	-	-	-	23
Social Entrepreneurship and Social Work: The Need for a Tran ...	2012	3	3	1	1	3	2	4	4	5	3	1	29
Stimulating learning via tutoring and collaborative entrepre ...	2012	-	-	-	-	-	-	-	-	-	1	-	1
Theory to practice: Real-world case-based learning for manag ...	2012	-	-	1	1	-	-	1	1	1	2	-	7
Examining competence factors that encourage innovative behav ...	2012	1	1	4	2	2	7	8	7	4	4	-	40
Revisiting Vico's pedagogy of invention: The Intellectual En ...	2012	-	3	1	1	1	-	-	-	-	-	-	6
[The 'Ecosportech' project as an example of entrepreneurial ...	2012	2	-	-	-	-	-	-	-	-	-	-	2
Preparing mechanical engineering students for product design ...	2011	2	-	-	-	-	-	-	-	-	-	-	2
Developing Entrepreneurship in Social Work Through Internati ...	2011	1	-	-	4	1	-	-	-	2	-	-	7
The role of project based learning in IT: A case study in a ...	2011	5	-	2	-	4	3	6	-	3	3	-	22
Improving lecturers' facilitative approach in the problem-ba ...	2010	-	-	-	-	-	-	-	-	1	-	-	1
Development of contemporary problem-based learning projects ...	2009							1		1			2
Entrepreneurship education: Towards an industry sector appro ...	2008	7	2	1	-	-	5	4	3	1	1	1	20
Utilization of problem-based learning in an entrepreneurship ...	2008	3	1	-	-	-	-	2	1	2	-	1	7
Innovations in bioengineering education for the 21st	2007	1	-	-	-	-	-	-	-	-	-	-	1
A problem-based learning approach to entrepreneurship educat...	2006	31	7	6	18	12	7	9	18	11	11	3	112
A scalable problem-based learning system for entrepreneurshi ...	2006	2	-	-	1	-	-	1	1	-	-	-	3
Problem-based learning approach in accomplishing innovation ...	2005	8	4	-	3	1	3	2	3	2	1	1	20
A scalable problem-based learning system for entrepreneurshi ...	2005	6	1	1	-	1	1	-	1	1	-	-	8
Entrepreneurs in Action!: A problem-based learning environme ...	2005	3	-	-	-	-	1	-	-	-	-	-	4
Supporting Undergraduate Biomedical Entrepreneurship	2004	-	-	-	-	1	-	-	-	-	-	-	1
A problem-based learning approach in entrepreneurship educat...	2004	11	-	3	3	2	1	3	5	3	3	1	26
Assessing engineering entrepreneurship	2003	6	-	1	-	-	-	1	-	-	-	-	2

Launching an undergraduate engineering entrepreneurship prog ...	2002	4	-	1	-	-	-	-	-	-	-	-	1
The center for engineering design&. entrepreneurship: An ...	2002	1	-	-	-	-	-	-	-	-	-	-	1
	Total	106	34	44	64	68	86	85	132	125	193	53	990

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