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Discovering Entrepreneurship Competencies through Problem-Based Learning in Higher Education Students

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Abstract: The increase in student engagement in the learning process has driven educators to use more dynamic pedagogical methodologies. Several studies have shown evidence of increased interest in learning when real-world problems are integrated into the learning environment. This paper presents the competencies developed by higher education students through application of the problem-based learning (PBL) methodology in higher education courses. The research begins with the identification of a set of competencies developed by higher education students in other studies developed and reported in the last five years and includes them in a survey to analyze the level of development of those competencies when problem-based learning is applied in university courses. To identify the competencies developed by applying the problem-based learning methodology, the research employed a document analysis and a survey of the students that participated in the experimental application. The research questions "What are the competencies developed by students in problem-based learning?" and "Are the competencies identified by the students sufficiently learned in universities?" guided the study. The competencies found by the students were identified through a questionnaire given as an online survey to 76 students. The key outcome of the research is the identification in the bachelor courses of the competencies perceived as essential by students participating in the application of PBL in terms of their advancement.

Keywords: problem-based learning; entrepreneurship competencies; higher education students; management; HRM and information technologies courses

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1. Introduction

Conceptualization of the Research

The primary objective of this research was to identify competencies gained by students in problem-oriented learning and make suggestions for higher education courses based on this methodology. In this context, the research questions "Which competencies were developed by students with the PBL approach?" (RQ1) and "What was the level of development of competencies gained in HE courses regarding the application of the PBL approach?" (RQ2) guided the present study. This study's research methodology was quantitative and based on an online survey.

The main innovation of this study is the link it establishes between the PBL methodology and the potential to develop competencies needed by organizations and in a real-life context. Students need to find strategies to work in teams and use their knowledge to create new knowledge and help the team find the best solution to the problem. As several students participate in the process, it is the integration of all their knowledge that will enable them to converge on the solution. This study provides a real notion of the competencies needed to potentiate the process of finding a solution and potentiate learning, as students learn by searching for the solution but also from the knowledge of their colleagues

when collaborating to find the solution. This research also gives directions to the lecturers that will be tutoring the process as they can learn from this experience and results about the competencies that students need, but they will also come to know the process better, facilitating implementation in their classes. In sum, this research aims to identify the competencies associated with problem-solving situations and contribute to problem-based learning theory in terms of defining the competencies developed by students in the learning process and the way to find the best solution to real organizational problems.

This research is based on an experiment conducted in several courses and aims to motivate students to be more active in their learning process and implement innovative learning methodologies to increase their motivation and learning outcomes.

This article is structured as follows. First, we briefly discuss problem-based learning and business competencies in conjunction with these contexts. Then, we present the empirical study, the results of the research, and our conclusions.

2. Literature Review

2.1. Problem-Based Learning

Problem-based learning is an innovative pedagogical methodology that helps students with the learning process and to find solutions to real problems through continuous engagement [1–4]. In a collaborative environment, students work together in teams and can search for the best solution to a problem [5] based on their knowledge and the knowledge they acquire during the process. These learning activities lead to the creation of conceptual models and promote the formation of self-directed learning habits through practice and reflection.

The fundamental theory of PBL is therefore that learning should be considered a "constructive, self-directed, collaborative, and contextual" activity [2] (p. 39). The principle of constructivism regards students, with the aid of prior knowledge, as active information seekers and co-creators who organize new relevant experiences into personal mental representations or schemes [6–10].

It encourages students to learn while actively dealing with important problems, and students are allowed to solve problems in a collaborative environment, build mental learning models, and form self-directed learning habits through practice and reflection, as the idea underlying PBL is that learning can be considered a "constructive, self-directed, collaborative, and contextual" activity [6] (p. 12). The philosophy of constructivism posits that students are active knowledge-seekers and co-creators who organize new relevant experiences into personal mental images with the assistance of prior knowledge. In a standard PBL environment, learning is enabled by an issue that needs resolution [7–13].

As a pedagogical approach, PBL appeals to many lecturers because it provides a context that promotes active and group learning based on the premise that successful learning takes place when learners create or co-construct ideas through social experiences and self-directed learning. Its execution may vary between organizations and processes, but it is usually an iterative process consisting of self-directing learning, which is the first step in problem analysis [14–16].

The lecturer is a facilitator who guides students' learning, especially in the problem analysis [17–20] and reporting components of the PBL tutorial, and facilitates students' paths of inquiry as they discuss and share their ideas [21–23]. Prior studies on PBL show that it leads to an improvement in the learning process [24] by improving students' reflective, rational, and collaborative skills [25,26]. Results on the effectiveness of PBL appear to be mixed but the studies have typically shown that students who have undergone PBL make equal or fewer learning gains when it comes to the short-term acquisition of knowledge in comparison with students in a lecture-based-learning environment [27].

Strobel and van Barneveld analyzed a variety of meta-analyses on the effectiveness of PBL [25] and found that it is more successful than traditional methods when the assessment of learning outcomes focuses on long-term knowledge gain, performance or skill-based evaluation, and combined knowledge and skills [26–28]. According to this study, it was only

when the emphasis was placed on the acquisition and retention of short-term knowledge that PBL seemed to be less successful. PBL tends, therefore, to be a superior and reliable method for "training qualified professionals and encouraging long-term retention of the information and skills gained during the learning process" [27] (p. 55).

2.2. Problem-Based Learning Competencies Development

In the context of PBL, the process of learning begins with the definition of a problem and its analysis, followed by autonomous learning or self-directed learning [29], and ends with a presentation of the potential solutions to the problem first identified.

The collaborative learning approach and self-directed learning are two powerful approaches to the development of competencies in a real-life problems context. They make students more independent and autonomous in the learning process and create a healthy competitive environment in the search for the best solution. Studies show that interaction between students regarding the search for a solution to a problem increases learning gains compared with the traditional approach [23,24].

One approach to the development of competencies is to establish a contest where students work and learn in a team-based learning environment supported by the tutor or lecturer and the individual or organization that launches the problem to be solved.

In an experimental environment, an organization presents a problem to a group of students who from that moment on work as a team to find the best solution. In the process, they need to collaborate and search for knowledge on their own, guided by the wisdom of the lecturer, on an independent path [24].

A student is a problem-solver who, in a defined learning framework, describes the problem and the conditions for its resolution and identifies possible impacts of the solution's implementation [24]. A student is a self-directed trainee for whom the issue is at the center of the learning process, starting with a diagnosis and relating the learning process to the real world that inspires it [30]. With the incorporation of acquired information, the acquisition of knowledge is boosted by constructive learning processes, enabling various theoretical perspectives. The instructor triggers the student's interest in critical thought and promotes collaborative learning through effective learning. The problem based-learning process includes the following steps [5,10,29]: (a) identification of the problem; (b) identification of the necessary knowledge; (c) definition of the problem; (d) gathering information and making a diagnosis; (e) designing an action plan to solve the problem; (f) building possible solutions; and (g) selecting the best-fitting solution. Finally, regarding the methodologies, problem-based learning relies on an authentic evaluation methodology, including self-reflection, peer reflection, process assessment, assessment of the solution portfolio, and positive feedback.

2.3. Entrepreneurship Competencies Development

Entrepreneurship competencies are considered to be fundamental to lifelong learning [20]. However, there are few studies in this field, creating a research gap [28,29]. From the advances in this field, we verified that some approaches to developing entrepreneurship competencies in higher education students have recently been developed. The Venessar et al. study [15] focuses on a broad model that covers all courses and levels of education based on the theory of systems thinking. It is a promising model that is still under development and has not been validated to date.

The study of Hermann et al. [19] integrated problem-based learning into course design and assessment to develop entrepreneurship competencies in students at a summer school. The experience occurred in the COVID-19 pandemic context, so the authors also used online learning. Although the study was exploratory and the results seem encouraging, the authors suggest the use of quasi-experimental designs in future research.

In the analysis of the articles selected for the literature review, a set of competencies were identified and are presented in Table 1.

Table 1. Description of the competencies.

Competencies	Description	Studies
Time management	The capacity of organizing and planning and dividing up time between activities.	Beagon, Niall, and Ní Fhloinn [31]
Responsibility	The capacity of being accountable for the actions and decisions within the power or control of an individual.	Acton [32]
Decision-making	The capacity of selecting the best alternative from among several possible options.	Rovers, Clarebout, Savelberg, and van Merriënboer [33]
Analysis of information	The capacity of being systematic in discovering, analyzing, and interpreting information.	Dolmans [34]
Problem-solving	The capacity of defining a problem; determining the cause of the problem; identifying, prioritizing, and selecting alternatives for a solution; and implementing a solution.	Dahl [35]
Initiative capacity	The capacity of self-starting, being proactive, and having a persisting attitude to pursue a challenge or solve a problem.	Chen and You [36]
Coaching	The competence of providing ongoing and specific feedback in a supportive manner for individual learning and development.	Bijsmans and Schakel [37]
Team management	The capacity to lead people to achieve common objectives.	Golightly [38]
Creativity	The ability to generate, create, or discover new ideas, solutions, and possibilities.	Gao, Wang, Jiang, and Fu [39]
Communication	The process of exchanging information between two or more persons to achieve a mutual understanding.	Pu et al. [40]
Financial	Knowledge of capital structures and money management to help maximize returns and shareholder value.	Ikegami et al. [41]
Organizational change	The capacity to adapt to alterations in structural relationships and roles of people in the organization.	Blichfeldt and Smed [42]
Innovation	The ability to continuously transform knowledge and ideas into new products, processes, technology, and systems.	Vandenhouten, Groessl, and Levintova [43]
Entrepreneurship capacity	The ability to imagine new ways to solve problems and create value.	Luo [44]
Digital skills	The ability to use digital devices, communication applications, and networks to access and manage information.	Dearnley, Rhodes, Roberts, Williams, and Prenton [45]
Imagination	The faculty of forming mental images or concepts of what is not present to the senses.	Sriratanaviriyakul and El-Den [46]
Market knowledge	An understanding of the market context in which a business operates.	Doukanari, Ktoridou, and Epaminonda [47]
Independence	The ability to be autonomous, and self-directed learning.	Kwan [48]
Autonomy	The capacity for self-determination or self-governance.	Oderinu, Adegbulugbe, Orenuga, and Butali [49]
Integrity	The capacity to stand by righteous morals and values.	Davies and Harris [50]
Trust	The confidence in and reliance on the character and abilities of individuals.	Jong and Krumeich [51]
Ethical	The capacity to behave with honesty, integrity, justice, equality, and respect.	Wijnen and Loyens [52]

These competencies were used in a questionnaire administered to higher education students as explained in the following sections.

3. Methodology

Our study aimed to analyze the level of entrepreneurship competencies development in higher education students who apply problem-based learning [53–55]. In summary, we aimed to answer the following research questions:

1. Which competencies were developed by students with the PBL approach?
2. What was the level of development of competencies in HE courses regarding the application of the PBL approach?

Based on our aims, we applied the Creswell and Creswell [56] principles for quantitative studies (defining the problem in the introduction and presenting a literature review followed by the methods used, the results obtained, and the conclusions drawn).

To achieve our purpose, we designed a survey composed of 24 questions covering the following areas: (a) background information on students (Questions 1 and 2); and (b) a list of competencies developed during the application of the problem-based learning methodology (Questions 3–24). Regarding the study, 22 items reflecting competencies relevant to problem-based learning that resulted from the content review of the papers were presented to the respondents. Then, they were asked to rate the skills on a 5-point Likert scale (1 = no development; 2 = weak development; 3 = moderate development; 4 = considerable development; 5 = strong development).

The survey was applied in an online format to 123 students in 2019. We collected 76 answers, equivalent to a 61% response rate. The Cronbach's alpha, coefficient, and mean and standard deviation were statistically analyzed, and conclusions point to a considerable level of development of a competency upon the problem-based learning methodology's application.

The students answered the survey after being exposed to an Entrepreneurship Unit in several bachelor's degree courses (Management, HRM, and IT).

Sample

Respondents were primarily of the male gender (n = 54) and secondarily of the female gender (n = 22) (see Table 2).

Table 2. Student Information (Gender).

	n	%
Male	54	71.1
Female	22	289
Total	76	100.0

Respondents were distributed across Management (36.8%), Human Resources Management (32.9%), and Information Technology (30.3%) bachelor's degree courses (Table 3).

Table 3. Student Information (Course).

	n	%
Management	28	36.8
HRM	25	32.9
IT	23	30.3
Total	76	100.0

4. Results

After a brief analysis of the characteristics of students, it is important to analyze the level of development of competencies in higher education students regarding the application of the problem-based learning methodology. From these data, we were able to answer RQ1 ("Which competencies were developed by students with the PBL approach?").

The analysis of students' perceived development of competencies resulted in mean scores ranging from 3.64 (Financial) to 4.24 (Innovation) as illustrated in Table 4. Thus, all the competencies found in the articles had a considerable level of development in the higher education courses. These results present higher means than those described in the work of Asgari, Fard, and Tirgoo [57]. Despite the fact that they only evaluated the success, planning, and power variables, the use of problem-based learning may indeed have led to an improvement in the entrepreneurship competencies. However, since these studies did not use the same measurement instruments, further research is needed.

Table 4. Perceptions of students regarding the development of competencies (1 = no development; 2 = weak development; 3 = moderate development; 4 = considerable development; 5 = strong development) (Cronbach's alpha (number of items), Mean (1–5), SD).

Rank	Competencies	Cronbach's Alpha	Mean	SD
		0.877 (n = 22)		
1	Time management		4.13	0.596
2	Responsibility		4.12	0.565
3	Decision-making		3.96	0.642
4	Analysis of information		3.97	0.711
5	Problem-solving		3.97	0.610
6	Initiative capacity		4.05	0.651
7	Coaching		3.87	0.718
8	Team management		3.91	0.677
9	Creativity		3.87	0.806
10	Communication		3.95	0.710
11	Financial		3.64	0.667
12	Organizational change		4.00	0.542
13	Innovation		4.24	0.608
14	Entrepreneurship capacity		3.95	0.728
15	Digital skills		4.11	0.665
16	Imagination		3.97	0.692
17	Market knowledge		3.96	0.756
18	Independence		3.74	0.619
19	Autonomy		3.96	0.824
20	Integrity		3.99	0.721
21	Trust		4.07	0.772
22	Ethical		3.80	0.589

Regarding RQ2 ("What was the level of development of competencies in HE courses regarding the application of the PBL approach?"), we found that the competencies Innovation (4.24), Time management (4.13), Responsibility (4.12), Digital Skills (4.11), Trust (4.07), Initiative capacity (4.05), and Organizational change (4.00) exhibited a significant level of development. This finding is consistent with that of Biberhorfer, Lintner, Bernhardt, and Rieckmann [58], who conducted 48 semi-structured interviews and verified that problem-based learning improves the competencies of entrepreneurs.

Factor analysis helps to identify multiple profiles. A total of 37.884% of the overall variance was obtained by the first factor, which has 12 items and is called the "Problem-Solver" dimension. A total of 13.927% of the total variance was explained by the second factor, which has five items and is called the "Entrepreneur" dimension. Finally, 8.219% of

the total variance was explained by the third factor, which has five items and is called the "Team Manager" dimension (Table 5).

Table 5. Exploratory factor analysis.

	Components			
ITEM	**1**	**2**	**3**	**Dimensions**
Time management	0.758			Problem-Solver
Responsibility	0.724			
Problem-solving	0.703			
Coaching	0.817			
Creativity	0.622			
Communication	0.761			
Organizational change	0.559			
Digital skills	0.655			
Market knowledge	0.829			
Autonomy	0.502			
Integrity	0.709			
Trust	0.78			
Analysis of information		0.751		Entrepreneur
Initiative capacity		0.758		
Financial		−0.542		
Entrepreneurship capacity		0.695		
Imagination		0.699		
Decision-making			0.819	Team manager
Team management			0.851	
Innovation			0.422	
Independence			0.803	
Ethical			0.823	
% variance explained	37.884%	13.927%	8.219%	
Kaiser–Meyer–Oklin index		0.742		
Bartlett's test of sphericity		Chi-square = 1564.112; sig < 0.000		

Extraction method: principal component analysis and the varimax rotation method with Kaiser's index.

Once we obtained these three factors, we analyzed the correlation between them to test for a possible correlation between the different factors (Table 6).

Table 6. Correlations.

		Problem Solver (Mean = 3.99; SD = 0.511)	**Entrepreneur (Mean = 3.92; SD = 0.439)**	**Team Manager (Mean = 3.93; SD = 0.474)**
Problem-Solver	Pearson's Correlation		0.629 **	−0.098
	p-value		0.000	0.398
	N	76	76	76
Entrepreneur	Pearson's Correlation	0.629 **	1	0.031
	p-value	0.000		0.793
	N	76	76	76
Team Manager	Pearson's Correlation	−0.098	0.031	1
	p-value	0.398	0.793	
	N	76	76	76

** The correlation is expressed at the 0.01 level.

Table 6 shows that there is a positive and significant correlation between the Problem-Solver factor and the Entrepreneur factor. However, there is no significant correlation between the Problem-Solver and Team Manager factors, nor is there a significant correlation between the Entrepreneur and Team Manager factors. Therefore, if there is a correlation

between the competencies that form the Problem-Solver and Entrepreneur factors, there is no correlation between the competencies that form the Team Manager factor and all the others.

5. Conclusions

The motivation for this research was the lack of a systematic approach to the development of competencies by universities using the problem-based learning methodology. The methods are based on the skills-learning methodologies of universities analyzed in this report. To adapt to the sector's demands, this study may help universities and employers to be more integrated and reconsider their strategies according to the development of skills. When they apply PBL, the following procedures should be used to guide students in the learning process:

(a) The identification of an organizational problem in a public entity or body;
(b) A diagnosis of the problem situation to be analyzed;
(c) A proposal for an action plan to resolve the diagnosed problem; and
(d) A prediction of the possible effects of the implementation of the solution for the problem under study.

The literature review indicates that PBL is an effective learning approach, especially when it is evaluated in terms of long-term retention of knowledge and applications. There is an increasing number of experimental studies concerning lecture conditions that provide evidence of the success of students who use PBL in, for example, programming (Costa [59]), medicine (Mistry et al. [60]), and economics (Affolderbach [61]).

As described in the PBL literature review, the learning process, which begins with a problem analysis, is followed by self-directed learning, and finishes with a reporting stage, is important for driving student learning with a collaborative component or self-directed learning. Finally, student engagement with the problem is important to maximize learning gains and to improve the advantages of collaborative study perceptions.

This study reinforces the findings of Asgari et al. [57] and Biberhorfer et al. [58]. From the exploratory analysis of the survey results from 76 students, we verified that the use of PBL has significant potential in the development of entrepreneurship competencies that should be further explored in greater depth.

6. Implications, Limitations, and Future Research

The main theoretical implication is the identification of the main competencies developed in the context of problem-based learning. In terms of practical implications, universities need to implement these types of methodologies to create a stronger link to organizations and develop students' competencies to help them solve real problems in a future work context. This methodology also has implications for the autonomy and independence of students, as they learn on the basis of both their own knowledge and the knowledge they need to obtain to help the team find a solution to the problem under study. Moreover, competencies such as teamwork and trust in a colleague's work and knowledge are very important learning outcomes. In addition, competency development also occurs in lecturers that are involved in the process of learning with the PBL methodology because they play a fundamental role in motivating students to be engaged in the learning process.

One of the limitations of this study is the sample size, as the limited number of respondents may have biased the results. Another limitation is that this study did not investigate the effect of PBL on the learning activities or learning materials but only the competencies. To reduce the length of the questionnaire, the study did not include many questions on demographics, and we were not able to analyze the results by gender or by age.

These limitations could be the basis for further research enlarging the sample and applying the same methodology to other universities who use PBL as a pedagogical methodology. Additionally, further studies are needed to determine the appropriateness and effectiveness of the learning process in the long term and a real-world context. Moreover, it

may be interesting to study how individuals acquire, create, and share knowledge among students. Research focus could be placed on the activities developed and the learning material used in the delivery of solutions to the problems using the PBL methodology.

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