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Understanding the effectiveness of the PBL method in different regional contexts: the case of Colombia

Mario Alberto de la Puente Pacheco [a], Carlos Mario de Oro Aguado [b] and Elkyn Lugo Arias [c]

[a]Department of Political Science and International Relations, Universidad Del Norte, Barranquilla, Colombia; [b]Department of Matemathics and Statistics, Universidad del Norte, Barraquilla, Colombia; [c]Faculty of Economic and Business Sciences, Corporación Universitaria Minuto de Dios, Barranquillaa, Colombia

ABSTRACT

This study compared the effectiveness of the Project-Based Learning method (PBL) with the conventional teaching method in developing cross-curricular skills and improving academic performance among 1064 undergraduate students at the north coast of Colombia. A t–student test, Welch test, and the Tau Kendall correlation coefficient were used to analyse the PBL and non-PBL groups in 40 Economic Integration courses in three years. A pre-test, post-test, and achievement of academic objectives questionnaire was applied, as well as a verification test of previous knowledge and a focus group at the end of the courses. It was observed that the PBL method is superior in the development of *problem-solving* and *teamwork* skills only of five observed. The application of the PBL method was associated with the fulfilment of two of the five academic objectives analysed, which is confirmed by the feedback from the focus groups. This research contributes to the analysis of the usefulness of teaching methods in different geographical contexts.

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KEYWORDS
Project-based learning; teaching method; problem-solving; teamwork; north coast of Colombia; skills

Introduction

Studies on the effectiveness of teaching methods in developing countries have focused on understanding how cross-curricular skills of students in different socio-economic and cultural realities can be improved.

This research seeks to respond to criticism from various sectors that state that students must develop skills beyond the curriculum through field experiences. These criticisms are strongest in economically disadvantaged regions of developing countries that have yet to achieve universal coverage for higher education.

Among the most-researched and discussed teaching methodologies for active learning in local contexts is Project-Based Learning (PBL), which develops the following transversal skills: *knowledge construction, problem-solving, critical thinking, teamwork,* and *autonomy* (Shekhar et al., 2019).

This study analysed the effectiveness of the PBL method compared to the conventional teaching method in developing cross-curricular skills from the students' perception, as well as its effectiveness in meeting the objectives of 40 Economic Integration courses, which correspond to two undergraduate degree programmes (International Relations at Universidad del Norte located in Barranquilla and International Business at Universidad de Buenaventura located in Cartagena) in the northern region of Colombia. The economic courses have similar content and duration in both programmes (Appendices 1 and 2).

CONTACT Mario Alberto de la Puente Pacheco mdelapuente@uninorte.edu.co

Project-based learning (PBL) is a teaching method in which students learn through active exploration of real-world problems. With this method, students plan, implement, and evaluate projects that have real-world applications beyond the classroom. It is thought that skills such as those involving autonomy and problem-solving are developed, given that participants learn as they investigate possible solutions to the problems at hand. With the PBL, students define the purpose of creating a final product, investigate an issue, create a plan for the management of project, and design and elaborate on the product. Within this framework, participants pursue solutions by generating and refining questions, debating ideas, designing plans or experiments, collecting and analysing data, and establishing conclusions.

PBL is a successful strategy in teaching social science careers (economics, political science, international relations, etc.) since the participants usually apply concepts from various areas of knowledge for the formulation and development of their projects. It also serves as a motivation for students to generate active learning. However, few studies have examined the effectiveness of the method in enhancing cross-curricular competencies in different regional contexts. The few existing studies have been in the Latin American and Caribbean countries. Thus, this lack of studies on the effectiveness of the method in different regional contexts is an issue that should be addressed.

This study contributes to literature by examining the effectiveness of the PBL method in meeting the objectives of undergraduate courses in different regional and cultural contexts through the perception of students and the comparison of academic performance.

Literature review

The existing literature on the effectiveness of the PBL teaching approach in the improvement of transversal skills in localised contexts has yielded combined results. Its application in different areas of knowledge influences how valuable students consider it (Grissom & Bartanen, 2019; de la Puente et al., 2019a). The following review associates the ex-ante and ex-post perceptions of students who applied PBL in their undergraduate and postgraduate courses, as well as their effect on the development of the following transversal skills: *knowledge construction*, *problem-solving*, *critical thinking*, *teamwork,* and *autonomy* (Baessler et al., 2019; Blumberg, 2019; Luo, 2019).

Chin and Chia (2004) studied the effectiveness of the PBL method in improving the *knowledge construction* skill in an undergraduate biology course. It was found that the method was effective from the student's appropriation of practical concepts through the group projects. However, the conventional teaching method was better in enabling students to learn theoretical concepts. The students expressed difficulties in applying abstract concepts to practical projects. Similarly, Wu (2019) analysed the application of PBL in Argentina in the areas of medicine and economics and its implications in improving students' competency in developing countries. Although it is tempting to incorporate educational innovations from developed countries, the particular situation of each school and faculty must be taken into account when considering curricular changes for improving this competency.

On the other hand, Lyons (2008) analysed the relationship between the development of *critical thinking* skill and the PBL method. According to the author, there is no substantial evidence of the effect of PBL on the development of critical thinking of nursing students. This is based on the fact that the development of a group project does not necessarily support the multidimensional approach to a topic or case study. In the authoŕs study involving 550 nursing students, it was found that the PBL methodology did not improve critical thinking any better than the conventional method. According to the author, PBL participants tended to accept the opinions of members who possessed greater powers of persuasion. With the conventional method, students were exposed to less external stress in the development and defence of a medical diagnosis.

Tiwari et al. (2006) carried out a theoretical and empirical review of the relationship between the PBL and the development of *critical thinking* skills in developing countries, yielding results similar to that of Lyons. The authors found that students who feel pressured to accept the majority opinion are less likely to defend their positions in order to maintain social cohesion.

Leggett and Harrington (2019) confirm the association of *autonomy* and the PBL method in their literature review. According to the authors, the association is conditioned by the teacher's role as an initial guide in the planning of a group project through group tutoring. Additionally, Akhand (2015) discovered that students who worked with the PBL method were freer to adjust the planning and execution of their projects to their interests and abilities.

However, for Stanley and Marsden (2012), the students' previous experience conditions the development of the *autonomy* skill with regard to the planning and execution of a research project. In local contexts of developing countries, where the teaching model is based on the "transfer" of knowledge, the improvement in the competence of autonomy through PBL must be accompanied by a prior explanation of how the PBL works (Stanley & Marsden, 2012).

On the other hand, a study conducted by Pyle and Hung (2019) examined the effectiveness of the PBL in retaining academic concepts in marketing. The study involved 30 graduate students who were observed for six months. It was found that the method adequately enhanced the *autonomy* skill. For the authors, the method must be accompanied by the democratisation of academic courses' curricular objectives, thus giving students greater decision power.

Regarding the effectiveness of the PBL method in the *problem-solving* competency, de la Puente et al. (2019a) highlighted the review of nine studies by McGonigal (2004), who measured the results of the NBME 1 standardised test. In comparing them with the traditional curriculum, the latter found that students rated PBL as a more effective method for solving clinical cases. Other authors have supported the conclusions of McGonigal, affirming that the development of projects focusing on a problem-solving strategy in the field of economics and business is more effective than traditional teaching methods (Lehman et al., 2008).

De la Puente Pacheco et al. (2019b) recognise that the PBL method advocates that the members of the working group create various answers for a case study.

Helle et al. (2006) emphasises that the improvement of problem-solving competency through PBL is notably related to how students perceive their classmates' critics. In group contexts where critical opinions are considered personal, learners tend to abstain from sharing and defending their positions even if the curricular objectives of an undergraduate course are met.

The *teamwork* skill has been investigated in detail in different socio-economic and cultural contexts and has yielded mixed results. Takeshita et al. (2016) analysed the external factors that promote teamwork in various regional contexts. The authors found that students only apply said skill when they consider it strictly necessary.

Carvalho (2016) found similar results by applying a quantitative analysis that determines the perception of the skill criteria in Business Management students. However, the author assumed that this does not necessarily mean that these learners will perform better academically than those who used the conventional method.

The review of literature shows that results on the effectiveness of the PBL in developing skills in different regional contexts have been vague. This is because the cases presented were applied in different academic and geographical settings, responding to individual curricular purposes. The exposed cases of developing countries place great importance on increasing the coverage of university students and the number of students per classroom, thus limiting the quality of care that teachers can give in the planning, implementation, and evaluation of the projects of students under a PBL method.

Furthermore, development strategy and skills are limited when students do not have prior knowledge on planning, writing, and presenting projects. Previous identification makes teachers adjust the PBL application schedule so that pupils have similar chances to improve their skills. However, this previous knowledge must be followed by a prior student's reflection that teamwork requires deliberation on how a project should be developed, while remaining open to observations from their peers. The lack of students' prior reflection is accentuated in developing countries that usually implement conventional teaching methods where pupils learn individually and perceive other students' critiques as unfavourable (de la Puente Pacheco, 2015; De la Puente, 2015; Garnjost & Brown, 2018).

The literature review recognises that the implementation of the PBL encourages learning through the search for solutions (Dochy et al., 2003). Students address problems with their prior knowledge, which then leads to a series of challenges that they must solve.

By allowing them to find answers for themselves, *teamwork* and *problem-solving* skills seem to improve. Additionally, the method encourages collaboration and research in the classroom, generating new ideas during projects that connect various academic concepts. The present research article analyses if the skills of *teamwork* and *problem-solving* are developed regardless of the regional context.

An application of PBL in two Colombian Caribbean universities was examined to resolve if both skills change and if so, the reasons therefor. This research explains why the literature review showed mixed results in the development of *knowledge construction*, *critical thinking,* and *autonomy*.

It also discusses the gaps found in the reviewed literature on the relationship between students' expectations about the effectiveness of PBL and academic performance by linking the participants' subjective impressions with their grades during the Economic Integration courses.

This research seeks to clarify whether students perceive the application of the PBL method to be better compared to the conventional method and whether there is a relationship between the used method and academic performance for students in the north coast of Colombia. The main research questions of the study were: (1) Is Project-Based Learning suitable for the Colombia Caribbean coast? (2) What are the cross-curricular competencies developed in the study?

The following working hypotheses were verified in the study:

H_1: Students perceive differences in cross-curricular competencies when the classes are taught using the conventional teaching method compared to the PBL.

H_2: At the end of the course, students perceive differences in cross-curricular skills favouring the PBL compared to the conventional teaching method.

H_3: Not all cross-curricular competencies promoted by PBL receive a positive student evaluation regarding the fulfilment of the course objectives.

Materials and methods

Participants

The participants in this research were 1064 undergraduate students at the International Relations programme of the Universidad Del Norte and the International Business programme of the University of Buenaventura, both located on the north coast of Colombia.

Two hundred thirty-nine students from Universidad del Norte and 264 participants from Universidad de Buenaventura applied the PBL method, while 289 and 272 students, respectively, learned with the conventional teaching method. Data on perceptions and academic performance were obtained from 40 undergraduate Economic Integration courses for during a three year period.

Six hundred and twelve participants had prior knowledge about the PBL method and had already applied it in other courses. Seven hundred twenty-six women and 338 men participated in the investigation.

Females were in their fifth to eighth semesters of the undergraduate programmes, with an average GPA of 4.26 (lowest being zero, highest being five) and an average age of 20 years. Males were in their sixth to eighth semesters of the same academic programmes, with an average GPA of 4.28 and an average age of 20 years. Three full-time professors used the PBL method in ten economic integration courses (9 with 25 students each and 1 with 14 participants), while five (two full-time and three part-time) applied the conventional teaching method in twelve economic integration courses (11 with 25 students each and 1 with 14 participants) at Universidad Del Norte.

In Universidad de Buenaventura, four full-time professors used the PBL teaching method in 9 courses (8 with 30 students each and 1 with 24 participants), while three professors (one full-time

and two part-time) used the conventional teaching method in 9 courses (8 with 30 students and 1 with 32 participants). The content of the courses in both universities was as follows: (1) Principles of international trade, (2) Free trade and protectionism, (3) Economic integration processes, (4) International and regional economic integration and cooperation organisations, and 5) 2010–2017 economic integration processes (Sanabria-Landazábal et al., 2017) (See Appendices 1 and 2).

Materials

At the beginning of the research, participants completed a Likert pre-test survey to show their expectations of improvement of knowledge-construction, problem-solving, critical thinking, teamwork, and autonomy skills.

A diagnostic test was used to estimate previous knowledge regarding basic concepts of economic integration among all the participants. This estimation was made to examine if both groups shared the same characteristics. Scores varied from 1 (lowest level) to 5 (highest level).

All printed copies were completed during class hours. The students voluntarily completed all the tests. They were reminded that completing the surveys would not affect their academic grades and that the results would be kept anonymous. The diagnostic test was created by the Centre for Teaching Excellence (CEDU) at the Universidad Del Norte (de la Puente Pacheco et al., 2018).

At the end of the course, the students completed a post-test answering the same evaluative questions to find out if there was any variation in their perceptions.

Finally, the participants completed a questionnaire that showed which of the two methods used (PBL or conventional teaching) was more useful in achieving the objectives of the course. "The professors participating in the study collected data on the change of students" cross-curricular competencies through class notes of the group and individual work, group tutorials in the PBL group, images that provided evidence of group work, and the participants' academic grades'. (De la Puente et al., 2019b).

The professors based their class lessons on the textbook *The Theory of Economic Integration* by Balassa (2013).

Procedure

Students who applied the conventional teaching method were taught each course topic without innovative strategies that are said to motivate students (according to the impressions of the participants indicated in the post-test). On the other hand, students who studied using the PBL method were given five issues to develop in their projects, which encouraged greater freedom of analysis based on the group's interests.

Each professor was assigned an economic integration course according to personal work conditions. Students then selected the course that best suited them according to their academic schedule, without having prior information on the courses for which PBL and conventional method would be used. The demographic data of the students was collected before the beginning of the courses to verify that both groups had similar characteristics.

A diagnostic test was applied to examine the studentś previous knowledge about economic integration. Professors who applied the methods along with the content of the course presented the purpose of the study and the skills that were observed, the number of assessments, and the essential readings. In both universities, the courses required classroom lessons for three hours per week, which were designed by the professors-in-charge.

Professors who used the conventional teaching method assessed the students through three multiple-choice exams throughout the semester, weekly reading control, lectures in approximately the first two hours of classes, and limited student participation in answering questions about the topics discussed.

Students who experienced the PBL method were examined based on four academic grades corresponding to the delivery of two drafts of the research project, a final version of the document, and an oral presentation.

The students had weekly group work sessions, where they developed parts of the project. This was particularly useful for teachers to take note of the progress of the students' transversal skills. The projects were developed based on the following issues: (1) Subnational economic integration, (2) Actions of regional organisations in local economic integration, (3) Regional financial integration, (4) Interregional trade, and (5) Economic integration and economic development. The projects had to cover the following aspects: presentation of the problem, research method, objectives and hypothesis, data collection, data analysis, application in the context of the Colombian Caribbean, and the solution. Each group selected an issue to address from the professors' database (Börzel & Risse, 2019; Dorrucci et al., 2004; Florensa et al., 2015; Humphrey, 2019).

The courses lasted 18 weeks for both groups. The tutoring sessions given by the professors were reduced to allow more autonomy in the development of the project.

The first three academic grades corresponding to the delivery of the first two drafts and the final document were made in seven weeks. During the first two weeks of classes, the students selected their issue area and began working in groups to define the subtopic. In the second week, teachers instructed the first group to answer questions about an effective way to develop a project, taking into account the course content. Two PBL professors mentioned that the students of Universidad del Norte did not know how to start a written project because they confused it with an essay.

Three PBL professors of Universidad de Buenaventura highlighted the lack of student experience in the use of data management tools, which delayed the application of the method until the participants were more adept in using them. Teachers corrected these limitations during the first three hours of classes over the first two weeks. Once the difficulties were overcome, they noted that the students had more confidence in proposing possible solutions to the selected issues, thus increasing class participation towards *teamwork* and *problem-solving* skills. The teachers emphasised that once the students overcame this initial barrier, collaborative work was encouraged even though group members (especially at Universidad Del Norte) would sometimes not receive criticism from their groupmates well. Students from both universities delivered the first drafts in the seventh week of classes.

From the eighth to the thirteenth week, the groups underwent tutoring with their professors-in-charge, during which the latter corrected certain aspects of their projects and helped the students develop the methodology and procedure of their study in light of local contexts. In both universities, the professors-in-charge agreed that in the course of tutoring, the working groups could already relate the selected issues to economic integration processes. It was during this time that the teachers covered topics three and four of the course.

From weeks 14–18, the students delivered the final version of the written project, presented them orally, and covered the last topic of the course. The professors-in-charge pointed out that although they did a group work, the students did not feel comfortable listening to their classmates criticise their work. The feedback tended to focus only on the negative aspects that should be changed, while the positive factors were never highlighted in comments from their peers. Several teachers who applied the PBL method stated that their students felt the need to meet their classmates in advance, since it took them longer to open up to each other.

Despite this, the members of the working groups fulfilled their specific tasks, suggesting that they could have felt the obligation to remain in the groups without wanting to express empathy in front of their little-known colleagues. At the end of the course, the students shared their impressions of the PBL method in a focus group.

One of the common opinions of students in both universities is that they felt they could improve their ability to work as a team. They mentioned that despite not feeling entirely comfortable with working with people they had never met before, they were able to achieve the objectives of the project and maintain a cordial relationship with their peers.

Table 1. Socio-demographic characterisation according to teaching method: PBL ($n = 503$) and the conventional teaching method ($n = 561$) (Tests applied: Welch and chi-square).

Variables	Total $n = 1064$	PBL $n = 503$	Traditional $n = 561$	Statistical (P value)
Age	Average (DS)	Average (DS)	Average (DS)	
	20,17 (0,83)	20,15 (0,77)	20,19 (0,89)	0.820 (0.4123)
	Median 20 Min-Max 18–22	Median 20 Min-Max 19–22	Median 20 Min-Max 18–22	
Gender	n (%)	n (%)	n (%)	0.687 −0,4069
Female	726 (68,2)	350 (69.6)	376 (67,0)	
Male	338 (31,8)	153 (30,4)	185 (33,0)	

More than 30% of participants acknowledged that it is necessary to address the criticisms of their peers better and not take criticism personally. The participants who answered that they knew of and have applied the PBL method in the past had difficulty in taking the criticism from a purely professional perspective. It is not common to apply unconventional methods in their university careers. Nevertheless, they consider it to be necessary training to "face diverse work environments".

The students also indicated that the PBL method allowed them to apply theoretical concepts on international trade to their written projects, apply them to problems they wanted to address during the development of their work, and to better understand technical jargon for their oral presentations. They recommended an application of multiple teaching approaches in a single course so that new students can appreciate the benefits of the PBL method and be more careful in verifying the oral, written, and technical skills of the participants.

Results

The average age of the students was 20 years, with a standard deviation of 0.83 years, where the maximum is 22, and the minimum is 18 (Table 1). It was verified that the socio-demographic characteristics, academic performance, and preliminary test of the teaching methods were similar. Table 1 shows the average age and its deviation, as well as the gender proportions of the study group. Welch's correction test shows that the average ages between teaching groups are statistically similar ($p = 0.412$); the chi-squared test ensures that gender ratios are also similar ($p = 0.406$) Table 2.

Previous academic performance is 4.37 and 4.18 in the PBL group and conventional teaching group, respectively. The Welch test shows that there are statistically significant differences in academic performance according to the teaching method ($P < 0.001$), while the chi-square test shows that there is no association between prior knowledge of the PBL method and academic performance of the groups observed ($P = 0.6352$).

Table 2. Academic performance and previous knowledge of the PBL method in the groups studied (Test applied: Welch and chi-square).

Variables	Total $n = 1064$	PBL $n = 503$	Traditional $n = 561$	Statistical (P value)
Academic performance	Average (DS)	Average (DS)	Average (DS)	6.819 (<0.001)
	4.27(0,47)	4.37 (0,42)	4.18 (0,5)	
	Median 4.3 Min-Max 03-may	Median 4.4 Min-Max 3.1–5	Median 4.1 Min-Max 03-may	
Previous knowledge of the PBL method	n (%)	n (%)	n (%)	0.225
No	452 (42.5)	218 (43.3)	234 (41.7)	(0.6352)
Yes	612 (57.5)	285 (56.7)	327 (58.3)	

Table 3. Comparison of teaching methods and cross-curricular competencies in the pre-test (Applied tests: Welch and t student).

Pre-test variables	Methods	Average (DS)	Median	Min-Max	Statistical (*P* value)
Knowledge construction	PBL	4.48 (2.10)	5	1–9	1.7728 (0.077)
	Traditional	4.69 (1.85)	5	1–9	
Problem solving	PBL	4.27 (1.90)	5	1–9	5.1332 (<0.001)
	Traditional	4.85 (2.04)	5	1–9	
Critical thinking	PBL	4.22 (1.96)	5	0–8	2.837 (<0.05)
	Traditional	4.57 (2.03)	5	0–9	
Teamwork	PBL	4.41 (1.97)	5	1–9	2.218 (<0.05)
	Traditional	4.68 (2.02)	5	0–9	
Autonomy	PBL	3.94 (1.88)	4	0–8	6.379 (<0.001)
	Traditional	4.68 (1.92)	5	1–9	

Table 4. Comparison of teaching methods and cross-curricular competencies in the post-test (Welch test).

Post-test Variables	Methods	Average (DS)	Median	Min-Max	Statistical *P* Value
Knowledge construction	PBL	5.20 (1.86)	5	1–10	1.2511 (0.211)
	Traditional	5.35 (2.05)	5	1_10	
Problem solving	PBL	8.13 (1.24)	8	3–10	18.76 (<0.001)
	Traditional	6.45 (1.66)	6	4–10	
Critical thinking	PBL	5.92 (1.81)	6	1–9	2.2973 (<0.05)
	Traditional	5.65 (2.00)	5	1–10	
Teamwork	PBL	7.91 (1.58)	8	1–10	18.118 (<0.001)
	Traditional	5.84 (2.12)	6	1–10	
Autonomy	PBL	5.64 (3.63)	5	1–10	2.8742 (<0.001)
	Traditional	5.10 (2.27)	5	0–10	

The Welch test confirms that both groups had a similar perception of the competency *knowledge construction* at the beginning of the course ($P = 0.077$). The t-student test shows that students had different perceptions of the other competencies and that the previous academic performance of the non-PBL group was higher than that of the PBL group ($P < 0.05$). Table 3 summarises the averages with their deviations, similarities, and differences between the two groups (PBL and traditional education).

The Welch test shows that in the PBL group, the scores given by the students in the *problem-solving*, *critical thinking*, *teamwork,* and *autonomy* competencies ($p < 0.05$) were higher than in the traditional method (Table 4). Both groups increased their scores in the *knowledge construction* competency at the end of the course, but the result was not statistically significant ($P > 0.05$).

Figure 1 shows the changes in academic performance, comparing the academic grades of both groups in the three exams (also known as "*parcial*" in the local context) and the corresponding final grades (definitive note). Again, a Welch test was applied, showing that there are no differences in the first exam.

However, there was a statistical difference in the following two exams and the final grade. The average score in the PBL group was higher than that of the non-PBL group.

Students were asked to rate their perception of academic compliance with the objectives of the course on a ten-point Likert scale. Table 5 shows significant differences between the two groups with regard to perceived attainment of course objectives ($p < 0.05$).

Figure 2 illustrates the average level of attainment of course objectives of the two teaching methods. The PBL method is superior to the conventional method in the attainment of 4 out of 5 course objectives.

This study also aimed to confirm if the achievement of course objectives is related to the skills observed. Spearman's correlation coefficient was used since the data sets do not follow a normal distribution. Table 6 shows that there are correlations between some course objectives and some curricular competencies.

The *problem-solving* competency was positively correlated with objective 5 (0.088; $P < 0.05$). *Teamwork* was positively correlated with the achievement of the first objective (0.087; $P < 0.05$). On the other hand, *critical thinking* was inversely correlated with the achievement of objective 3 (−0.119, $P < 0.001$) and directly with objective 4 (0.097, $P < 0.05$), as shown in Table 6.

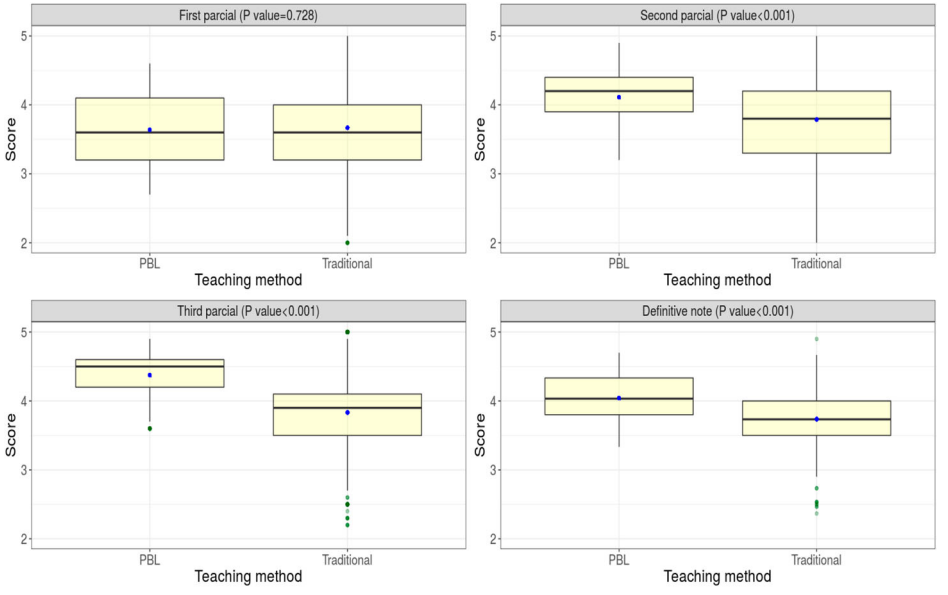

Figure 1. Comparison of academic grades by teaching methods.

Discussion

The results of the pre-test, post-test, focus group, and the questionnaire about the fulfilment of the academic objectives of the course all show the development of *teamwork* and *problem-solving* skills. The results of the application of the PBL method in the north coast of Colombia agreed with the literature review that PBL improves these two skills, regardless of geographical contexts. This is because the PBL method encourages collaborative work during the construction and oral presentation of a project; this is not achieved through the conventional method.

However, the lack of prior knowledge about the written design of a project and quantitative data management tools made it difficult to fully implement the PBL at the beginning of the course.

This illustrates the need to improve the construction of future diagnostic tests.

Concerning the association between the PBL method and the development of the curricular objectives of the course, it is found that the PBL was suitable for the fulfilment of question 5 (Q_5) (Can you analyse the threats to economic integration in the twenty-first century?). However, this does not mean that the PBL is the best method to develop all the skills analysed. As the professors-in-charge pointed out, PBL students did not share all their project proposals and opinions in front of their colleagues, worried that their comments would be undervalued. On several occasions, the most persuasive members of the groups received support from other students even when their arguments were

Table 5. Questions to students about fulfilment of course objectives (Test applied: Welch and t student).

Objectives	Methods	Average (DS)	Median	Min-Max	*P* value
Do you understand the different theoretical approaches to economic integration?	PBL	7,32 (1,47)	8	1–10	17.579
	Traditional	5,44 (2,01)	5	1–9	(<0.001)
Can you identify the different degrees of economic integration between countries?	PBL	5,49 (1,79)	5	1–10	4.5216
	Traditional	6,03 (2,10)	6	1–10	(<0.001)
Can you identify the costs and benefits of regional integration agreements?	PBL	6,06 (2,08)	6	1–10	2.2755
	Traditional	5,77 (2,06)	6	1–10	(<0.05)
Can you measure the degrees of trade integration between countries?	PBL	7,52 (1,64)	8	2–10	13.088
	Traditional	5,97 (2,20)	6	1–10	(<0.001)
Can you analyse the threats to economic integration in the twenty-first century?	PBL	7,84 (1,59)	8	1–10	27.938
	Traditional	4,80 (1,96)	5	1–10	(<0.001)

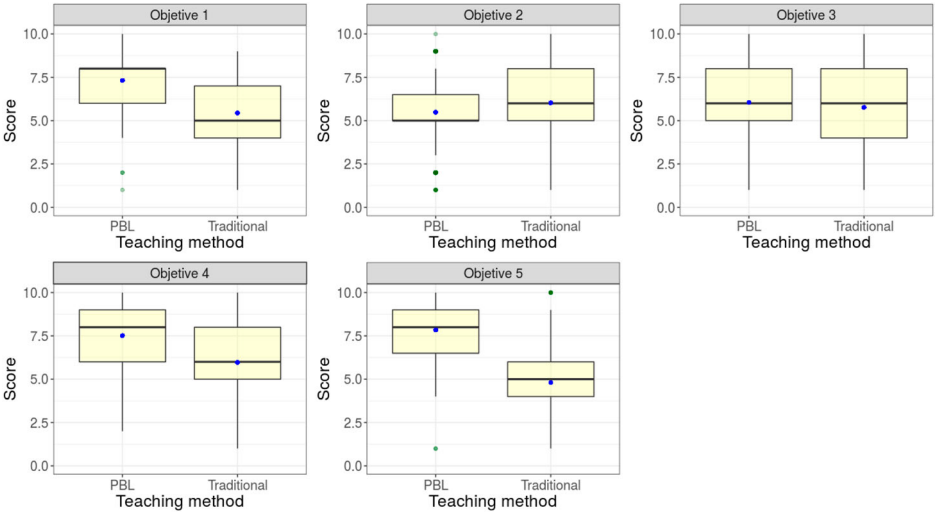

Figure 2. Scores of the course objectives.

wrong. This means that the application of the PBL method needs to consider the dynamics in social relationships that help uncover conditions for the development of the skills studied.

The PBL method was not superior in achieving all the objectives of the course. Although there is a positive association between the method and Q_5, the others did not show a substantial improvement compared to the conventional teaching method. Although the standardised application of the PBL method in developed countries tends to improve both aspects (cross-curricular competencies and academic objectives), this study confirms that the PBL method is not always suitable for achieving the educational goals of an undergraduate course. This is consistent with the findings in the literature review.

This was evident in the focus group, where the participants stated that the teaching method does not necessarily improve all the cross-curricular competencies evaluated in the pre-test and post-test. According to them, changing a teaching method in which they become active agents in the learning process could be misunderstood as lack of guidance from the professor. Implementing PBL, alongside the complexity of the academic content, may affect the development of the skills studied and the students' perception.

Table 6. Kendall Tau rank's correlation coefficient and the *P*-value between the accomplishment of the course objectives with the PBL method and cross-curricular competencies.

		Post-test				
Results		Problem solving	Knowledge construction	Teamwork	Critical thinking	Autonomy
Do you understand the different theoretical approaches to economic integration? (Q_1)	Correlation coefficient	−0.046	−0.012	0.087	0.038	0.033
	Sig. (bilateral)	0.1909	0.7496	<0.05	0.2874	0.3523
Can you identify the different degrees of economic integration between countries? (Q_2)	Correlation coefficient	−0.009	−0.027	0.000	0.019	−0.036
	Sig. (bilateral)	0.7988	0.4508	0.9856	0.5929	0.3055
Can you identify the costs and benefits of regional integration agreements? (Q_3)	Correlation coefficient	0.032	−0.064	−0.003	−0.119	−0.003
	Sig. (bilateral)	0.3645	0.0748	0.9249	<0.001	0.92
Can you measure the degrees of trade integration between countries? (Q_4)	Correlation coefficient	−0.040	0.049	0.000	0.097	0.025
	Sig. (bilateral)	0.2605	0.1825	0.998	(<0.05)	0.4817
Can you analyse the threats to economic integration in the twenty-first century? (Q_5)	Correlation coefficient	0.088	0.003	0.035	−0.047	−0.023
	Sig. (bilateral)	<0.05	0.9274	0.3212	0.1906	0.5128

The conventional teaching method has been dominant in the north coast of Colombia, where students are accustomed to having a passive role in the learning process. A constant pedagogy must accompany the application of an unconventional method, such as PBL, that assigns an active role to students. PBL exalts the importance of the development of teamwork and problem-solving skills and encourages students to reflect on their role in the learning process.

As mention by de la Puente et al. (2019a) the findings advocate the integration of the PBL method throughout academic courses in order to generate positive evaluation from students once they fulfil all the requirements to create and present a project. Students seem to evaluate PBL positively when it is implemented at the onset of the academic course, since they need time to adapt to the method and familiarise themselves with the new dynamics.

This study was limited in finding sufficient previous data on students' misperception regarding the reception of their opinions in workgroups. Additionally, it is essential to develop future studies on social relations and the effectiveness of the PBL method in local contexts.

Conclusions

The results of this study reinforce the idea that the effectiveness of teaching methods should be evaluated from multiple dimensions and through various instruments. Student perception verifies how active participants believe that unconventional methods contribute to meaningful learning in different geographic contexts.

It also strengthens the relevance of associating students' perception with academic performance, since this methodology is not always efficient in revealing the objectives of the undergraduate courses. The study gives a better comprehension of the teaching process in different contexts and highlights the local singularities that influence the transformation of students as active agents.

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Notes on contributors

Professor Mario de la Puente is a professor in the Department of Political Science and International Relations at Universidad Del Norte (Colombia). Professor De la Puente has worked on the implementation of teaching methodologies in vulnerable socio-economic contexts and especially on the impact of the PBL methodology in the development of cross-curricular competencies in various areas of knowledge.

Professor Carlos Mario De Oro Aguado is a mathematician from the Department of Mathematics and Statistics of Universidad del Norte, currently working on the implementation of logistic regressions applied in case studies involving teaching methodologies with Professor Mario de la Puente.

Professor Elkyn Lugo Arias is a member of the Social Development Management Group (DESOGE) of the Faculty of Economic and Business Sciences of the Corporación Universitaria Minuto de Dios, UNIMINUTO.

ORCID

Mario Alberto de la Puente Pacheco http://orcid.org/0000-0002-0783-1267
Carlos Mario de Oro Aguado http://orcid.org/0000-0002-4990-6554
Elkyn Lugo Arias http://orcid.org/0000-0002-7049-4451

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Appendices

Appendix 1: PBL group and professors' scheduled activities.

Course duration by weeks	Course content	Course sub-content	PBL group activities	Percentages of academic grades
1	Principles of international trade	Basic concepts of trade	Presentation of the course and the PBL method	Delivery of the first written draft of the group project: it must contain the problem, objectives, hypothesis, and the research method — 35% of the total academic grade.
2		Trade and history	Selection of an issue and sub-issue. First groupwork session.	
3		Instruments of trade and protectionism	Second groupwork session. First group tutoring by the professor-in-charge.	
4	Free trade and protectionism	Global trade	Third groupwork session. Define the problem question.	
5		Regional trade	Fourth groupwork session. Define the research method.	
6		sub-regional trade	Define the objectives and hypothesis.	
7		Global and regional finance	Send the first draft to the professor-in-charge.	
8	Economic integration processes	Basic concepts of economic integration	Second tutoring.	Delivery of the second written draft of the group project: it must contain the development of the research method and procedure 35% of the total academic grade.
9		Global experiences	Sixth groupwork session: Revise the project based on the professorś second tutoring recommendations.	
10			Seventh groupwork session.	

(*Continued*)

Continued.

Course duration by weeks	Course content	Course sub-content	PBL group activities	Percentages of academic grades
11			Eight groupwork session: Develop the research procedure.	
12	International, regional	European Union	Ninth groupwork session: Draft the research procedure.	
13	economic integration and	ASEAN	Second draft: Write the project method and procedure.	
14	cooperation organisations	MERCOSUR	Tenth groupwork session: Write the project results.	Delivery of the final document that includes the recommendations
15		IMF, WB, regional economic organisations	Select the final references for the projects.	of the teacher-in-charge —15% of the cumulative academic grade.
16	2010–2017 economic	Africa	Send the final version of the project.	
17	integration	North America	Oral presentations.	Oral presentations —15% of the
18	processes	Asia Pacific and Latin America	Focus group.	cumulative academic grade.

Appendix 2: non-PBL group and professors' schedule activities.

Course duration by weeks	Course content	Course sub-content	Activities of the Non-PBL group	Exam design and grade percentages
1	Principles of international trade	Basic concepts of trade	Introduction of the course.	First multiple choice written
2		Trade and history	First lecture, individual classwork, and pop quiz.	exam. 35% of the total grade.
3		Instruments of trade and protectionism	Second lecture, individual classwork, and pop quiz.	
4	protectionism	Global trade	Third lecture, individual classwork, and pop quiz.	
5		Regional trade	First optional tutoring.	
6		sub-regional trade	Fourth lecture, individual classwork, and pop quiz.	
7		Global and regional finance	First multiple-choice written exam.	Second multiple choice written
8	Economic integration processes	Basic concepts of economic integration	Fifth lecture, individual classwork.	exam. 35% of the total grade.
9		Global experiences	Sixth lecture, individual classwork, and pop quiz.	
10			Seventh lecture, individual classwork, and pop quiz.	
11			Second optional tutoring.	
12	International, regional	European Union	Eight lecture, individual classwork, and pop quiz.	
13	economic integration and	ASEAN	Second multiple choice written exam.	
14	cooperation organisations	MERCOSUR	Ninth lecture, individual classwork, and pop quiz.	Third multiple choice written
15		IMF, WB, regional economic organisations	Tenth lecture, individual classwork, and pop quiz.	exam. 30% of the total grade.
16	2010–2017 economic integration	Africa	Third multiple choice written exam.	
17	processes	North America	Feedback of the students about	
18		Asia Pacific and Latin America	the method of the course.	