

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/338386516>

Does Project-Based Learning work in different local contexts? A Colombian Caribbean case study

Article in *Educational Review* · January 2020

DOI: 10.1080/00131911.2019.1694489

CITATIONS

3

READS

22

4 authors, including:



Mario de la puente
Universidad del Norte (Colombia)

46 PUBLICATIONS 47 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Comparative Medical Tourism in Colombia and Singapore: sectorial study and Development Perspectives [View project](#)



Financiacion del postconflicto [View project](#)




Does Project-Based Learning work in different local contexts? A Colombian Caribbean case study

Mario Alberto de la Puente Pacheco, Dick Guerra Florez, Carlos Mario de Oro Aguado & Humberto Llinas Solano

To cite this article: Mario Alberto de la Puente Pacheco, Dick Guerra Florez, Carlos Mario de Oro Aguado & Humberto Llinas Solano (2020): Does Project-Based Learning work in different local contexts? A Colombian Caribbean case study, Educational Review, DOI: [10.1080/00131911.2019.1694489](https://doi.org/10.1080/00131911.2019.1694489)

To link to this article: <https://doi.org/10.1080/00131911.2019.1694489>




View supplementary material 



Published online: 03 Jan 2020.



Submit your article to this journal 



View related articles 



View Crossmark data 



Does Project-Based Learning work in different local contexts? A Colombian Caribbean case study

Mario Alberto de la Puente Pacheco ^a, Dick Guerra Florez ^b,
Carlos Mario de Oro Aguado ^c and Humberto Llinas Solano ^c

^aDepartment of Political Science and International Relations, Universidad Del Norte, Barranquilla, Colombia; ^bCentre for Teaching Excellence (CEDU), Universidad Del Norte, Barranquilla, Colombia; ^cDepartment of Mathematics and Statistics, Universidad del Norte, Barraquilla, Colombia

ABSTRACT

Studies on the effectiveness of the Project-Based Learning (PBL) method in different local contexts require non-conventional approaches that clarify if the methodology is suitable in other settings compared to the conventional teaching practice. This study examined students' perception of the effectiveness of the PBL method in developing cross-curricular competencies and improving the academic performance of undergraduate students in the Colombian Caribbean coast. A sum of Wilcoxon ranges and Spearman's correlation coefficient were used on two groups of 481 students who were taught using the traditional method and the PBL method from six professors of the Economic Development course. It was observed that the autonomy and problem-solving competencies received a positive impression from the students and that the application of the PBL method was superior to the traditional teaching method in improving academic performance. However, it was found that the characteristics of social communication within the local context limited the reflection of the participants in the PBL group. This study contributes to future studies by using a complementary instrument that provides an analysis of the effectiveness of teaching methods in different geographical contexts.

ARTICLE HISTORY

Received 7 January 2019
Accepted 13 November 2019

KEYWORDS

Academic competencies;
undergraduate studies;
Project-Based Learning;
students' assessment;
Colombian Caribbean coast

Introduction

One of the interests in the studies on teaching methods in developing countries is to comprehend their effectiveness in improving cross-curricular competencies within local contexts. This study attempted to respond to criticisms from various sectors (including employers) that argue that universities need to strengthen the students' cross-curricular competencies by connecting what is covered in class with real-life experiences. These criticisms are emphasised even more in developing countries where public administration still focuses on achieving universal coverage in all educational cycles. Among the most researched and discussed teaching methodologies for active learning in local contexts is Project-Based Learning (PBL), which, according to different authors, improves the development of the following cross-curricular skills: *knowledge construction*, *problem-solving*,

critical thinking, teamwork, and autonomy (Blumenfeld et al., 1991; Helle, Tynjälä, & Olkinuora, 2006).

This study examined the students' evaluation of the PBL method's effectiveness compared to the conventional teaching method in fulfilling the objectives of the Economic Development undergraduate course within the International Relations degree programme at the Universidad Del Norte, located in the Colombian Caribbean coast. Four hundred and eighty-one students attended the course in two groups; the first group of 229 students studied the course using the PBL method, while the other group of 252 participants used the conventional teaching method. At the beginning of the course, both groups completed a Likert pre-test questionnaire regarding their expectations on the development of the five cross-curricular competencies mentioned above. During the classes, the PBL method was implemented and divided into two phases. In the first phase, participants shared their teaching method opinions following a focus group protocol. Then, both groups responded to the questionnaire to verify that their expectations were met (post-test). Both groups then completed a survey on whether the implemented teaching method had improved the achievement of the course objectives. The teaching methods and cross-curricular competencies in the pre-test and post-test were compared using the Wilcoxon rank-sum test and Spearman's correlation coefficient.

This study explored whether students perceived the implementation of the PBL method as superior to the traditional teaching methodology and whether the aforementioned was associated with different academic performance.

Literature review

The case studies on the effectiveness of the PBL method compared to the conventional teaching method in the development of cross-curricular competencies within local contexts have produced mixed results. This shows that this methodology is not always successful. Its application in different settings and areas of knowledge results in different perceptions of students and mixed academic performance (Colliver, 2000; de la Puente Pacheco, Guerra, & de Oro Aguado, 2019; Vernon & Blake, 1993).

The following literature review was based on previous studies that associate students' perception of a teaching process using PBL with geographical contexts in the following cross-curricular competencies: *knowledge construction, problem-solving, critical thinking, teamwork, and autonomy* (Albanese & Mitchell, 1993; Baş & Beyhab, 2017; Berkson, 1993; Colliver, 2000; Cook & Moyle, 2002; Vernon & Blake, 1993).

Garnjost and Brown (2018) studied the development of the *knowledge construction* competency, which included ten field studies in two Eastern Europe countries, 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 using the conventional teaching method, concluding that the pupils did not value positively the use of PBL for learning basic concepts and developing competency. The authors affirmed that the students perceived that the PBL method was not appropriate for learning abstract concepts and that for them, it was better to perform individual written repetition exercises (Garnjost & Brown, 2018).

Similarly, Dods (1997) and Carrera, Tellez, and D'Ottavio (2003) analysed the application of PBL in Argentina in the areas of medicine and economics and its implications in improving competency in developing countries. For the authors, although it is tempting to incorporate educational innovations from developed countries, in emerging nations, the particular situation of each medical school and economics faculty must be taken into account when considering curricular changes for improving *knowledge construction*. This is because the problem seems to be the local circumstances that affect students' perception of PBL's effectiveness (Carrera et al., 2003; Dods, 1997).

Studies that have investigated the development of the *critical thinking* competency using the PBL method produced mixed results. Various authors found that PBL encourages students' critical thinking more than traditional teaching methods do (Cook & Moyle, 2002; Frank & Barzilai, 2004; Kong, Qin, Zhou, Mou, & Gao, 2014; Morales-Mann & Kaitell, 2001).

However, Lyons (2008), in a study of outpatient diagnosis for patients in the emergency room involving 550 undergraduate nursing students, found that PBL methodology did not improve *critical thinking* compared to the conventional method. According to Lyons, PBL participants tended to embrace the opinion of a member with the higher ability, while the rest reaffirmed the diagnosis. With the conventional method, the students were exposed to less external stress in the elaboration and defence of a diagnosis (Lyons, 2008).

On the other hand, an experimental study conducted by Ehrenberg and Häggblom (2007) analysed the perception of the favourability of nursing students with PBL in four emerging Asia Pacific countries and an improvement in critical thinking skills was observed. According to the authors, the students felt that the cases were analysed from different angles (91% of the total respondents) and they felt encouraged to think critically (74%); thus, the PBL improved cross-curricular competency (Ehrenberg & Häggblom, 2007).

In terms of the *autonomy* competency, the association between the PBL methodology and the skill acquired in the learning process has been confirmed by the empirical results of Albanese and Mitchell (1993) and Savery's (2015) studies. According to the authors, the association is positive if PBL is implemented in a pedagogical model where teachers serve as guides on the concepts to be learned. Their findings suggest that the students who learned using the PBL method studied for their examinations differently than those who received the conventional teaching method since they had greater freedom to adjust the planning and execution of their projects to their interests and abilities (Albanese & Mitchell, 1993; Savery, 2015).

However, Somekh and Zeichner (2009) consider the development of the *autonomy* competency using the PBL as conditioned by the students' previous experience on how to plan and execute a research project. In the local contexts of developing countries where the teaching model is based on the "transference" of knowledge, improvement in the *autonomy* competency through PBL has mixed effects. This conclusion was reached after practising PBL in three rural areas and two urban districts in middle-income countries. According to the authors, students who were taught using conventional pedagogical methods were less likely to reflect on their educational process (Somekh & Zeichner, 2009).

Additionally, Kokotsaki, Menzies, and Wiggins (2016) used the PBL method with ten undergraduate student groups from five branches of knowledge at the beginning and at the end of their careers. The authors concluded that although some careers were more likely to use the method in areas such as medicine, nursing, and economic

sciences, this does not mean that the pupils improved *autonomy* in their learning process. For the authors, the method must be accompanied by the democratisation of academic courses' curricular objectives, thus giving more decision power to students (Kokotsaki et al., 2016).

With regard to the last two competencies, previous studies indicate that the PBL method does improve *problem-solving* and *teamwork* skills within different local contexts, regardless of undergraduate course objectives (Lehman, Christensen, Du, & Thrane, 2008; Nargundkar, Samaddar, & Mukhopadhyay, 2014; Sart, 2014; Stanley & Marsden, 2012).

PBL has documented changes in students' capability to explain problems and plan projects that better suit their learning style or inclination for collaboration. Hartling, Spooner, Tjosvold, and Oswald (2010) reviewed nine studies that measured the results of the NBME 1 standardised test, comparing them with traditional curricula, and found that the students rated PBL as a more effective method to resolve clinical cases than the conventional method. Other authors have supported the conclusions of Hartling et al., stating that the development of projects focused on a problem-solving strategy in the field of economics and business is more effective than traditional teaching methods (Dochy, Segers, Van den Bossche, & Gijbels, 2003).

The authors agree that the PBL method improves *problem-solving* competency and promotes workgroup members in conceiving various solutions to a case study applicable to real life. Although individual skills can induce a solution (even if it is incorrect), the method encourages meaningful deliberation among students.

De la Puente Pacheco et al. (2019) emphasises that the improvement of *problem-solving* competency through PBL is notably related to how students perceive their classmates as 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 authors affirm the need to prepare undergraduate students to adopt critiques of their proposals from their classmates in a PBL application (de la Puente Pacheco et al., 2019).

The effectiveness of PBL on the improvement of *teamwork* competency has been investigated in great depth beyond the mixed studies that have analysed students' responses in focus groups. For example, Albanese and Mitchell (1993) analysed the results of a pre-test and post-test of 201 students of an undergraduate International Economics course in two developing Southeast Asian countries. In the study, the participants had to create and present an export project of manufactured goods from a Southeast Asian country. They found that individuals who studied using the PBL method perceived a positive relationship between the technique and the development of competency. The students affirmed that the PBL method "made it easier to focus their efforts on aspects of the project in which they were better such as the macroeconomic analysis of a country, the classification of export costs and tariff subheadings" (Albanese & Mitchell, 1993).

This supports the view of de la Puente, Selene, Acuña, and Delgado (2018), who emphasise that the PBL method helps students to develop skills that involve teamwork better, compared to the traditional teaching method within local contexts. However, the authors state that this does not necessarily imply that students will achieve better academic grades than those who studied using conventional teaching methods (de la Puente et al., 2018).

This coincides with what was mentioned by Barrow's and Bamford's studies, where PBL provided a better learning experience for students in different geographical contexts but did not guarantee better academic results if, for example, it is evaluated by conventional methods such as multiple-choice tests or short trials (Bamford, Karjalainen, & Jenavs, 2012; Barrow, 2006).

The literature reviewed shows inconsistent findings related to the effectiveness of the PBL method in developing cross-curricular competencies within different local contexts in developing countries. One reason is an educational model that gives high importance to increasing the coverage of university students, and the number of students per classroom, which limits the time of quality attention that teachers can offer in the planning, application, and evaluation of student projects in a PBL context.

Another reason is that undergraduate students do not always begin a course with prior knowledge on how to plan and structure a project. Teachers must identify in advance that their students have this previous experience; therefore, the PBL method can be as effective as possible in the improvement of cross-curricular competencies.

However, this previous knowledge must be followed by a prior students' reflection that teamwork requires deliberation on how a project should be developed and 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 et al., 2019).

The literature review also provides evidence of why *teamwork* and *problem-solving* competencies seem to improve with the PBL method in local contexts compared to the other competencies discussed earlier.

On the one hand, the implementation of the PBL method promotes *heuristic tasks* or learning through trial-error and finding solutions through group work (Juliani, 2014). Students address problems with their previous knowledge in groups, leading to a number of issues that they will have to solve. By allowing pupils to find answers for themselves and to generate new solutions, the *teamwork* and *problem-solving* competencies seem to improve. On the other hand, according to the literature review, the PBL method stimulates collaboration and inquiry in the classroom, bringing out new ideas during the projects that connect various academic concepts and areas of knowledge.

This study helps to clarify whether *teamwork* and *problem-solving* competencies develop regardless of geographical context. An analysis of the PBL application in a University at the Colombian Caribbean coast was conducted to find out whether both these skills improve and the reasons thereof. Additionally, the study helps to explain more clearly why different studies tend to show different findings and (if it is confirmed) the inconsistent results related to the effectiveness of the PBL method on developing the *knowledge construction*, *critical thinking*, and *autonomy* competencies.

This study also attempted to address the gaps found in the literature reviewed regarding the association between the students' perception of the effectiveness of the PBL method and academic performance in undergraduate courses. This was done by combining the subjective impression of the students on PBL and traditional teaching methodology with their academic grades during the undergraduate Economic Development course.

This answers the research question, which sought to find out whether students perceived the application of the PBL method as superior to the traditional teaching methodology and whether this was associated with academic performance.

The main research questions of the study were: (1) Is Project-Based Learning suitable for the Colombian Caribbean coast? (2) What are the cross-curricular competencies developed in the study?

The following working hypotheses were verified in the study:

H₁: The students do not see any difference in cross-curricular competencies when the classes are taught at the start of the course using the PBL method or the traditional teaching method.

H₂: At the end of the course, students perceive differences in cross-curricular skills when the classes are developed applying the PBL method or the traditional method of teaching.

H₃: The students to whom the PBL method has been applied have mixed evaluation positions on the effectiveness of this method in meeting all of the Economic Development course objectives.

H₄: Not all cross-curricular competencies promoted by PBL receive a positive student evaluation regarding the fulfilment of the course's purposes.

Methodology

Participants

Participants in this research were students from the undergraduate programme of International Relations at the Universidad Del Norte located in the Colombian Caribbean coast. Data on students' perceptions and academic performance were obtained from thirteen undergraduate courses in Economic Development of approximately 34 students each, over two years.

Four hundred and eighty one students received the courses, of which 229 used the PBL methodology and the other 252 used the traditional teaching method. All the students had previously taken academic courses using the conventional teaching methodology and 187 had used the PBL method. In terms of gender representation, 324 students were women between the ages of 18 and 22. The women were from the sixth to eighth semesters of the undergraduate programme, with an academic average of 4.4 on a scale where the lowest grade was zero and the highest grade was five. The remaining 157 students were men between the ages of 18 and 22, with an academic average of 4.2 in either the seventh or the eighth semester.

Seven full-time professors from the Economics faculty also participated in the study. They all had a bachelor's degree in economics and a graduate degree in development economics or international economics. The professors claimed to have certified experience in university pedagogy and four had experience in using the PBL method with undergraduate students. It was observed that the three professors used the PBL method with the 229 students mentioned above. The content of the undergraduate courses, regardless of the teaching

method, was as follows: (1) introduction to economic development theories; (2) cost-benefit analysis of economic decisions in developing countries; (3) qualitative and quantitative methods; (4) internal and external factors on economic development; and (5) poverty-inequality analysis within local contexts (de la Puente Pacheco, 2017).

Each of the six professors was assigned two undergraduate courses in Economic Development, and the seventh educator was assigned only one course; thus, there were thirteen courses. The first six implemented the PBL method in one course and the traditional methodology in the other, while the seventh only applied the conventional method in their assigned course.

Materials

Before the students started the Economic Development courses, they completed a Likert pre-test questionnaire to indicate their initial expectations regarding the development of the different competencies of *knowledge construction*, *problem solving*, *critical thinking*, *teamwork*, and *autonomy*. A diagnostic test was administered, which examined prior knowledge in economic development principles of both the PBL and the non-PBL groups. This was done to verify if both groups had the same knowledge level prior to the experiment.

The scores ranged from 1 (lowest level) to 5 (highest level). The 481 pupils voluntarily completed the tests and the questionnaire. All hard copies were completed during class time. The students were reminded that the completion of the surveys would not affect their academic grades and that the results would be anonymous. The diagnostic test was created by the Centre for Teaching Excellence (CEDU) at the Universidad del Norte (de la Puente 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 had been any variations in their perceptions.

Finally, the students completed a questionnaire that showed which of the two methods used (PBL or traditional teaching) was more useful in achieving the objectives of the course.

The objectives of the Economic Development course were converted into questions from the general course information available on the University website to find out the students' perceptions without including a categorisation of the cross-curricular competencies studied, thus avoiding students' bias in their results for or against certain competencies (for detailed course information, see www.shorturl.at/lqxEV). Below is an example:

Objective 1:

Analyse the most relevant Economic Development theories of the twentieth and twenty-first centuries from a historical-conceptual perspective.

Question:

Do you understand the theories of Economic Development?

This procedure was proposed by CEDU (Universidad del Norte) and implemented by de la Puente et al. (2018). 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. The professors based their class lessons on the Handbook of Development Economics, Volume 5, by Rodrick and Rosenzweig (2010).

Procedure

The different approaches in the implementation of the PBL and the traditional methods were based on case reports from the literature review. On the one hand, for students who learned using the conventional teaching methodology, each subject of the course was explained in a standardised way and without innovative approaches that generate motivation in the students (according to the students who shared their impressions in the final feedback session). On the other hand, the students who learned using the PBL method were given five issues stated below, leading to a small research project using freedom of analysis based on their group interests.

As mentioned above, each of the six professors was assigned two undergraduate courses in Economic Development, and the seventh educator was assigned only one course, adding up to thirteen courses. The first six implemented the PBL method in one course and the traditional methodology in the other, while the seventh educator only used the traditional method. Each course had approximately 34 students, and 45 work-groups resulted from the courses taught using the PBL method (almost all with five members, except one that had four students). The students of the PBL and the non-PBL groups were randomly assigned to the Economic Development courses after verifying that they met the academic requirements to take the course.

First, the students' demographic data such as gender, age, undergraduate studies, and average grade were collected before starting the Economic Development courses to assess whether both groups possessed similar characteristics. A diagnostic test was applied, which examined prior knowledge of both the PBL and the non-PBL methods of economic development principles, as mentioned above.

Professors who applied both teaching methods introduced these along with the course content, the academic competencies to be developed, the forms and number of evaluations, and the essential readings. The seventh professor only introduced the traditional method. Both groups (PBL and non-PBL) developed the topics of the course through weekly work planning. The thirteen courses had three hours of weekly classroom lessons each, designed by the professors in charge. Professors who applied the traditional method developed the content of their course conventionally, i.e. through lectures, review of readings on case studies and weekly quizzes. This group was examined using three written multiple-choice tests with the remark that there was limited class participation and few deliberations in the case studies (approximately five participations for each case reviewed).

The students who learned using 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 group work sessions each week, where they developed parts of the project, which was useful for professors who could take notes on the academic performance and the development of cross-curricular competencies of the students. [Appendices 1](#) and [2](#) provide further clarification on what students and professors did in each of the classes.

The projects proposed improvements in domestic factors for the development of the Colombian Caribbean coast. The students had the opportunity to select their groups and their project topics. 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 from the professors' database. The projects were based on the following issues: (1) improvement of health systems in the Colombian Caribbean cities; (2) rural migration; (3) effects of the national armed conflict in the Colombian Caribbean coast; (4) corruption in local political parties; and (5) impact of drug trafficking on the rural Colombian Caribbean population (Asiedu & Nandwa, 2007; Barrientos & Niño-Zarazúa, 2011; Benhabib & Spiegel, 1994; de la Puente Pacheco et al., 2019).

The courses lasted 18 weeks for both groups. The tutoring sessions given by the professors were reduced to allow more autonomy in the elaboration of the project, following Ertmer and Simons' (2005) argument that students must have enough autonomy to solve problems in groups.

The first term of the PBL group evaluation was done after seven weeks of class, in which two topics of the course content were covered: *Introduction to economic development theories* and *Cost-benefit analysis of economic decisions in developing countries*. In the first two weeks of classes, the students selected their respective project topics and started group work to define the subtopic.

In the second week, the professors tutored their first group to clear doubts about an effective way to develop a project, taking into account the content of the course. In the early group tutoring, the professors stated that they emphasised the difference between a monography and a project since several students confused the concepts. Various groups had not applied research methodology in the correct way, which made it challenging to write the project, while the others had difficulties with data analysis due to a lack of prior training in the use of statistical tools. To continue the implementation of the PBL method, the PBL professors spent two hours after classes with their students, teaching them the correct application of research methodology. Once the difficulties were corrected, the professors noted that the students had more confidence in proposing potential solutions to the issues selected, thus increasing the class participation towards *teamwork and problem solving*.

During the following three weeks, the students continued working in groups on the definition of the main objectives, hypothesis, and the problem statement.

The professors stated that the interaction between the group members made it easier to solve problems in various parts of their projects. The workgroups submitted their first drafts in the seventh week. From the eighth to the thirteenth week, the groups had their second tutoring with their professors in charge, corrected previously worked aspects of their projects, and developed the methodology and procedure of their topics in the light of local contexts. In the second group tutoring, the participants identified the economic viability of the projects using statistical tools and learned how to implement a research method correctly. During that time, they covered the content of *qualitative and quantitative methods* and *internal and external factors in economic development*. The second drafts were submitted by the thirteenth week, including the research methodology. From week 14 to week 18, the workgroups wrote the results of their projects, the conclusions, and the references, covering the topic of *poverty-inequality analysis within local contexts*.

They also submitted the final version of their documents and gave an oral presentation. The non-PBL group developed the content of the course in the tenth lecture, which included the review of readings on case reports. The students also did individual work in

class to strengthen the academic concepts taught. During classwork, the professors found that most of the PBL group participants did not feel comfortable listening to their peers criticise their work because the criticism tended to concentrate only on the aspects to be improved, while the positive elements were often not highlighted as they wished, which could explain the group dynamics. This could be understood as a lack of initial empathy within the groups.

Several members of the workgroups were not previously known and did not feel comfortable expressing their opinions on the work of their colleagues, worrying that the criticism would be received negatively, which actually happened in several work sessions. Various professors who applied the PBL method stated that their students felt the need to get to know their classmates beforehand as it took longer for them to open up to each other. Despite this, the members of the workgroups fulfilled their specific tasks, which suggests that they might have felt the obligation to remain in the groups without wanting to express empathy in front of their little-known companions. At the end of the course, the PBL groups shared their impressions on the development of cross-curricular competencies through a focus group protocol (de la Puente et al., 2018).

The students' opinions showed that the classes conducted using PBL allowed them to develop the *teamwork* competency because it allowed several members to interact with each other and approach the selected issue from different perspectives, even if some members of the observed groups did not show enough empathy towards others.

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 the post-test. According to them, changing the teaching method, where they become active agents in the learning process, could be misunderstood as a lack of help from the teacher.

Additionally, the participants highlighted that the application of a different teaching method produced a lack of empathy among them, as they were more accustomed to 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 they could appreciate a new teaching approach without feeling lost in the learning process.

Results

The following results include comparisons of test scores and ratings. The normality of the scores was identified using the Kolmogorov-Smirnov test, verifying that they are not normally distributed ($p < 0.05$). For this reason, comparisons were made using the chi-square test for the categorical variables and the Wilcoxon Ranges Sum test for the numerical variables (discrete and continuous).

As an initial condition of the study, it was required to verify that the groups were identical in their characteristics of age, gender, and academic performance. Table 1 shows the average age and its deviation, as well as the academic performance and its dispersion. The Wilcoxon Sum of Ranges test showed that the groups (traditional and PBL) had similar ages and gender proportions ($p = 0.464$ and 0.685 , respectively), although they differed significantly in their academic performance ($p < 0.05$), which was higher in the PBL group.

Four of the five cross-curricular competencies under study were similar at the beginning of the course ($p > 0.05$), with the exception of the *autonomy competency*, which

Table 1. Sociodemographic and academic variables of students by teaching method (applied tests: sum of Wilcoxon ranks and chi-square test).

Variables	PBL Method N = 229	Traditional Method N = 252	P Value
Age	20.1 (0.77)	20.2 (0.92)	27810 (0.4654)
Academic performance	4.36 (0.39)	4.16 (0.52)	42808 (<0.05)
Gender	159 (69.4%) 70 (30.6%)	165 (65.5%) 87 (34.5%)	0.6846 (0.408)

turned out to be mostly scored in the traditional group ($p < 0.05$). However, as will be seen later, the intervention in PBL achieved an increase in the respective groups, which led to the homologising of the scores in both groups. Table 2 summarises the similarities and differences between the two groups.

The Wilcoxon Sum of Ranks, which is summarised in Table 3 shows that in the PBL group the scores given by the students in *knowledge construction*, *problem solving* and *teamwork* ($p < 0.05$) were higher. Both groups increased their *Critical Thinking* scores evenly without observing statistically significant differences at the end of the course ($p > 0.05$).

Autonomy competency scores increased in the PBL group, enough to match the scores in the traditional teaching group ($p > 0.05$) as shown in Figure 1.

The changes in academic performance were analysed, comparing scores of both groups in each of the four examinations. Again, a non-parametric test was applied to compare scores, which were not distributed normally. As shown in Figure 2, the scores of the first examination were not statistically different ($p > 0.05$), as were the scores in the second, third, and last examinations, in which the PBL group exceeded the Traditional group ($p < 0.05$).

With regard to their perception of academic compliance with the course objectives, the students were asked to rate this compliance on a ten-point scale. Table 4 shows significant differences between the two groups, in favour of the PBL group ($p > 0.05$).

This study also set out to find out if the cross-curricular competencies were related to the achievement of the course objectives. For this, Spearman's correlation coefficient, usually used in cases where data sets do not follow a normal distribution, was used. Indeed, Table 5 shows that correlations exist between some competencies and some course objectives.

Table 2. Comparison of teaching methods and cross-curricular competencies in the pre-test (Wilcoxon rank-sum test).

Pre-test variables	Methods	Average (DS)	P Value
Knowledge construction	PBL	4.60 (2.03)	27173
	Traditional	4.74 (1.78)	(0.2589)
Problem solving	PBL	4.24 (1.91)	26472
	Traditional	4.54 (1.96)	(0.1122)
Critical thinking	PBL	4.31 (1.95)	30962
	Traditional	4.08 (1.88)	(0.1576)
Teamwork	PBL	4.34 (1.99)	29368
	Traditional	4.25 (1.91)	(0.7306)
Autonomy	PBL	4.02 (1.95)	25498
			(<0.05)

Table 3. Comparison of teaching methods and cross-curricular competencies in the post-test (Wilcoxon rank-sum test).

Post-test Variables	Teaching Methods	Average (DS)	P Value
Knowledge construction	PBL	5.76 (1.75)	31866
	Traditional	5.33 (2.10)	(<0.05)
Problem solving	PBL	7.93 (1.47)	42796
	Traditional	6.42 (1.65)	(<0.005)
Critical thinking	PBL	6.22 (1.94)	31662
	Traditional	5.96 (1.83)	(0.0601)
Teamwork	PBL	7.56 (1.71)	40047
	Traditional	6.15 (2.11)	(<0.005)
Autonomy	PBL	5.41 (2.03)	31176
	Traditional	5.10 (2.28)	(0.1216)

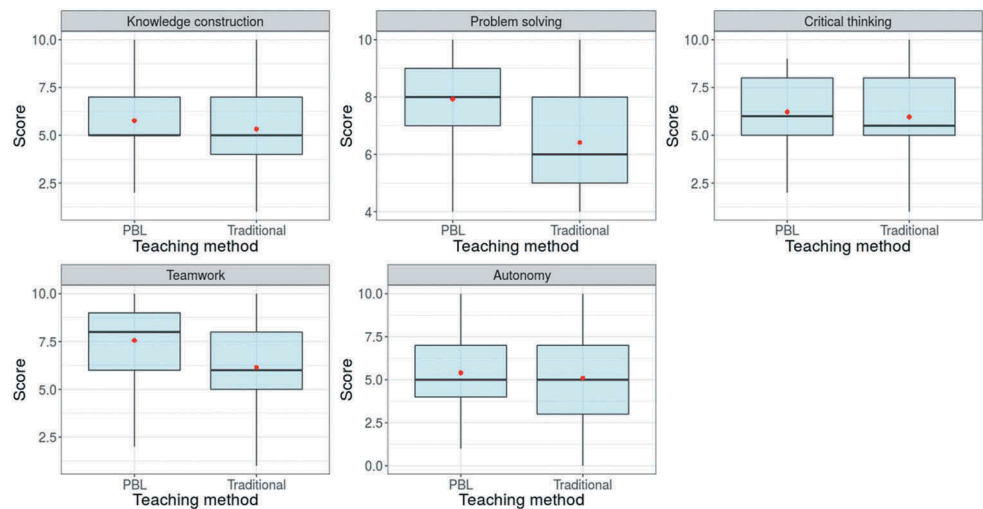


Figure 1. Comparison of teaching methods according to cross-curricular competencies (post-test).

Knowledge construction competency correlated negatively with Objective 1 (-0.196 ; $p < 0.05$) and Objective 3 (-0.194 ; $p < 0.05$), while *teamwork* positively correlated with the achievement of the first objective (0.160 ; $p < 0.05$) and inversely with the third objective (-0.132 ; $p < 0.05$). On the other hand, an inverse correlation was found between *problem-solving* competency and the achievement of the second objective (-0.013 ; $p < 0.05$), as shown in [Table 5](#).

Discussion

The pre-test and post-test showed a significant difference in students' perceptions of PBL's effectiveness in developing the cross-curricular competencies of *teamwork* and *problem-solving*. The results of the application of the PBL methodology in the Colombian Caribbean coast matched the findings in the literature review that PBL improves these two competencies within different geographical contexts compared to the conventional teaching method. This is because the PBL method promotes group

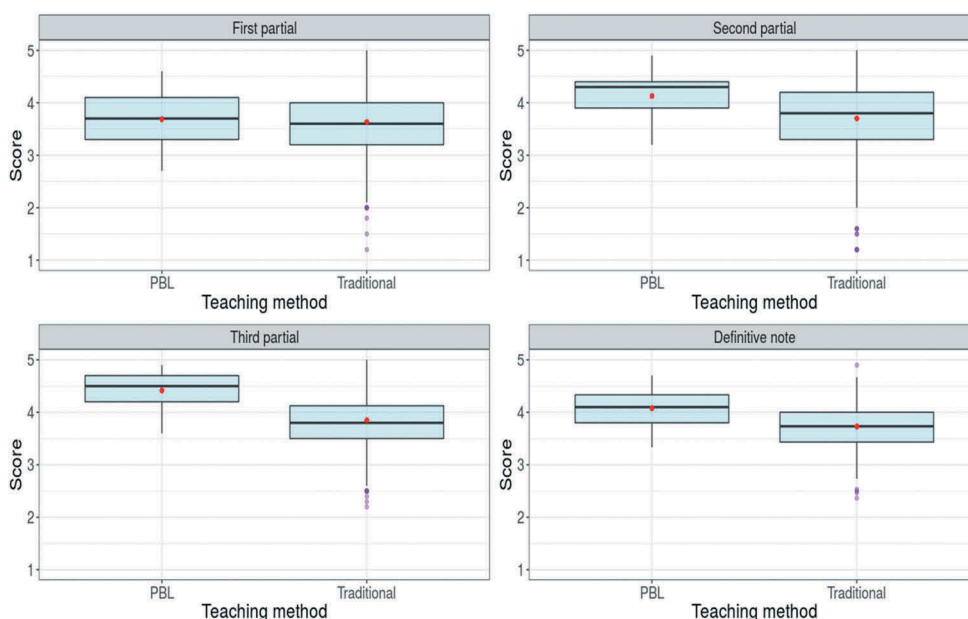


Figure 2. Scores comparison by teaching method.

Table 4. Averages of the questions by teaching method (Wilcoxon rank addition tests).

Question	PBL Method Average (DS)	Traditional Method Average (DS)	P Value
Do you understand the theories of Economic Development?	7.59 (1.46)	5.98 (1.79)	43206 (<0.005)
Can you analyse the benefits and disadvantages of a country's potential economic decisions through cost-benefit analysis?	5.28 (1.62)	6.17 (2.02)	21135 (<0.005)
Can you demonstrate your knowledge of the fundamental and technical concepts of development economics through qualitative and quantitative methods?	6.89 (1.81)	6.04 (2.08)	35656 (<0.005)
Do you understand the process of economic development from multiple theoretical approaches?	7.05 (1.74)	6.77 (1.92)	31634 (0.063)
Can you apply the different measures of poverty and inequality within a local context?	8.26 (1.53)	4.97 (1.90)	52548 (<0.005)

reflection for the elaboration of a project regardless of the educational system in which it is implemented.

The group project had several components to address *problem-solving* and *teamwork* competency in each section, unlike the other three skills.

During the PBL implementation, the participants had difficulties applying the research method and analysing data. The International Relations undergraduate students did not have prior knowledge of data analysis using statistical tools, making it necessary to spend extra hours after class to teach the topic and continue developing the projects. This shows the need to improve future diagnostic tests regarding the use of research tools necessary to carry out a local oriented project.

Table 5. Spearman's correlation coefficient and the P-value between cross-curricular competencies and the accomplishment of course objectives in the PBL method.

Results		Post-test			
		Problem Solving	Critical Thinking	Knowledge Construction	Autonomy Teamwork
Do you understand the theories of Economic Development?	Correlation coefficient	-0.008	0.059	-0.196	-0.004
	Sig. (bilateral)	0.898	0.372	0.003	0.943
	N	229	229	229	229
Can you analyse the benefits and disadvantages of a country's potential economic decisions through cost-benefit analysis?	Correlation coefficient	-0.013	-0.033	-0.003	0.025
	Sig. (bilateral)	0.038	0.620	0.955	0.703
	N	229	229	229	229
Can you demonstrate your knowledge of the fundamental and technical concepts of development economics through qualitative and quantitative methods?	Correlation coefficient	-0.076	-0.03	-0.194	0.121
	Sig. (bilateral)	0.254	0.621	0.003	0.067
	N	229	229	229	229
Do you understand the process of economic development from multiple theoretical approaches?	Correlation coefficient	0.002	0.118	0.078	0.023
	Sig. (bilateral)	0.966	0.086	0.238	0.730
	N	229	229	229	229
Can you apply the different measures of poverty and inequality within a local context?	Correlation coefficient	0.001	0.003	-0.038	-0.060
	Sig. (bilateral)	0.987	0.963	0.568	0.365
	N	229	229	229	229

With regard to the appropriateness of the PBL method for the course objectives, the study found that the methodology was more suitable in achieving the course objective of *application of different measures of poverty and inequality within a local context* than the conventional method. However, the findings suggest that the traditional method encouraged the development of some competencies.

The development of the competencies mentioned above does not necessarily indicate empathy among the members of the workgroups. As the professors in charge pointed out, the students who received the PBL method did not share all their points of view in front of various colleagues, worrying that they would regard their comments as personal. On several occasions, the members of the groups with the most power of persuasion received the support of other students even when their arguments were wrong.

Many professors stated that they had to intervene to remind the students that their opinions were also valid and that other group members should not regard them as personal. This means that the application of the PBL method needs to consider the dynamics in the social relations within local contexts that help to know if there are conditions for the development of the *autonomy, critical thinking, and knowledge construction* competencies.

Additionally, the PBL method was not superior to the traditional method in the development of all the academic objectives of the undergraduate course. While the PBL methodology was preferred in the application of theoretical concepts to the projects, other goals that focused on individual analysis were perceived as inferior by the participants compared to the traditional 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 to achieve the educational goals of an undergraduate course. This is consistent with the findings in the literature review.

This was exposed 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 a lack of help from the professor. The students recommended the application of multiple teaching approaches in a single course so that they could appreciate a new teaching approach without feeling lost in the learning process.

The planning and implementation of the method by the professor, the complexity of the academic content, and the objectives of the course are all variables that affect the development of cross-curricular competencies and positive student assessment. Most college students in the Colombian Caribbean are familiar with the traditional teaching method, which assigns to them a more passive role in the learning process, thus associating a positive *ex ante* evaluation with the application of this method.

Findings advocate integrating the PBL method throughout the academic course in order to generate positive evaluation from the students once they fulfil all the previous requirements to create and present a project. Students seem to evaluate PBL positively when it is implemented from the beginning of the academic course, since they need time to adapt to the method and familiarise themselves with the new dynamics.

The limitation of this study was that there was insufficient data on the antecedents of some students' misperception regarding the reception of their opinions in their work-groups. Although there is preliminary information in the literature review and the presented results, it is important to develop future studies on social relations and the effectiveness of the PBL method, especially in local contexts.

Conclusions

The findings of this study reinforce the idea that the implementation of PBL in the Colombian Caribbean coast must not only be evaluated based on the development of cross-curricular competencies but also based on the students' perceptions once they become active agents in the learning process. It also strengthens the relevance of associating the students' perception of the effectiveness of the PBL method with academic performance, since this methodology is not always efficient in developing undergraduate course objectives or improving all cross-curricular competencies.

The study of the effectiveness of the PBL method provides a better understanding of the teaching process in different geographical contexts and highlights the local singularities that influence the transformation of students as active agents during their learning process.

Acknowledgments

This research was funded by the Centre for Teaching Excellence [CEDU]. We thank our participants for their generous contribution to this work.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the Centre for Teaching Excellence (CEDU) [2017-1-3A].

ORCID

Mario Alberto de la Puente Pacheco  <http://orcid.org/0000-0002-0783-1267>

Dick Guerra Florez  <http://orcid.org/0000-0001-8329-7759>

Carlos Mario de Oro Aguado  <http://orcid.org/0000-0002-4990-6554>

Humberto Llinas Solano  <http://orcid.org/0000-0002-2976-5109>

References

- Albanese, M., & Mitchell, S. (1993). Problem-based learning: A review of literature on its outcomes and implementation issues. *Academic Medicine*, 68(1), 52–81. Retrieved from <https://bit.ly/2vqAqNG>
- Asiedu, E., & Nandwa, B. (2007). On the impact of foreign aid in education on growth: How relevant is the heterogeneity of aid flows and the heterogeneity of aid recipients? *Review of World Economics*, 143(4), 631–649.

- Bamford, D., Karjalainen, K., & Jenavs, E. (2012). An evaluation of problem-based assessment in teaching operations management. *International Journal of Operations & Production Management*, 32(12), 1493–1514.
- Barrientos, A., & Niño-Zarazúa, M. (2011). Financing social protection for children in crisis contexts. *Development Policy Review*, 29(5), 603–620.
- Barrow, L. H. (2006). A brief history of inquiry: From Dewey to standards. *Journal of Science Teacher Education*, 17(3), 265–278.
- Baş, G., & Beyhab, Ö. (2017). Effects of multiple intelligences supported Project-Based Learning on students' achievement levels and attitudes towards English lesson. *International Electronic Journal of Elementary Education*, 2(3), 365–386. Retrieved from <https://bit.ly/2KznEyG>
- Benhabib, J., & Spiegel, M. M. (1994). The role of human capital in economic development evidence from aggregate cross-country data. *Journal of Monetary Economics*, 34(2), 143–173.
- Berkson, L. (1993). Problem-based learning: Have the expectations been met? *Academic Medicine*, 68(10), 79–88. Retrieved from <https://bit.ly/2vIY0Cf>
- Blumenfeld, P. C., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., & Palincsar, A. (1991). Motivating Project-Based Learning: Sustaining the doing, supporting the learning. *Educational Psychologist*, 26(3–4), 369–398.
- Carrera, L. I., Tellez, T. E., & D'Ottavio, A. E. (2003). Implementing a problem-based learning curriculum in an Argentinean medical school: Implications for developing countries. *Academic Medicine*, 78(8), 798–801.
- Colliver, J. A. (2000). Effectiveness of problem-based learning curricular: Research and theory. *Academic Medicine*, 75(3), 259–266. Retrieved from <https://bit.ly/2AMBLBb>
- Cook, M., & Moyle, K. (2002). Students' evaluation of problem-based learning. *Nurse Education Today*, 22, 330–339.
- de la Puente, M., Selene, H., Acuña, L., & Delgado, M. (2018). The effectiveness of Project-Based Learning methodology in an external commerce course: A preliminary analysis for the Colombian Caribbean region. *Journal of Economics and Economic Education Research*, 19(2), 1–15. Retrieved from <https://bit.ly/2KxUlwe>
- de la Puente Pacheco, M. A. (2017). Turismo médico comparado en Colombia y Singapur: Estudio sectorial y perspectivas de desarrollo [Comparative medical tourism in Colombia and Singapore: Sectoral study and development perspectives]. *Revista de derecho: División de Ciencias Jurídicas de la Universidad del Norte*, 47, 290–309.
- de la Puente Pacheco, M. A., Guerra, D., & de Oro Aguado, C. M. (2019). Undergraduate students' perceptions of Project-Based Learning (PBL) effectiveness: A case report in the Colombian Caribbean. *Cogent Education*, 6(1), 1–17.
- Dochy, F., Segers, M., Van den Bossche, P., & Gijbels, D. (2003). Effects of problem-based learning: A meta-analysis. *Learning and Instruction*, 13(5), 533–568.
- Dods, R. F. (1997). An action research study of the effectiveness of problem-based learning in promoting the acquisition and retention of knowledge. *Journal for the Education of the Gifted*, 20(4), 423–437.
- Ehrenberg, A. C., & Häggblom, M. (2007). Problem-based learning in clinical nursing education: Integrating theory and practice. *Nurse Education in Practice*, 7(2), 67–74.
- Ertmer, P. A., & Simons, K. D. (2005). Scaffolding teachers' efforts to implement problem-based learning. *International Journal of Learning*, 12(4), 89–110. Retrieved from <https://bit.ly/2NM59sd>
- Frank, M., & Barzilay, A. (2004). Integrating alternative assessment in a Project-Based Learning course for pre-service science and technology teachers. *Assessment & Evaluation in Higher Education*, 29(1), 41–61.
- Garnjost, P., & Brown, S. M. (2018). Undergraduate business students' perceptions of learning outcomes in problem based and faculty centered courses. *The International Journal of Management Education*, 16(1), 121–130.
- Hartling, L., Spooner, C., Tjosvold, L., & Oswald, A. (2010). Problem-based learning in pre-clinical medical education: 22 years of outcome research. *Medical Teacher*, 32(1), 28–35.
- Helle, L., Tynjälä, P., & Olkinuora, E. (2006). Project-Based Learning in post-secondary education—Theory, practice and rubber sling shots. *Higher Education*, 51(2), 287–314.

- Juliani, A. J. (2014). *Inquiry and innovation in the classroom: Using 20% time, genius hour, and PBL to drive student success*. New York, NY: Routledge.
- Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-Based Learning: A review of the literature. *Improving Schools*, 19(3), 267–277.
- Kong, L. N., Qin, B., Zhou, Y. Q., Mou, S. Y., & Gao, H. M. (2014). The effectiveness of problem-based learning on development of nursing students' critical thinking: A systematic review and meta-analysis. *International Journal of Nursing Studies*, 51(3), 458–469.
- Lehman, M., Christensen, P., Du, X., & Thrane, M. (2008). Problem-oriented and Project-Based Learning (POPBL) as an innovative learning strategy for sustainable development in engineering education. *European Journal of Engineering Education*, 33(3), 283–295.
- Lyons, E. M. (2008). Examining the effects of problem-based learning and NCLEX-RN scores on the critical thinking skills of associate degree nursing students in a southeastern community college. *International Journal of Nursing Education Scholarship*, 5(1), 1–17.
- Morales-Mann, E., & Kaitell, C. A. (2001). Problem-based learning in a new Canadian curriculum. *Journal of Advanced Nursing*, 33(1), 13–19.
- Nargundkar, S., Samaddar, S., & Mukhopadhyay, S. (2014). A guided problem-based learning (PBL) Approach: Impact on critical thinking. *Decision Sciences Journal of Innovative Education*, 12(2), 91–108.
- Rodrick, D., & Rosenzweig, M. (2010). *Handbook of development economics*. New York, NY: Elsevier.
- Sart, G. (2014). The effects of the development metacognition on Project-Based Learning. *Procedia-Social and Behavioral Sciences*, 153, 135–136.
- Savery, J. R. (2015). Overview of problem-based learning: Definitions and distinctions. *Essential Readings in Problem-based Learning: Exploring and Extending the Legacy of Howard S. Barrows*, 9, 5–15.
- Somekh, B., & Zeichner, K. (2009). Action research for educational reform: Remodelling action research theories and practices in local contexts. *Educational Action Research*, 17(1), 5–21.
- Stanley, T., & Marsden, S. (2012). Problem-based Learning: Does accounting education need it? *Journal of Accounting Education*, 30, 267–289.
- Vernon, D. T. A., & Blake, R. L. (1993). Does problem-based learning work? A meta-analysis of evaluative research. *Academic Medicine*, 68(7), 550–563.

Appendices

Appendix 1. PBL group and professors' scheduled activities for the undergraduate Economic Development course.

Course duration in weeks	Course content	Course sub-contents	PBL group activities during the course	Exam design and grade percentages
1	Introduction to economic development theories	The concept of economic development; economic development versus economic growth	Presentation of the course and the PBL method	First draft of the group projects, which includes the problem question, general objectives, hypothesis, and the definition of the research method. 35% of the total grade.
2		History and theories of economic development / the most influential theories of economic development	Selection of a topic and sub-topic. First workgroup session	
3		New theoretical perspectives of economic development	Second workgroup session. First group tutoring by the professor in charge.	
4	Cost-benefit analysis of economic decisions in developing countries	An introduction to cost-benefit analysis	Defining the problem statement.	The second draft of the group projects, which includes the development of the research methodology and procedure. 35% of the total grade.
5		Market failures in developing countries	Defining research method, objectives and hypotheses.	
6		Application of cost-benefit analysis in developing countries	First draft sent by the groups.	
7	Qualitative and quantitative methods	Fragmentation of methods and qualitative and quantitative paradigms	Second group tutoring.	The second draft of the group projects, which includes the development of the research methodology and procedure. 35% of the total grade.
8		The degrees of freedom and case studies of poor and developing countries	Sixth workgroup session. Revision of the projects based on the professor's second group tutoring indication.	
9		Application of methods in official databases and NGOs	Seventh work group session. Develop the research methodology.	
10			Eighth workgroup session. Develop the research procedure.	
11	Internal and external factors in economic development	Institutional stability	Ninth workgroup session. Draft the research procedure.	Final written document with the corrections made throughout the workgroup sessions. 15% of the total grade.
12		Foreign trade and economic development	Second draft. The methodology of investigation and procedure	
13	Poverty-inequality analysis within local contexts	The effectiveness of development aid	Draft the project results and references for the project.	Oral presentations accompanied by technological instruments.
14		Differentiation of local contexts	Send the final version of the project.	
15		The phenomenon of inequality: The Colombian case	Oral presentations of the projects.	
16			Focus group.	
17				
18				

Appendix 2. Non-PBL and professors' scheduled activities for the undergraduate Economic Development course duration.

Course duration in weeks	Course content	Course sub-contents	Activities of the Non-PBL group	Exam design and grade percentages
1	Introduction to economic development theories	The concept of economic development; economic development versus economic growth	Introduction of the course.	First multiple choice written exam. 35% of the total grade.
2		History and theories of economic development / the most influential theories of economic development	First lecture, individual classwork and pop quiz.	
3		New theoretical perspectives of economic development	Second lecture, individual classwork and pop quiz.	
4		An introduction to cost-benefit analysis	Third lecture, individual classwork and pop quiz.	
5	Cost-benefit analysis of economic decisions in developing countries	Market failures in developing countries	First optional tutoring.	Second multiple choice written exam. 35% of the total grade.
6		Application of cost-benefit analysis in developing countries	Fourth lecture, individual classwork and pop quiz.	
7			First multiple choice written exam.	
8	Qualitative and quantitative methods	Fragmentation of methods and qualitative and quantitative paradigms	Fifth lecture, individual classwork.	
9		The degrees of freedom and case studies of poor and developing countries	Sixth lecture, individual classwork and pop quiz.	
10		Application of methods in official databases and NGOs	Seventh lecture, individual classwork and pop quiz.	
11			Second optional tutoring.	
12	Internal and external factors in economic development	Institutional stability	Eighth lecture, individual classwork and pop quiz.	
13		Foreign trade and economic development	Second multiple choice written exam.	
14		The effectiveness of development aid	Ninth lecture, individual classwork and pop quiz.	
15	Poverty-inequality analysis within local contexts		Tenth lecture, individual classwork and pop quiz.	Third multiple choice written exam. 30% of the total grade.
16		Differentiation of local contexts	Third multiple choice written exam.	
17		The phenomenon of inequality: The Colombian case	Feedback of the students about the method of the course.	
18				