Undergraduate students’ perceptions of Project-Based Learning (PBL) effectiveness: A case report in the Colombian Caribbean

Mario Alberto de la Puente Pacheco1*, Dick Guerra2, Carlos Mario de Oro Aguado3 and Callum Alexander McGarry4

Abstract: Differentiated geographical and institutional contexts imply the need to examine the effectiveness of non—conventional approach learning methods in contrast to generalist assumptions. One way is to examine the perceptions of undergraduates of a teaching method applied to specific individuals, geographical contexts, and their relationship to achieving the objectives of the course. This study analysed students’ perceptions of the effectiveness of the Project-Based Learning (PBL) method within the Colombian Caribbean. The study used both Chi-square, Wilcoxon rank sum and independent variable correlation tests in a survey of 340 students in the Economic Development undergraduate course in a total of four cohorts over two years. The students compared the PBL to a traditional teaching method to fulfill the course’s objectives, identifying cross—curricular skills that were considered better and worse during the learning process. It was found that only competencies of Autonomy and Critical Thinking had significant positive perceptions when using the PBL revealing that perceptions of students form a complementary tool that contributes to the analysis of the usefulness of teaching methods in different geographical contexts.

ABOUT THE AUTHORS

Mario Alberto de la Puente Pacheco Professor in the Department of Political Science and International Relations at Universidad Del Norte (Colombia), PhD. in International Economics. 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.

Dick Guerra M.Sc. in Statistics has an expertise of more than three years in classroom research, also in educational research and data analysis for Social Sciences.

Carlos Mario de Oro Aguado 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.

PUBLIC INTEREST STATEMENT

This paper compares the student perception of the effectiveness of the PBL methodology with the conventional teaching method applied in the Colombian Caribbean region. The findings reinforce the idea that the implementation of PBL in the Colombian Caribbean should not be evaluated by the development of cross-curricular competencies but also by the students’ perception once they become active agents in the learning process. The use of this instrument helps to know in much greater depth the effectiveness of this method within different geographical contexts.
1. Introduction
The effectiveness of different learning methodologies compared to traditional methods in which the professor conceives of their students as “empty vessels” of knowledge (McGonigal, 2004, p. 33) has been the subject of studies, with mixed results (Hart Research Associates [HRA], 2013).

These studies have responded to criticism from various sectors (including employers) who state that universities need to strengthen students’ cross-curricular/cross-sectional competencies by connecting what is covered in class with real-life experiences (Bowden & Marton, 1998; Hart Research Associates [HRA], 2013; Peters, 2000). These criticisms are even more accentuated in developing countries where national authorities are still focused on achieving universal coverage in all educational cycles rather than on improving the quality of education (Asiedu & Nandwa, 2007; Kong, Qin, Zhou, Mou, & Gao, 2014; Barrientos & Niño-Zarazúa, 2011; Tilak, 1988; Benhabib & Spiegel, 1994; Angrist et al., 2006). Among the most researched and discussed learning and teaching methodologies is Project-Based Learning (PBL), with a wealth of literature regarding its effectiveness in various contexts. According to Angrist et al. (2006) this methodology encourages the development of cross-curricular competencies and promotes autonomy.

Blumenfeld et al. (1991); Helle, Tynjälä, and Olkinuora (2006); Boud (2001) and Barrow (2006) affirm that the standardised application of PBL promotes the development of the following cross-curricular competencies: Knowledge Construction, Problem Solving, Critical Thinking, Teamwork, and Autonomy. This exploratory study analysed students’ assessment of the PBL method’s effectiveness compared with traditional teaching methods in achieving the objectives of the Economic Development undergraduate course. The study ultimately aims to determine whether the implementation of PBL has a greater influence on students’ perceptions of the fulfilment of course objectives and, on the other, to learn which of the cross-curricular competencies mentioned by Blumenfeld et al. (1991); Helle et al. (2006); Boud (2001) and Barrow (2006) possess a higher weight in the fulfilment of the course objectives.

Two groups of 340 students took the Economic Development course. The first group of 167 participants studied the course using the PBL method, while the second group of 176 participants followed a traditional teaching method. At the start of the course, both groups answered a Likert pre-test questionnaire based on a 3-point scale (in which 1 represents the lowest score and three the highest) regarding their expectations of the development of the five cross-curricular competencies.

The questionnaires were applied over two years and included four cohorts of International Relations students, with ethical requirements consent given for the academic use of their data. They were fully informed regarding the purpose, intent, motivation, sponsoring organisations, the potential use of data, and methods of data collection. The teacher in charge informed the students on the confidentiality and anonymity of their identifications before completing the questionnaires.

The implementation of the PBL method was carried out during the courses.

The projects proposed improvements in domestic factors for the development of the Colombian Caribbean. The teacher implemented the method into two phases. First, participants shared their impressions of the teaching method following a focus group protocol, and both groups answered
the questionnaire for a second time to verify whether their expectations had been met (post-test). Then, both groups completed a questionnaire concerning whether the implemented learning method had helped to achieve the course objectives. A Chi-square test was applied to the data obtained from the pre-test, post-test, and assessment questionnaire for both the PBL and non-PBL method for each competency of the Economic Development course. Subsequently, the study employed an appropriate correlation test to determine if there was a relationship between the items of the post-test and those of the student assessment questionnaire.

It was anticipated that the results would reveal the PBL method’s influence on students’ perceptions of the fulfilment of course objectives and, additionally, if the five cross-curricular competencies affect to the same extent their assessment of the course objectives fulfilment. The results of this exploratory study will contribute to the understanding of how students in the Colombian Caribbean perceive their learning process under the PBL method.

Walker, Bridges, and Chan (1996) found that PBL students scored comparably or better than conventional taught peers in Chinese business undergraduate courses regarding oral and written financial presentations. They also reported higher cross-curricular skills in Spanish students following integrated or PBL curricula compared to conventional teaching although only part of this variance may be attributable to PBL per se.

2. Literature review

The literature review of students’ perceptions of the PBL method was based on previous studies that focused largely on reflection capacity in the learning process (Albanese & Mitchell, 1993; Berkson, 1993; Colliver, 2000; Vernon & Blake, 1993).

The PBL began its applications in business and social sciences undergraduate and graduate courses after their positive learning outcomes in medical and nursing programs was verified. The most widely researched issues in PBL were knowledge, improvement of informal learning, retention and test performance compared to conventional teaching method. Most literature on PBL learning outcomes and cross-curricular competencies are available from business programs based on PBL pedagogy mainly at a graduate level.

For undergraduate business programs, research is more limited where we found evaluations of PBL primarily at a single course compared to conventional teaching in different geographical contexts. On the one side, Norman and Schmidt (1992) found several studies to support PBL improved knowledge retention in Medicine, Economics and Business graduate programs compared to conventional teaching. Three other reviews found that PBL students scored lower in basic sciences or knowledge or showed a lower performance in the exam while the size of the effect was short and not reproducible (Vernon & Blake, 1993). On the other side, Berkson (1993) found no difference in her review, so there is no evidence consensus to support PBL’s superiority over traditional knowledge acquisition methods. Three reviews found that PBL students in nursing programs experienced similar or better results in clinical skills than traditionally taught peers (Dods, 1997; Peters, 2000). In Dutch pupils, Schmidt, Machiels-Bongaerts, and Hermans (1996) also reported higher diagnostic skills following integrated curricula or PBL compared to conventional pedagogy, although only part of this variance can be associated with PBL per se.

Various reviews did not found that PBL students developed every cross-curricular competencies better than traditionally taught peers. Garnjost and Brown (2018, p. 124) cited the results of Albanese and Mitchell (1993) study of the development of the knowledge construction competency and included ten field studies, eight of which examined the implementation of PBL to measure the relationship that existed between the method and the competency. According to the authors, “the PBL students obtained lower grades in basic sciences compared to another group under the traditional teaching method” (Albanese & Mitchell, 1993, p. 55) concluding that the
students did not value the use of PBL for positive learning of basic concepts. Hartling, Spooner, Tjosvold, and Oswald (2010) found that the students rated PBL as a more effective method of resolving clinical cases compared with the rating students gave to the traditional method. Other authors have supported the conclusions of Hartling et al. (2010) stating that the development of projects focused on the resolution of cases in the field of economics and business is more effective than traditional teaching methods (Dochy, Segers, Van Den Bossche, & Gijbels, 2003).

Studies that have investigated the development of critical thinking as competency with the PBL method have produced mixed results. Cook and Moyle (2002); Morales-Mann and Kaitell (2001) and Joe and Elizabeth (1999) found that PBL encourages students’ critical thinking more than traditional teaching methods. However, Lyons (2008) found that courses that apply PBL methodology do not improve critical thinking compared to traditional methods. The investigations above that relate students’ perceptions with the development of the cross-curricular competencies determined this study’s investigation methodology and the hypothesis to be tested.

3. Materials and methods

This study analysed student assessments of the effectiveness of PBL methodology compared to traditional teaching methods in the fulfilment of the Economic Development undergraduate course objectives. Additionally, the investigation identified the cross-curricular competencies that most influenced the perceptions of both groups of students. First, before students started the Economic Development course, they took a pre-test to discover their initial expectations of the development of the different competencies of Knowledge Construction, Problem Solving, Critical Thinking, Teamwork and Autonomy.

Additionally, both groups took a diagnostic test before the courses started to determine if they had previous basic knowledge in economic development. The teacher divided the course into two parts. In the first part, the teacher explained each segment and the participants worked in groups during class to elaborate on the project. In the second, the teacher wrote class notes during class hours on the development of cross-curricular competencies in the participants. At the end of the course, the PBL group shared their impressions of the development of cross-curricular competencies through a focus group protocol (De la Puente, Selene, Acuña, & Delgado, 2018).

Then, at the end of the course, the students completed a post-test answering the same evaluative questions to highlight if there had been any changes in their perceptions. Finally, students answered a questionnaire that showed which of the two methods used, PBL or traditional teaching, was the most effective in achieving the objectives of the course. Once the data obtained by the pre-test, post-test, and student assessment questionnaire, a Chi-square test calculated the equivalence or significant difference of both tests with the PBL and non-PBL methods showing no significant difference in the pre-test which was different from the post-test result which showed a significant change.

Once extrapolated from the pre-test, post-test and questionnaire regarding student perception of the achievement of course objectives, the data obtained were employed in a Chi-square test comparing the two methods (PBL and non-PBL). Correctly, the Chi-square test was applied to each of the objectives of the Economic Development course.

It resulted in five crossed tables that demonstrate the association between each of the objectives and the degree of association between them; only the results that rated significant (p < 0.05) were included in the analysis. Then, an appropriate correlation test was applied to determine if there was a relationship between the items in the post-test and the items included in the student assessment questionnaire. The items that emerge as significant will have a correlation coefficient that can be used to interpret the extent of their association. A high coefficient will indicate a high association or contribution between the post-test and the questionnaire.
First, demographic information such as gender, age, undergraduate studies, and the average grade was collected before starting the Economic Development course, to assess whether both groups possessed similar characteristics. Then, a Likert pre-test questionnaire was carried out using a 3-point scale in which 1 was the lowest valuation, and three was the highest. The assessment shows the expectations of students from both groups regarding the development of cross-curricular competencies from the outset of the course.

The investigation focused upon the cross-curricular competencies—Knowledge Construction, Problem Solving, Critical Thinking, Teamwork, and Autonomy—highlighted beforehand by the literature review (mainly from the authors Barrow, 2006; Blumenfeld et al., 1991; Boud, 2001; Helle et al., 2006). Once the course ended, both groups of students retook the questionnaire (post-test) with the same assessment scale and variables. Finally, both groups filled out a questionnaire on how much the applied teaching method (either PBL or non-PBL) contributed to the fulfillment of the Economic Development course objectives proposed by the professor in charge.

The participants of this exploratory study were students of the International Relations undergraduate program at the Universidad Del Norte, Colombia. During four cohorts over two years, 340 students took the Economic Development course, of which 167 experienced the PBL methodology between 19 and 22 years old and the other 173 a traditional teaching method between 18 and 22 years old. These students were studying from the sixth to the eight semesters of the International Relations degree program. Also, evaluations in the process have scores between 0 and 5.

The 340 students voluntarily filled in the tests and questionnaire, all physical copies completed during class time. The students were reminded that the completion of the surveys would not impact their academic performance and that the results would be anonymous. The test and questionnaire were approved in their design and structure by the Centre for Teaching Excellence (CEDU) at the Universidad Del Norte (De la Puente et al., 2018); all the students had previously taken academic courses under traditional teaching methodology while 240 students had studied under the PBL method.

The working hypotheses that were verified in the study were the following:

**Procedure 1:**

H1: Students in international relations do not perceive any difference in cross-curricular competencies at the beginning of the course when the courses are taught with the PBL method or with the traditional teaching method.

H2: Students in international relations perceive differences in cross-curricular competencies at the end of the course when the courses are taught with the PBL method or with the traditional teaching method.

H3: The students with whom the PBL method was applied have better academic performance in knowledge assessments during the course, compared to the traditional teaching group.

**Procedure 2:**

H4: Students in international relations perceive differences related to the accomplishment of course objectives when the courses are taught with the PBL method or with the traditional teaching method.

**Procedure 3:**

H5: Cross-curricular competencies at the end of the course are related to the accomplishment of course objectives.
4. Implementation of the teaching methods (PBL and non-PBL) throughout the economic development courses

The implementation of the PBL method was carried out over four Economic Development courses. The projects proposed improvements in domestic factors for the development of the Colombian Caribbean region. The projects had to fulfil 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 solutions.

Each aspect had an equal percentage of the total academic grade. The courses were divided into two parts. In the first part, the teacher explained each aspect, and the participants worked in groups during class to complete the project. In the second part, the teacher wrote class notes during class hours on the development of cross-curricular competencies in the participants. The students had the opportunity to receive tutorials from the teacher and advice on how to conduct the project. The non-PBL group received the course in a traditional way throughout the semester; the teacher explained the topics and rated the students' performance with multiple-choice written exams.

The implementation was divided into two phases. In the first phase, a diagnostic test was applied which examined previous knowledge of both PBL and non-PBL groups of economic development principles. The purpose was to verify if both groups had the same knowledge level before applying the experiment. The scores ranged from 1 to 5 (1 was the lowest level, and 5 was the highest). Centre for Teaching Excellence of Universidad del Norte created the diagnostic test (De la Puente et al., 2018).

The Kolmogorov normality test (Ks test) dismissed the hypothesis of normality in both distributions so that the comparison was developed with the support of a non-parametric test, the sum of Wilcoxon ranks. No significant differences were found at the 95% confidence level, (W = 14,175, p-value = 0.75), which verified the homogeneity of both courses in terms of prior knowledge.

The second phase analysed the progress of the PBL group in the elaboration of a short-term project during the course from the teacher's class notes and group tutoring on domestic factors that promote economic development in the Colombian Caribbean region. Each group selected an issue provided by the teachers' database.

33 groups developed the projects, most of which consisted of five participants each selecting the following issues: 1) water access in rural areas, 2) microfinancing and entrepreneurship, 3) effects of the national armed conflict in the Colombian Caribbean region, 4) clientelism and local political institutions, and 5) the drug problem in the local context. The tutoring sessions given by the teacher were reduced to allow more autonomy in the elaboration of the project, following Ertmer and Simons’s views (2005) which mention that students must have enough autonomy to solve problems in groups.

During the first group tutoring (at the beginning of the semester) 12 groups had not accurately applied the research methodology, which made it difficult to write the project while the others had difficulties in data analysis owing to the lack of previous training in the use of statistical tools. To continue the implementation of the PBL method the teacher spent three weeks with the PBL group teaching them the correct application of the research methodology applied to the Colombia Caribbean region and training the students in the use of statistical tools. Once the difficulties were corrected, the teacher noted that the students had more confidence in proposing potential solutions to the issues selected, increasing class participation in Teamwork and Problem Solving.

In the second group tutoring the participants identified the economic viability of the projects through statistical tools and implemented the research method correctly; however, although they
collaborated in the project design, they tended to work separately after classes, spending little
time revising and correcting each other’s work.

During classwork, the teacher found that most of the PBL group participants did not feel
comfortable listening to their peers criticise their work because it tended to concentrate only on
the aspects to be improved, while the positive elements were often not highlighted as they would
have liked, which could explain the group dynamics. This may be understood as a lack of initial
empathy within the groups.

At the end of the course, the PBL groups shared their impressions of the development of cross-
curricular competencies through a focus group protocol (De la Puente et al., 2018). They shared the
opinion that the class conducted based on PBL allowed them to be more autonomous in the way
they developed their projects and promoted alternative ways of solving real-life issues.

Also, they expressed their satisfaction with the development of critical thinking on how a local
problem can be solved in a regional area such as the Colombian Caribbean. However, all of the PBL
participants thought that the teaching method does not necessarily improve all the cross-
curricular competencies valued in the pre-test and post-test. According to them, substituting
a teaching method in which they become active agents in the learning process could be misunder-
stood as a lack of accompaniment from the teacher.

Additionally, the participants highlighted that the application of a different teaching method
produced a lack of empathy between them when they were accustomed to several courses that
applied the conventional teaching method. This could partly explain the way the students worked
and the cross-curricular competencies that were used. They recommended an application of
multiple teaching approaches in a single course so that they could appreciate a new teaching
approach without feeling alone in the learning process.

5. Results

In total, the sample is composed of 340 students, of which 167 experienced the PBL methodology
whose average age is 20 years (standard deviation, SD, 0.77 years) and the other 173 students of
the traditional teaching method have an average age of 20 years (SD, 0.87 years).

Students with the PBL method have an academic average of 4.25 (DS 0.44) and the other
students of the traditional method have an academic average of 4.26 (DS 0.49). With the con-
fidence of 95%, we can say that the median of the academic average of the students did not
present statistically significant differences (P-value = 0.49) between the PBL methods and the
traditional teaching. Besides, there is no statistically significant evidence to say that the propor-
tions of students in each teaching method are different. It is also statistically shown that the
proportion of men and women are similar in traditional teaching methods and PBL. See Table 1.

5.1. Procedure 1

This test highlights if two categorical variables are in some way related or if, on the contrary, they
are independent. A Chi-square test was used which results in a non-significant difference between
the groups for each variable of cross-curricular competencies; this indicates a similarity between
the groups for each teaching method in the pre-test (See Table 2).

At the end of the course, the post-test was conducted, which showed a significant difference in
the groups after the application of the PBL and traditional teaching methods for each variable of
the cross-curricular competencies (See Table 3).

By itself, the chi-square test of independence does not locate the direction of the same; that is if
the assessments offered by the subjects are better in the PBL group or vice versa. Figure 1 allows
us to conclude precisely that such assessments are better in the group that applied PBL concerning
the five cross-curricular competencies evaluated, given that the proportion of responses located at the high-level increases in this group.

With the intention of contrasting these changes in the perceptions of the students with a real and evident change in their academic performance, a comparison was made between three knowledge evaluations, consecutive, in three different moments of the semester.

The following diagrams in Figure 2 present the distribution of ratings, which, as a continuous numerical variable, took values between 1 and 5.

Figure 2 offers the first indications to conclude that, although at the beginning of the study the PBL does not generate differences in academic performance in the first evaluation, they do in the following two evaluations. The medians in the PBL group move forward presenting even less variability for evaluations 2 and 3. Table 4 confirms that such differences are statistically significant ($p < 0.05$) for the second and third knowledge evaluation but not for the first.

| Variables         | Met. PBL | Met. Traditional teaching | P Value |
|-------------------|----------|---------------------------|---------|
| N = 167           | N = 173  |                          |         |
| Age (SD)          | 20.18 (0.77) | 20.13 (0.87)  | 15,002 (0.51) |
| Average grade (SD)| 4.25 (0.44)  | 4.26 (0.49)  | 13,824 (0.49) |
| Gender N Female (%)| 119 (71.25 %)  | 108 (62.43 %) | 2.601 (0.11) |

| Variables                  | Value | Df | Significance asymptote (bilateral) |
|----------------------------|-------|----|-----------------------------------|
| Knowledge construction     | 1.967 | 2  | 0.374                             |
| Problem solving            | 0.365 | 2  | 0.833                             |
| Critical thinking          | 4.921 | 2  | 0.085                             |
| Teamwork                   | 1.244 | 2  | 0.537                             |
| Autonomy                   | 2.919 | 2  | 0.234                             |
| Number of valid cases      | 340   |    |                                    |

| Variables                  | Value  | Df | Significance asymptote (bilateral) |
|----------------------------|--------|----|-----------------------------------|
| Knowledge construction     | 89.441 | 2  | <0.05                             |
| Problem solving            | 56.318 | 2  | <0.05                             |
| Critical thinking          | 78.466 | 2  | <0.05                             |
| Teamwork                   | 83.781 | 2  | <0.05                             |
| Autonomy                   | 79.152 | 2  | <0.05                             |
| Number of valid cases      | 340    |    |                                    |

Df = Degrees of freedom
An important aspect to consider was the proportion of subjects whose valuations changed significantly compared to those whose valuations did not change. Figure 3 shows the fraction of students who had positive perception changes (their response in the posttest was higher than in the pretest), others negative (their response in the posttest was lower than in the pretest) and other nulls (without the change in his answer). As expected, the proportion of subjects in the PBL group that had positive changes was more significant than its counterpart in the traditional teaching group, both for the Knowledge Construction competition and the others evaluated. (Figure 3).

| Table 4. Three partial notes according to teaching method (Wilcoxon sum rank) |
|---------------------------------|-----------------|----------------|
| First exam                      | W               | Significance asymptote (bilateral) |
| Second exam                     | 14,885          | 0.6269          |
| Third exam                      | 23,636          | < 0.05          |
|                                | 25,691          | < 0.05          |
5.2. Procedure 2
The following are the specific questions extracted from the student assessment questionnaire related to the accomplishment of course objectives. The response options were for each: Low (1), Medium (2) and High (3).

Do you understand the theories of Economic Development?

- Can you analyse the benefits and disadvantages of a country's potential economic decisions through cost-benefit analysis?
- Can you demonstrate your knowledge of the fundamental and technical concepts of development economics through qualitative and quantitative methods?
- Do you understand the process of economic development from multiple theoretical approaches?
- Can you apply the different measures of poverty and inequality within a local context?

Table 5 summarises the distribution of subjects who scored low, medium or high in each group, for the first question. Similar tables were formed for the other four questions and a summary of the chi-squared test, which sought to determine whether such responses varied from the experimental group to the control group, is presented in Table 6 below.

The results of Table 6 indicate that the value of statistical significance p is less than 0.05 for the first, second and fourth questions; therefore there is an association between the variable teaching method and question 1, 2 and 4. Such an association seems to describe a trend towards higher valuation responses in the PBL group. From Figure 4 it is confirmed that, in fact, in the PBL group there is a tendency towards more positive evaluations, when compared with the traditional methodology group, concerning questions 1, 2 and 4. The proportion of low responses is lower in

| Cross-curricular competencies | Change | Equal | Positive |
|-------------------------------|--------|-------|----------|
| Teaching method               |        |       |          |
| PBL                           | 15%    | 53.9% | 31.1%    |
| Non-PBL                       | 37%    | 45.1% | 18%      |

Table 5. Cross-frequency between the variable teaching method and question 1

|              | Low | Medium | High | Total |
|--------------|-----|--------|------|-------|
| PBL          | 11  | 77     | 79   | 167   |
| Non-PBL      | 40  | 104    | 29   | 173   |
|              | 51  | 181    | 108  | 340   |
the PBL group and the higher the proportion of high responses, confirming a greater perception of the achievement of the learning objectives in the PBL course.

5.3. Procedure 3

The purpose of this section is to determine if there is a relationship between the variables of the post-test of the students that participated in the PBL method and those of the final questionnaire. A Spearman correlation coefficient was calculated resulting in a matrix (Appendix A) with all the coefficients, which varies between \(-1\) and \(1\), where the value indicates that there is no association. Tables 7–8 shows only the significant correlation coefficients, their p-value (Sig), and the amount of processed data (N) between the items of the questionnaire (result), and post-test.

There is a positive relationship between Teamwork and question 1, as indicated by the correlation coefficient obtained from the Rho value (question 1) = 0.244. In contrast, question 4 correlates negatively to the post-test with correlation coefficients Rho (question 4) = \(-0.182\). Next, the correlation coefficients between Problem Solving and question 4 are shown. The results indicate that Problem Solving has a negative relation with question 4 shown with the Rho correlation coefficient = \(-0.194\).

In summary, the students who, from their perception, most developed the competence of teamwork (teamwork) better understood the different theories of economic development, although they were those that, to a lesser extent, understood the economic development from the different theoretical approaches that they worked in the class. A similar case occurs with
problem-solving competence. The students who best developed the problem-solving competence were those who, to a lesser extent, understood the economic development from the different theoretical approaches.

6. Discussion
The findings from this exploratory study reaffirm the idea shared by Dods (1997), Bamford, Karjolainen, and Jenavs (2012), Lyons (2008), Lehman, Christensen, Du, and Thrane (2008), Stanley and Marsden (2012), Mergendoller and Thomas (2005), and Frank and Barzilai (2004) that student perception is another instrument that contributes to the analysis of the effectiveness of teaching methods within differentiated geographical contexts. In this specific case, PBL showed superiority in developing certain cross-curricular competencies.

There are two results in this study that invite further discussion. First, the students that experienced the PBL method perceived that they had higher development in some cross-curricular competencies. However, there was no significant difference in the student evaluations for the pre-test, post-test or final questionnaire. These results are consistent with the literature reviewed.

During the PBL implementation, the participants had difficulty applying a research method and analysing data which highlights the need to improve future diagnostic tests not only regarding curriculum content but also the research tools necessary to elaborate a regionally oriented project. Second, not all of the selected cross-curricular competencies promoted by PBL were developed to the same extent.

The findings suggest that the traditional teaching method encouraged, even more, the development of some competencies that are seen as characteristic of PBL. In the focus group, PBL participants stated that the teaching method does not necessarily improve all the cross-curricular competencies valued in the pre-test and post-test.

| Table 7. Correlation coefficients (Rho) between the cross-curricular competency teamwork, questions 1 and 4 |
|---------------------------------------------------------------|
| Results | Statistics | Post-test Teamwork |
| Q1 | Do you understand the theories of Economic Development? | Correlation coefficient | 0.244** |
| | | Sig. (bilateral) | 0.001 |
| | | N | 167 |
| Q4 | Do you understand the process of economic development from multiple theoretical approaches? | Correlation coefficient | −0.182** |
| | | Sig. (bilateral) | 0.019 |
| | | N | 167 |

| Table 8. Correlation coefficients (Rho) between problem solving and question 4 |
|---------------------------------------------------------------|
| Results | Statistics | Post-test |
| Q4 | Do you understand the process of economic development from multiple theoretical approaches? | Correlation coefficient | −0.194 |
| | | Sig. (bilateral) | 0.012 |
| | | N | 167 |
Again, according to them, the substitution of a teaching method in which they become active agents in the learning process could be misunderstood as a lack of accompaniment from the teacher. In this sense, it is essential to take into account how students may react to a change in the method of a single course when they probably receive several courses based on different learning methodologies. They recommend the application of multiple teaching approaches in a single course so that they can appreciate a new teaching approach without feeling alone in the learning process.

The planning and implementation of the method by the teacher, the complexity of the academic content, and the objectives of the course are all variables that affect the development of cross-curricular skills and positive student assessment. Most college students in the Colombian Caribbean are familiar with traditional teaching methods which assign them a more passive role in the learning process; thereby associating a positive evaluation with the application of this method. However, their perception may change depending on the effectiveness of the PBL method throughout the courses.

Thus, the findings advocate integrating the PBL method throughout the whole academic programme of a course to generate positive evaluations from students once they fulfill all the previous requirements to create and present a project. Students value PBL when it is implemented from the beginning of an academic course since they need time to adapt to the method and familiarise themselves with the new dynamic. The change in roles and, as a consequence, the behaviour and expectations required of student-centred pedagogy require time to influence the perception of students.

7. Conclusions
This study analysed students’ assessment of the effectiveness of the PBL method compared to a traditional teaching method in the development of five selected cross-curricular competencies (Knowledge Construction, Problem Solving, Critical Thinking, Teamwork, and Autonomy) and the influence of each on the fulfilment of undergraduate course objectives in the Colombian Caribbean. There was an association between the implementation of the PBL method and students’ perceptions in the application of the theories of economic development, critical thinking, and the analysis of the benefits and harms of economic decisions. On the other hand, there was no significant correlation between the PBL method and the other competencies analysed.

The competencies Teamwork and Problem Solving were positively associated at the end of the course. On the other hand, it varied negatively with the ability to demonstrate knowledge of fundamental and technical concepts of development economics and to understand the development process. Due to the exploratory nature of this study, nothing is conclusive as the findings indicate that PBL had no significant effect on learner’s outcomes in all cross-curricular competencies. The common concern is the higher cost of achieving the PBL curriculum, both financially and in staff time. The PBL approach depends on the group’s functioning and requires an effective tutor who should be a facilitation expert. However, the findings reinforce the idea that the implementation of PBL in the Colombian Caribbean must not only be evaluated by the development of cross-curricular competencies but also by the students’ perceptions once they become active agents in the learning process. The use of this instrument helps to determine in much greater depth the effectiveness of this method within different geographical contexts.

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Author details
Mario Alberto de la Puente Pacheco¹
E-mail: mdelapuente@uninorte.edu.co
ORCID ID: http://orcid.org/0000-0002-0783-1267
Dick Guerra²
E-mail: dick@uninorte.edu.co
ORCID ID: http://orcid.org/0000-0001-8329-7759
Carlos Mario de Oro Aguado³
E-mail: cdeoroaguado@uninorte.edu.co
ORCID ID: http://orcid.org/0000-0002-4990-6554
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### Appendix A

| Results                                                                 | Problem Solving | Critical Thinking | Knowledge Construction | Autonomy | Teamwork |
|-------------------------------------------------------------------------|-----------------|-------------------|-------------------------|----------|----------|
| Do you understand the theories of Economic Development?                 |                 |                   |                         |          |          |
| Correlation coefficient                                                 | 0.034           | -0.025            | 0.016                   | -0.025   | 0.244**  |
| Sig. (bilateral)                                                        | 0.059           | 0.751             | 0.803                   | 0.751    | 0.001    |
| N                                                                       | 167             | 167               | 167                     |          | 167      |
| Can you analyse the benefits and disadvantages of a country’s potential economic decisions through cost-benefit analysis? |                 |                   |                         |          |          |
| Correlation coefficient                                                 | -0.010          | 0.083             | 0.059                   | 0.083    | 0.084    |
| Sig. (bilateral)                                                        | 0.895           | 0.286             | 0.240                   | 0.286    | 0.278    |
| N                                                                       | 167             | 167               | 167                     |          | 167      |
| Can you demonstrate your knowledge of the fundamental and technical concepts of development economics through qualitative and quantitative methods? |                 |                   |                         |          |          |
| Correlation coefficient                                                 | -0.017          | -0.145            | 0.091                   | -0.145   | -0.115   |
| Sig. (bilateral)                                                        | 0.824           | 0.062             | 0.240                   | 0.062    | 0.138    |
| N                                                                       | 167             | 167               | 167                     |          | 167      |
| Do you understand the process of economic development from multiple theoretical approaches? |                 |                   |                         |          |          |
| Correlation coefficient                                                 | -0.194*         | 0.066             | -0.055                  | 0.066    | -0.182** |
| Sig. (bilateral)                                                        | 0.012           | 0.394             | 0.477                   | 0.394    | 0.019    |
| N                                                                       | 167             | 167               | 167                     |          | 167      |
| Can you apply the different measures of poverty and inequality within a local context? |                 |                   |                         |          |          |
| Correlation coefficient                                                 | 0.016           | -0.030            | 0.052                   | -0.030   | -0.059   |
| Sig. (bilateral)                                                        | 0.839           | 0.700             | 0.507                   | 0.700    | 0.452    |
| N                                                                       | 167             | 167               | 167                     |          | 167      |
Appendix B

Focus group protocol

1. Introduction
   1.1. Presentation of each student mentioning his/her name and undergraduate studies.

2. Positive and negative experiences of the course
   2.1. Students discuss the experience of the course.
   2.2. Students discuss the regional issues selected and developed in the projects.
   2.3. Students discuss the effectiveness of the teaching method for an improvement in cross-curricular competencies.

3. Teaching style
   4.1. Students discuss how they felt about the learning methodology used in class.

4. Aspects of the PBL use that need to be improved
   5.1. The students highlight the elements they did not like and propose aspects to improve the course through PBL.

5. Closing ideas
   6.1. Students and the teacher highlight final aspects of the course.