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# Measuring the impact of inquiry-based learning on outcomes, student perception

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The aim of this study is to determine the impact of inquiry-based learning (IBL) on students' academic performance and to assess their satisfaction with the process. Linear and logistic regression analyses show that examination grades are positively related to attendance at classes and tutorials; moreover, there is a positive significant relationship between academic performance and IBL, which is considered useful for better understanding of the subject. While students' satisfaction is directly associated with class attendance and motivation and with the perceived usefulness of IBL, it is unaffected by attendance at tutorials. We conclude, therefore, that students become more involved in learning and acquire increased knowledge of the subject when an IBL-based method is followed.

**Keywords:** inquiry-based learning; financial statements analysis; university teaching; academic performance; satisfaction perceived

## Introduction

Inquiry-based learning (IBL) is a set of teaching methods characterised as providing the student with a learning strategy based on research-focused processes (Levy 2009; Aditomo et al. 2013), where the teacher's role is that of a facilitator. Thus, IBL methods are based on the constructivist educational theory. Working on a problem (performing a case study or solving a complex, real-world problem) allows students to acquire new knowledge and to further consolidate their current understanding and abilities (Sockalingam, Rotgans, and Schmidt 2011). In addition, through exploration and investigation, students assume a degree of responsibility for their own learning, and are forced to make decisions and reach judgements that might otherwise have been made by their teachers (Jonassen 2000). It has been shown that students are more likely to adopt durable and effective learning strategies when they engage in tasks that are true to life, using available skills and instruments (Duffy, Lowych, and Jonassen 1993). Therefore, IBL is highly recommended in university education (Inglis et al. 2004; Justice et al. 2007), playing a central role both for the individual and for the society (Levy and Petrulis 2012), and representing a promising means of support for student learning, facilitating the development of thought processes, problem-solving skills, communication skills and ethical reasoning (Kreber 2006).

In the past two decades, IBL has been addressed from different standpoints: developing a conceptual framework (Healey 2005; Spronken-Smith et al. 2007); comparing different experiences of IBL implementation in the classroom

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(Spronken-Smith and Walker 2010; Levy and Pretulis 2012); considering how it influences the context for curriculum change, and for designing and implementing inquiry within a new degree programme (Spronken-Smith et al. 2011); studying students' perceptions of these methods (Spronken-Smith et al. 2012; Visser-Wijnveen et al. 2012); or examining its impact on student learning outcomes (Justice, Rice, and Warry 2009). In these works, different terms have been used (IBL, enquiry-based learning, guided inquiry, problem-based learning, undergraduate research and research-based teaching), various definitions proposed and multiple forms of application considered (Aditomo et al. 2013).

To determine the effectiveness of teaching methods, various studies have evaluated the influence of specific strategies on student learning, either through their academic performance or by analysing their perception of the methods used (Prosser and Trigwell 1999; Ramsden 2003; Prosser and Barrie 2003; Barrie, Ginns, and Prosser 2005; Holmes 2014; Planas-Lladó et al. 2014). In most of these cases, systems of indicators have been created, based on the idea that student learning experiences influence the outcome (Ginns, Prosser, and Barrie 2007). However, in the case of IBL, and to the best of our knowledge, no examination has been made of the effectiveness of this methodology, jointly considering the grade obtained and the student satisfaction with the learning process. We believe this aspect is essential and it is the cornerstone of the present study. Thus, we pose the following questions: how do students perceive the use of IBL as a teaching and learning strategy? How does it affect their performance and satisfaction? Does a positive assessment of IBL by the student correspond with better academic results?

This paper seeks to obtain empirical evidence on the effectiveness of IBL in a university business administration course, thus contributing to the study of this methodology among different types of learners and disciplines, as recommended by Levy and Pretulis (2012).

## Methods

For this purpose, we developed a research methodology based on the use of longitudinal data in which, in contrast to most of the above-mentioned studies, the study focus was on a single year. Specifically, we analysed four consecutive academic years: during the first two years, the course was taught using conventional teaching methods, while in the last two years this approach was combined with IBL. In order to determine whether these methodologies produced a real improvement in the learning process, we compared the outcomes from each sub-period, and discussed the impact made by conventional methods and students' perceptions of IBL on academic performance and overall satisfaction.

### *Methodological framework and presentation of hypotheses*

The research questions were addressed using the methodological framework shown in Figure 1. Two sub-periods were considered: pre-IBL, corresponding to the years $(t-2, t-1)$ in which only the conventional teaching methods of classes and tutorials were applied, and during which the impact on the students was only measured by their academic performance; and the two following years $(t, t+1)$ in which this methodology was combined with IBL, and when the impact was measured in terms of both outcome and student satisfaction.

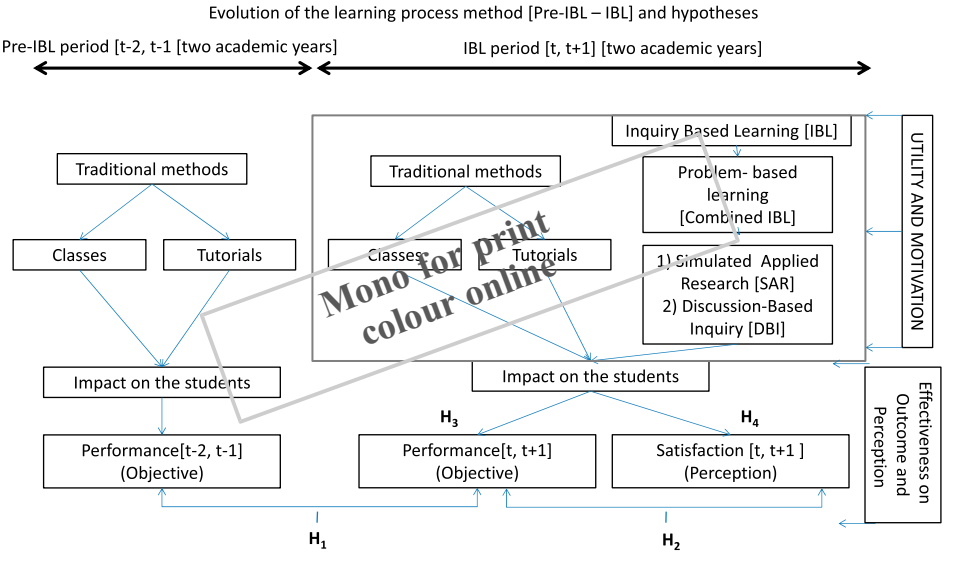


Figure 1. Methodological scheme of the study. Pre-Inquiry-Based Learning [Pre-IBL] and Inquiry-Based Learning period [IBL period].

Our initial premise was that if, as reported in the above-mentioned studies, IBL as a learning strategy produces higher returns for the student, there should be significant differences between the outcomes obtained before and after applying IBL (Drennan and Rohde 2002; Dowling, Godfrey, and Gyle 2003). Thus, the first hypothesis provides a measure over time and is stated as follows:

$H_1$: The students' academic performance is better in the IBL-period than during pre-IBL

However, as noted above, although academic results (outcomes) are certainly a good indicator of the effectiveness of the teaching methodology applied, it is also of great interest to determine the students' perceptions of the teaching methods implemented (Dowling, Godfrey, and Gyle 2003; Ginns and Ellis 2009). Specifically, three elements can be identified and evaluated in relation to students' views on these teaching methods: the perceived value (Miller et al. 1996), the motivation, under the assumption that students are more motivated by some learning strategies than others (Pintrich and De Groot 1990), and finally, students' satisfaction with the course subject (López-Pérez, Pérez-López, and Rodríguez-Ariza 2011). Previous studies of outcomes and students' perceptions have concluded that the two concepts are related (Drennan and Rohde 2002; Dowling, Godfrey, and Gyle 2003). Of the three elements mentioned above, satisfaction may be considered the most appropriate indicator to achieve an overall measure of the subject, from the students' standpoint (Lawless and Richardson 2002; Byrne and Flood 2003). Accordingly, we propose a second hypothesis to compare performance and satisfaction:

$H_2$: There exists a positive relationship between the students' final grades and their overall satisfaction with the subject in the IBL period.

Some studies have analysed the relationship between learning approaches, students' perceptions and academic achievement (Watkins 1998), concluding that there

is indeed a clear relationship between traditional methodologies in which the teacher is the referent, and the perception that students receive from them (Ramsden and Entwistle 1981). However, Justice et al. (2007) found that students who develop a deeper approach to learning are more receptive to active teaching methodologies that enhance their autonomy. In view of these findings, we set out to determine the effect of conventional methodologies and IBL on both academic performance and students' overall satisfaction. We first considered the students' assessment of conventional methods and then their assessment of IBL. Therefore, the following hypotheses were proposed:

$H_3$: Class attendance, the continued use of tutorials and students' perceptions of the usefulness and motivation of IBL are all directly associated with academic performance.

$H_4$: Class attendance, the continued use of tutorials and students' perceptions of the usefulness and motivation of IBL are all directly associated with their overall satisfaction.

### *Description of the study procedure*

Financial Statement Analysis is part of the third year of the degree in business administration, when students have learned to compile and present companies' financial information and are now learning to analyse it. The aim of this subject is to apply a specialised methodology to accounting information in order to achieve a good understanding of a company's economic and financial situation, and to issue judgements, on the basis of which well informed decisions may be taken.

Conventionally, the subject has been taught from both theoretical and practical standpoints, using standard teaching methods, by which the theory is taught in class, while the explanation and practical application of the subject matter is performed through a series of fictional exercises. In addition, students were able to attend tutorials to address specific issues, but in practice, very little use was made of this service.

Since 2009/2010, IBL has been implemented together with conventional method simultaneously, and consequently less time has been devoted to the explanation of theoretical content. Accordingly, it was necessary to select the content, providing a general, independent explanation, and not entering into a deeper discussion of the concepts in question or seeking to establish relations among them. Thus, the conventional methodology was aimed at providing the students with basic training in the subject matter, which they would then complement, through active participation in their own learning process, through IBL. Obviously, in these two approaches, there are differences as regards objectives and learning processes, and these have required differing forms of assessment (see Figure 2). Table 1 shows the differences between the subject goals when the conventional methodology was applied, and the intended learning outcomes (ILO) with the implementation of IBL. The methodology applied in IBL was structured into three phases:

#### *IBL phase 1*

After introducing the course content, the new methodology was explained. The students were told that the purpose of their research would be to conduct an

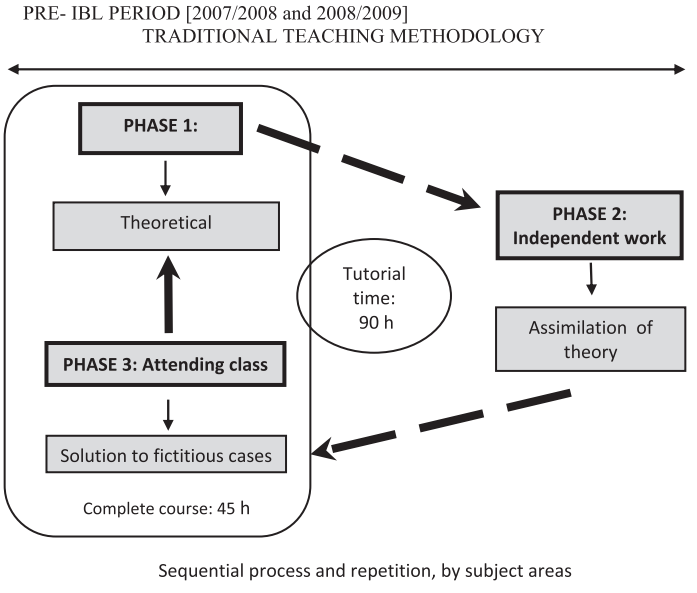


Figure 2. (a) Traditional Teaching & IBL Methodology [Part 1]. (b) Traditional Teaching & IBL Methodology [Part 2].

economic-financial diagnosis of a real company, which would require them to consider the underlying concepts of the subject area and acquire theoretical knowledge about the logical-deductive process that would allow them to interrelate the main aspects of the subject. This research would be carried out through a combination of two IBL methodologies. The first would consist of responding to a series of closed research questions posed by the teacher [in IBL literature, this is termed simulated applied research (Aditomo et al. 2013)], and in the second, the students would present and discuss, with their peers and with the teacher, the results obtained from the prior research process. This approach improves their learning process by generating knowledge in the ensuing discussion (in IBL literature, this is termed discussion-based inquiry).

Due to the large number of students enrolled in the course, we chose to establish work groups of no more than three students. Thus, in each academic year, approximately 100 work groups were created. In turn, these work groups were divided into four classes, resulting in a maximum of 25 different projects in each academic year. A list of large companies was drawn up and randomly distributed among the work groups. The students were then provided with sources of information from which they could derive the documents produced by professional analysts, both about the company itself and also referring to the environment in which it operates. Finally, a number of closed questions were posed, to guide the students in the first type of IBL methodology.

*IBL Phase 2*

In this stage, the students conducted their research. Most of this work took place outside class time, although 10 h of class were devoted to pooling research findings

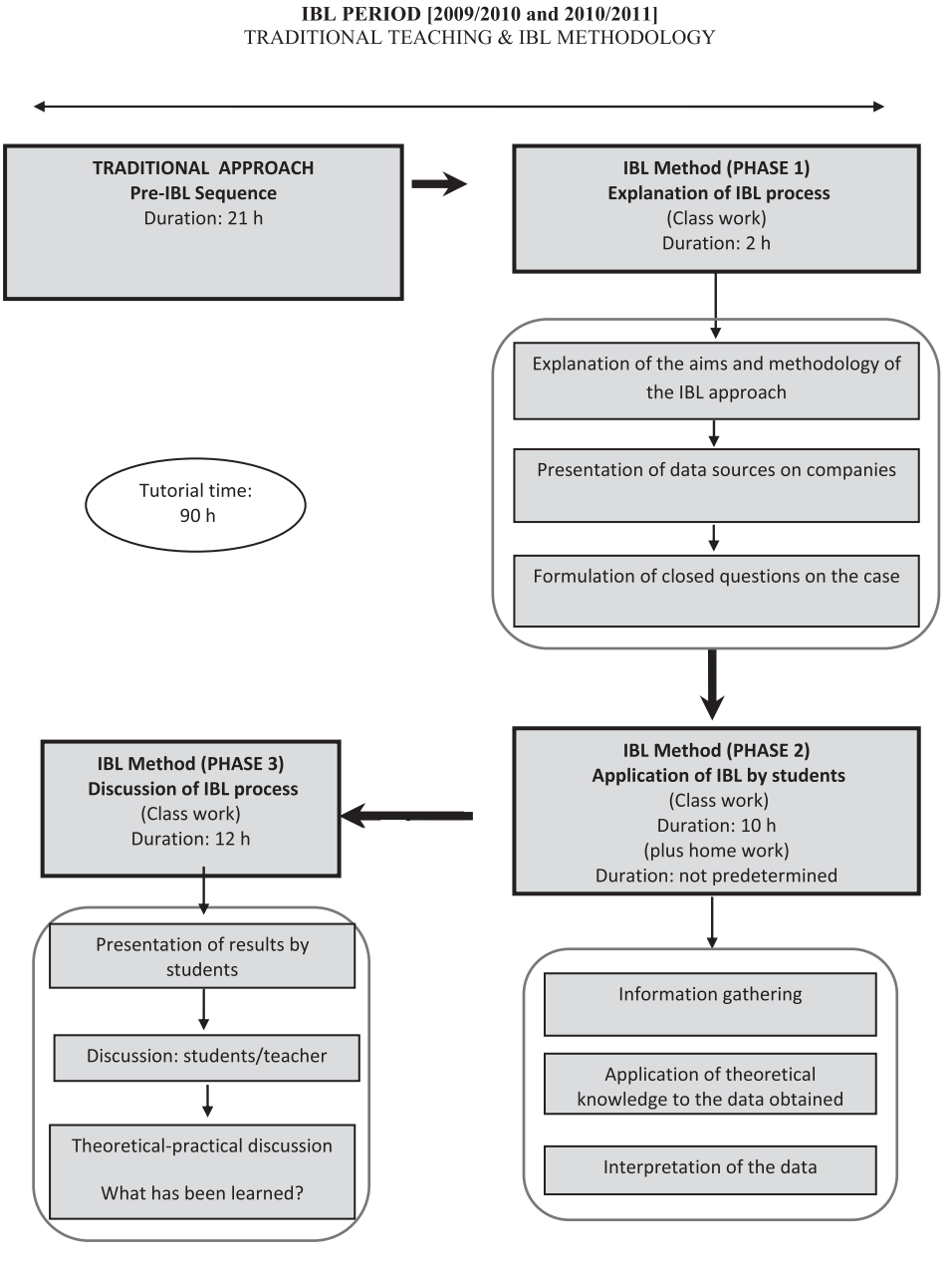


Figure 2. (*Continued*)

and to answering questions about the research process. Furthermore, and in the same way as in previous years, students could address comments and questions to the teacher in tutorial sessions. In this phase, attention was frequently required by students having difficulty in the development of their research. The work done in this phase produced answers to the research questions posed in line with the simulated applied research methodology, which were recorded in the document entitled 'SAR Working

Table 1. Differences between objectives (Pre-IBL period) and ILO (IBL period).

| Objectives of pre-IBL | Intended learning outcomes in IBL period |
|---|---|
| The student should acquire sufficient knowledge of the conceptual basics of accounting analysis by interpreting the information provided, fundamentally by the business accounting information system, which is the basis for appropriate decision-making | • To understand the usefulness of accounting information in business decision-making.<br>• To know the limitations of the data shown in financial statements, and the impact that they have on the application of alternative accounting criteria.<br>• To know what information is relevant for the analysis and where to find it. To be familiar with business accounting information issued by the company.<br>• To be able to reorganise the original accounting information and prepare financial statements tailored to the goals of the analysis.<br>• To understand commonly used analytical methods and techniques.<br>• To understand the variables that reflect the assets and the economic and financial situation of the company. To understand the relationships between them.<br>• To use the relevant indicators to evaluate the assets and the financial and economic situation. To be able to interpret the results obtained. |

Paper', which was handed in to the teacher and also made available to the other students enrolled in the course.

*IBL Phase 3*

Finally, the students presented the results for the case they had analysed, and identified the theoretical implications derived from their research. Afterwards, a debate of the results obtained was initiated, with the teacher and with the other work groups.

As well as the goals or ILO and the method of learning, we also changed the way in which the knowledge acquired by students was measured. Specifically, the examination questions varied depending on the goals or ILO proposed and on the learning method applied. By the end of the process, the students were expected to have achieved a meaningful learning of the subject area and to have acquired the tools required to solve problems and issues related to professional practice. Thus, we may speak of an alignment between ILO, teaching methods (IBL) and assessment, as recommended by Biggs and Tang (2007).

### *Definition of variables and sample selection*

Academic performance was measured by the students' grades, since the results achieved in the final examination are considered to provide a measure of the basic

knowledge that must be acquired in order to pass the course (Dowling, Godfrey, and Gyle 2003; López-Pérez, Pérez-López, and Rodríguez-Ariza 2011). Outcome data were available for the period from 2007/2008 to 2010/2011, during which the type of examination remained unchanged.

Students' perceptions of the development of this course were measured using a questionnaire that was completed by all those taking financial statement analysis as part of the bachelor's degree course in business administration at the University of Granada (Spain), in 2009/2010 and 2010/2011. This questionnaire measured overall student satisfaction and addressed the other variables considered, including those related to the students' perceptions of conventional methods (classes and tutorials) and IBL (simulated applied research and discussion-based inquiry), as well as those reflecting the students' motivation during the learning process. Finally, as control variables, we asked whether the student had enrolled more than once for this subject and the number of times he/she had taken the corresponding examination.

The variables considered and their descriptive statistics are shown in Tables 2 and 3. The questionnaire responses were originally scored on a Likert scale from 1 to 3, except the variable degree of satisfaction, which was measured on a scale from 1 to 10 for comparison with the academic performance (outcomes).

The sample consisted of 286 (examination 2009/10) and 229 (examination 2010/11), responses, corresponding to a response rate of 72% (total students registered 397) and 52%, (total students registered 440) respectively, sufficient to assume that the data obtained are representative of the whole class.

### *Specification of the model*

The first and second hypotheses were tested using nonparametric tests for the comparison of metric variables. Traditionally, in order to determine whether two distributions are significantly different, the $t$ value is used for related parametric samples, and the Wilcoxon test for unrelated nonparametric samples, based on mean values. However, there is an alternative to these tests that considers the notion of overall distance or proximity between two densities $f(x)$ and $g(x)$ through their integrated square error (Pagan and Ullah 1999). Specifically, we used Li's test to determine whether there were significant differences, following Simar and Zelenyuk (2006). This methodology provides a greater degree of accuracy in determining the relationship between two variables because it compares the distributions as a whole, while the Wilcoxon test only compares mean values.

Hypotheses 3 and 4 concern whether the students' perception of the usefulness of IBL and the motivation it produces, with respect to conventional classes, affect, firstly, the examination grades attained (hypothesis 3) and, secondly, their overall satisfaction with the development of the subject (hypothesis 4). The methodologies used to test each hypothesis were linear regression and logistic regression, respectively. The models used fit the following expressions:

### *Linear regression*

Final grade ($Y_t$) = $b_0$ + $b_1$ Year + $b_2$ 2 + Reg. + $b_3$ Examinations + $b_4$ Att. Class + $b_5$ Motive 1 + $b_6$ Motive 2 + $b_7$ Motive 3 + b8 Att. Tutorials + $b_9$ Use IBL + $b_{10}$ Mtvn. IBL + $e_i$.

Table 2. Codification of the variables used.

| Codification of the variables | | |
|---|---|---|
| 2+ registrations | The student has registered more than once for this subject. [Control variable] | 0: No<br>1:Yes |
| Exams | Number of times the student has taken this subject exam [Control variable] | 1: Once<br>2: Twice<br>3: Three or more |
| Year | Academic year when the survey was carried out [Control variable] | 0: 2010–2011<br>1: 2009–2010 |
| Attendance: classes | Frequency of attendance at subject classes [Usefulness of traditional classes] | 1: Never or hardly ever<br>2: Sometimes<br>3:All or nearly all |
| Motive 1 | Non attendance because the student is also working [Motivation for attendance at traditional classes] | 0: No<br>1: Yes |
| Motive 2 | Non attendance because the student prefers to self-study [Motivation for attendance at traditional classes] | 0: No<br>1: Yes |
| Motive 3 | Non attendance because the class coincides with another subject [Motivation for attendance at traditional classes] | 0: No<br>1: Yes |
| Attendance: Tutorials | Frequency of attendance at tutorials [Motivation for attendance at traditional classes] | 1: Never or hardly ever<br>2: Sometimes<br>3:All or nearly all |
| Usefulness IBL | Use of IBL methods helps understand the theory [Usefulness of IBL methods] | 1: Disagree<br>2: Agree<br>3: Strongly agree |
| Motivation IBL | Use of IBL methods is more interesting than performing fictitious case studies [Motivation of IBL methods] | 1: Disagree<br>2: Agree<br>3: Strongly agree |
| Final grade (IBL-period) | Final grade in the subject exam (2009/2010 and 2010/2011) | Numerical variable [1 -poor grade- to 10 -best grade-] |
| Final grade (Pre-IBL) | Final grade in the subject exam (before the introduction of IBL) | Numerical variable [1 -poor grade- to 10 -best grade-] |
| Degree of Student satisfaction | Grade of satisfaction | Numerical variable [1 -poor grade- to 10 -best grade-] |
| Student Satisfaction | The student is satisfied with how the subject is taught | 0: No<br>1: Yes |

### *Logistic regression*

Student satisfaction ($Y_t$) = $b_0$ + $b_1$ Year + $b_2$ 2 + Reg. + $b_3$ Examinations + $b_4$ Att. Class + $b_5$ Motive 1 + $b_6$ Motive 2 + $b_7$ Motive 3 + $b_8$ Att. Tutorials + $b_9$ Use IBL + $b_{10}$ Motivation IBL + $e_i$.

## Results

First, we show the results for hypothesis 1, aimed at determining whether the change in teaching method produced an improvement in student grades. Taking into account the mean grades obtained before and after the change in teaching method, we observed an improvement in outcomes, which rose from an average of 3.56 to 5.18.

Table 3. Descriptive statistics.

| | Mean | Standard deviation | *N* |
|---|---|---|---|
| Year | 0.444 | 0.497 | 515 |
| 2+ registrations | 0.800 | 0.400 | 515 |
| Exams | 1.176 | 0.519 | 515 |
| Attendance: classes | 2.738 | 0.571 | 513 |
| Motive 1 | 0.085 | 0.279 | 515 |
| Motive 2 | 0.081 | 0.273 | 515 |
| Motive 3 | 0.223 | 0.416 | 515 |
| Attendance: tutorials | 1.539 | 0.766 | 515 |
| Usefulness IBL | 2.739 | 0.559 | 515 |
| Motivation IBL | 2.598 | 0.653 | 515 |
| Final grade (IBL-period) | 5.478 | 2.182 | 515 |
| Degree of student satisfaction | 8.223 | 1823 | 515 |
| Student satisfaction | 0.726 | 0.446 | 515 |

However, it is interesting to consider further the distribution of these student grades; accordingly, to extract a greater amount of information from the student grades, we compared and analysed the density functions using Li's test.

Figure 3 shows the two density functions obtained. The juxtaposition of the two shows that there is a greater concentration of grades from 4 to 8 during the IBL period, which is not the case with those obtained prior to the change. In the latter situation, the probability mass for the grades is more widely dispersed, with five peaks: two at grades of 1 and at about 3.5, with the most frequently occurring value at about 5, and two more high values at 7 and at 9. In summary, the combination of the two methods (conventional and IBL) produces a greater number of pass grades

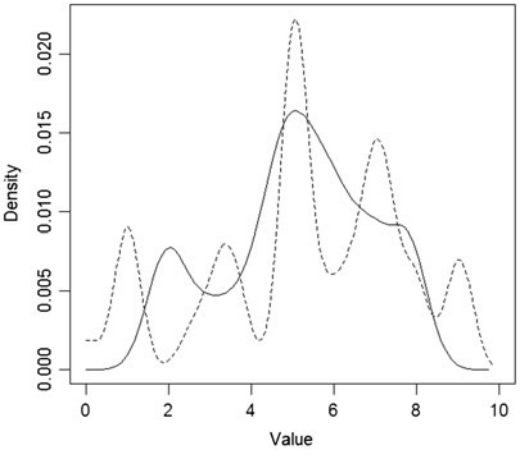


Figure 3. Density functions for the grades obtained.
Notes: Solid line - > IBL-period outcome; Dashed line - > Pre-IBL outcome. Figure 3 shows the two density functions obtained, with the solid line representing the students' exam grades after the change in methodology (IBL period), and the dashed line, the grades obtained before the change was made (Pre-IBL). The horizontal axis measures the grade, from 0 to 10, and the vertical axis, the density or frequency of repetition of each grade.

and more homogeneous grades among the students. Li's test (32.73 with *p*-value 0.000) confirms that the two density functions are different, and thus, the hypothesis of equality is rejected.

Hypothesis 2 considers whether in the IBL period, there was a positive relation between the students' grades and their satisfaction with the course (the latter was assessed before they knew the grades awarded). The hypothesis was tested following the same methodology as for hypothesis 1, calculating the density functions of the two distributions, as shown in Figure 4.

As can be seen, when the scores for students' satisfaction are juxtaposed with their grades, the two distributions are quite distinct and exhibit different behaviour patterns. While the solid line reflects the value of the satisfaction perceived, the dashed line shows the density of the grades. The students' assessment, in terms of their satisfaction with the course, ranges from 6 to 10, with the value of 8 being the most frequently given. However, it is apparent that the grades vary and that their probability mass is distributed more homogeneously among all the values, in the same way as shown in Figure 3, while the probability mass for the perceived satisfaction is situated to the right of the figure, around the higher values. This means that the students' satisfaction with the development of the course subject is higher than the grade they actually obtained.

That the density functions are different is confirmed by Li's test (220.96 with *p*-value 0.000). Furthermore, although the distributions are not equal, both variables are positively and significantly correlated, as indicated by Li's test and the bivariate correlations (Table 4), which reflect a significant positive relationship between the two variables. Moreover, there is also a significant negative correlation between the grade obtained and that the student had to repeat this study year. This finding

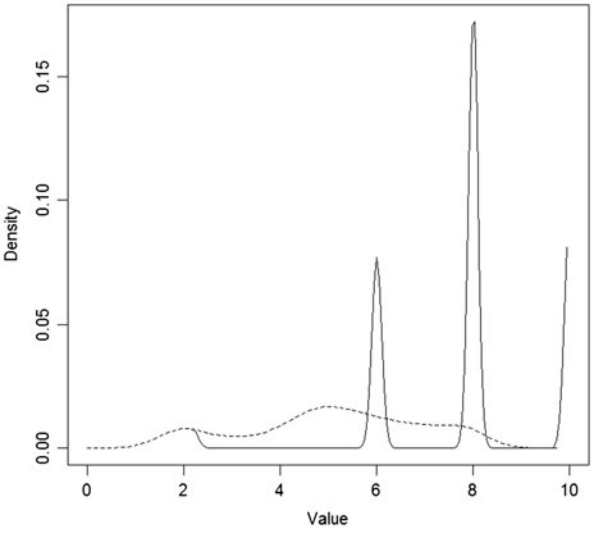


Figure 4. Density functions of students' grades and perceived satisfaction.
Notes: Solid line - > IBL-period satisfaction; Dashed line - > IBL-period outcome. The solid line reflects the value of the satisfaction perceived, the dashed line shows the density of the grades.

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Table 4. Partial correlations measured by Pearson's correlation coefficient.

| | Year | 2+ reg. | Exams | Att. class | Motive 1 | Motive 2 | Motive 3 | Att. tutorials | Use IBL | Mtvn. IBL | Final grade (CDC) | Stud. Satisfn. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1 | | | | | | | | | | | |
| 2+ Registrations | 0.086 | 1 | | | | | | | | | | |
| Exams | −0.041 | −0.680(**) | 1 | | | | | | | | | |
| Attendance: classes | −0.065 | 0.123(**) | −0.146(**) | 1 | | | | | | | | |
| Motive 1 | −0.022 | −0.195(**) | 0.150(**) | −.140(**) | 1 | | | | | | | |
| Motive 2 | 0.076 | 0.007 | 0.022 | −0.225(**) | −0.066 | 1 | | | | | | |
| Motive 3 | 0.036 | −0.058 | 0.087(*) | −.204(**) | 0.02 | 0.011 | 1 | | | | | |
| Attendance: tutorials | −0.008 | −.136(**) | 0.087(*) | 0.07 | −0.007 | −0.071 | −0.061 | 1 | | | | |
| Usefulness IBL | 0.004 | −0.007 | 0.011 | 0.062 | 0.018 | 0.05 | 0.083 | 0.042 | 1 | | | |
| Motivation IBL | −0.054 | −0.01 | 0.009 | 0.018 | −0.003 | −0.012 | 0.009 | 0.03 | 0.240(**) | 1 | | |
| Final grade (IBL period) | −0.015 | 0.072 | −0.066 | 0.179(**) | −0.065 | −0.071 | −0.236(**) | 0.128(**) | 0.134(**) | 0.098(*) | 1 | |
| Student satisfaction | −0.011 | −0.078 | 0.024 | 0.193(**) | 0.063 | −0.088(*) | −0.058 | 0.086 | 0.275(**) | 0.135(**) | 0.135(**) | 1 |
| Number of cases | 515 | 515 | 515 | 513 | 515 | 515 | 515 | 515 | 515 | 515 | 515 | 515 |

**Correlation significant at 0.01 (bilateral).
*Correlation significant at 0.05 (bilateral).

requires further study to better understand the factors that account for these two measures. Therefore, we proposed hypotheses 3 and 4, seeking to identify the influence of the different teaching methods on the students' grades and their satisfaction.

To test hypothesis 3, we show in Table 5 the results of the linear regression analysis, including the level of significance of the model presented and the percentage of the dependent variable accounted for by the independent variables. The model, overall, is significant, as evidenced by the Snedecor F value of 0.00. Moreover, the adjusted $R_2$ indicates that the input variables account for 10% of the dependent variable, and as the Durbin-Watson coefficient is close to 2, it can be concluded that the residuals are not correlated; as they are independent, the observed value of a variable in an individual should not be influenced in any way by the values of the same variable observed in another individual.

Regarding the level of collinearity of the model, it can be seen that the variance inflation factor (VIF) values are no higher than 10 for each variable, and so the model does not present serious problems of multicollinearity (Kleinbaum, Kupper, and Muller 1988). With respect to the levels of significance of the variables included in the model (Table 5), as regards traditional classes, the frequency with which students attend class is a significant variable in accounting for their final grade. One of the reasons they do not attend is because there is a clash with other subjects, which in turn is related to a worsening of final grades. Although in general, the three motivations for class attendance present the same pattern of relation, those of simultaneity of work and university study and of preference for self-study, are not significant. Finally, with respect to conventional classes, we examined the impact of students' attendance at tutorials on their final grade. As may be observed, this variable shows a positive relationship with the grade obtained, i.e. the students who attend tutorials

AQ6 Table 5. Coefficients of estimation for the linear regression model.

| Coefficients [a] | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Non-standardised coefficients | | Standardised coefficients | *t* Zero order | Sig. Partial | VIF |
| Model | | *B* | SE | Beta | | | |
| 1 | (Constant) | 1.934 | 0.892 | | 2.167 | 0.031 | |
| | Year | 0.010 | 0.186 | 0.002 | 0.053 | 0.958 | 0.002 |
| | 2+ Reg. | 0.364 | 0.320 | 0.066 | 1.135 | 0.257 | 0.048 |
| | Exams | 0.038 | 0.243 | 0.009 | 0.156 | 0.876 | 0.007 |
| | Att. class | 0.360 | 0.173 | 0.094 | 2.082 | 0.038* | 0.087 |
| | Motive 1 (Disagree) | −0.308 | 0.338 | −0.039 | −0.911 | 0.363 | −0.038 |
| | Motive 2 (agree) | −0.391 | 0.347 | −0.049 | −1.126 | 0.261 | −0.047 |
| | Motive 3 (Strongly agree) | −1.133 | 0.226 | −0.216 | −5.004 | 0.000*** | −0.210 |
| | Att. tutorials | 0.303 | 0.122 | 0.106 | 2.492 | 0.013** | 0.104 |
| | Use IBL | 0.539 | 0.173 | 0.136 | 3.116 | 0.002*** | 0.131 |
| | Motivation IBL | 0.223 | 0.145 | 0.066 | 1.535 | 0.125 | 0.064 |

[a]Dependent variable: final grade.

achieve better grades. Whether the student was enrolled for the first time in the subject, or was repeating it, or whether the examination had been taken on one or more occasions, did not affect the final grade. Another aspect of the results that should be considered is the consistency of the grades obtained by students over two consecutive years, an effect that is represented in the variable year. As can be seen in Table 5, this is not statistically significant, which implies that the methodology applied is equally valid for students in different academic years.

The students acknowledged IBL to be useful for understanding the subject; there was a positive relationship with the examination grade, although with respect to the motivation derived from its use, the model did not reveal any significant relationship with the grades obtained.

After analysing the variables that influence the students' final grade, hypothesis 4 was tested using the logistic regression model, to determine which of the variables significantly affected the students' satisfaction with the course subject. For this purpose, a stepwise strategy was employed, as this procedure is sensitive to problems of multicollinearity among the explanatory variables. As indicated above, this problem did not occur in the present study, as shown by the values of the correlation coefficients and the VIF for all the variables. This indicator shows that the increased variance is due to the existence of multicollinerarity. Values higher than 10 show that this increase may be very considerable.

As can be seen in Table 6, the model fits the data well; the Hosmer–Lemeshow test is statistically significant and the Nagelkerke $R^2$ value is high. Moreover, the rate of correct classifications provided by the model for the aggregate sample is 77.6%, and this value is even higher (96%) for the group of students who were satisfied with the course. On the other hand, the model correctly classified only 29.1% of the dissatisfied students, and so we conclude, there must exist other factors that influence this dissatisfaction.

Table 6. Logistic regression results.

| Variables in the equation | | | | |
|---|---|---|---|---|
| Variables | Parameter value | Wald value | Sig. | Probability ratio |
| Constant | 2.240 | 55.163 | 0.000* | 9.393 |
| 2+ Registrations | −0.603 | 4.178 | 0.041* | 0.547 |
| Att. class (3) | | 20.194 | 0.000* | |
| Att. class (2) | −1.561 | 15.513 | 0.000* | 0.210 |
| Att. class (1) | −0.824 | 7.560 | 0.006* | 0.439 |
| Use IBL (3) | | 33.824 | 0.000* | |
| Use IBL (2) | −1.915 | 18.624 | 0.000* | 0.147 |
| Use IBL (1) | −1.238 | 20.112 | 0.000* | 0.290 |
| Motivation IBL (3) | | 9.184 | 0.010* | |
| Motivation IBL (2) | −0.108 | 0.081 | 0.776 | 0.897 |
| Motivation IBL (1) | −0.761 | 9.134 | 0.003* | 0.467 |
| Hosmer–Lemeshow test: | | | | |
| Chi-square = 7893* | | | | |
| (Sig. 0.246) | | | | |
| Nagelkerke R square: 0.184 | | | | |
| % Total classification = 77.6% | | | | |
| % Classification satisfied students = 96.0% | | | | |
| % Classification dissatisfied students = 29.1% | | | | |

*Statistically significant at 5%.

The function is composed of four variables that are statistically significant at 5%. The first is the number of times the student has enrolled in the subject, such that students who have registered more than once for the subject have a negative impact on the overall satisfaction with it. The second is class attendance; we found that, with respect to those who attend every, or almost every, class, those who attend less frequently are less satisfied; this is especially so for those who attend only occasionally. The perceived usefulness of IBL is the third significant factor, so that students who strongly agree that this approach helps to better understand the theoretical knowledge are more satisfied. Finally, students who strongly agree that the use of simulated applied research is more interesting than the conventional approach are also more satisfied.

Turning to consider the variables that were not selected by the model, we conclude that the number of times the subject examination is taken, the reasons for not attending class and the frequency of attendance at tutorials are aspects that do not affect students' overall satisfaction. Neither is the academic year in question a statistically significant variable, i.e. the results are independent of the year in which the survey was carried out, and therefore can be considered stable over time.

Comparison of the statistically significant variables in the two regression analyses reveals which ones highlight the difference between the students' satisfaction and the examination grade. The variables class attendance and the perceived usefulness of IBL methods determine both the final grade for the students and their overall satisfaction; thus, students who attend all or almost all classes and are in complete agreement that the use of inquiry-based study helps them better understand the theoretical content of the course subject are those who are most likely to get better grades and to achieve higher levels of satisfaction.

However, while regular attendance at tutorials has a positive effect on the final grade and failure to attend classes because they coincide with other subjects has a negative impact, in neither case do these variables impact upon student satisfaction. In other words, neither attendance at tutorials, nor the reasons for not attending class are determinant factors in the students' subjective assessments.

Conversely, the number of times the student has enrolled in the subject and the use of simulated applied research are both variables that do impact on students' satisfaction, although they do not affect examination grades.

## Discussion and conclusions

Teachers should strive to improve their teaching strategies and, in this sense, previous research has shown that when teachers observe poor student performance in relation to objectives, they tend to revise their teaching practices in order to improve academic outcomes (Butler and Schnellert 2012). The degree of student engagement has been identified as an important issue in improving learning and teaching; in this respect, active and collaborative learning is one of the working principles that enhance students' participation in the learning process (Trowler 2010).

During the last decade, university teachers have been recommended to apply research-based methodologies (Inglis et al. 2004; Levy and Petrulis 2012), allowing students to develop skills such as self-reflection, critical thinking and responsibility for their own learning, thus producing intellectual growth and maturity (Lee et al. 2004). When students conduct their own research, in collaboration with their

teachers, this fosters intellectual and practical capabilities and outlook, factors that are very important for work and for life in general in modern society (Brew 2006).

Previous research has shown that teachers have a positive perception of IBL (Ramnarain 2014) and view it as a powerful teaching tool (Justice et al. 2007). However, little research has been carried out into the joint impact of conventional teaching methods and IBL on student achievement and satisfaction. Therefore, we decided to conduct this research in the context of a specific academic discipline.

The Financial Statement Analysis subject is part of the bachelor's degree course in business administration. The results obtained in the present study led us to conclude that the novel teaching methodology improved these students' academic performance. This result is consistent with those obtained in previous studies (Drennan and Rohde 2002; Dowling, Godfrey, and Gyle 2003), in which significant differences were detected between the results obtained before and after the application of IBL. Specifically, during the IBL period, more students passed the examinations and their average grade rose; moreover, there was a more homogeneous distribution of outcomes, which shows that, in this discipline at least, the use of research-based methods has a positive impact on university students' education. These results are in line with those of previous research and show that the use of IBL improves students' academic performance and learning outcomes (Justice et al. 2007; Hu, Kuh, and Li 2008; Spronken-Smith 2012).

In addition, during the IBL period, the probability distributions between the outcomes obtained by the students and their level of satisfaction with the course varied – in general, the students' grades were below their own levels of satisfaction. Similar results have been obtained in previous research (López-Pérez, Pérez-López, and Rodríguez-Ariza 2011). Given that students' level of satisfaction is highly correlated with their participation (Trowler 2010), it is no surprise that, in general, the students' level of satisfaction was higher than that of their grades. The explanation for this may be that students who are committed to the university experience are more satisfied with it (Bedggood and Donovan 2012), but their perceptions of their learning experience do not translate fully into the academic performance achieved.

Furthermore, the higher the degree of satisfaction felt, the better the grades achieved. These results were expected, as previous studies in this respect had reported a positive relationship between students' perceptions and outcomes (Visser-Wijnveen et al. 2012). However, the question remains, what is the origin of the positive relationship between students' grades and their level of satisfaction? In this respect, Hu, Kuh, and Li (2008) made significant findings, in that the effects of the participation by low achievers in research activities are not as strong as those who achieve medium-high levels of performance.

With regard to the factors influencing the two assessments considered, our study shows that students' academic performance improves if they regularly attend classes and tutorials throughout the year, i.e. if the conventional classroom method is followed; moreover, the perceived usefulness of IBL presented a positive relationship with the learning process and the final grades obtained. This can be explained by the degree of usefulness perceived by students involving a positive attitude to learning by the students, which leads to better grades (López-Pérez, Pérez-López, and Rodríguez-Ariza 2011).

With respect to the impact made by the combination of conventional methods and IBL on students' satisfaction (the subjective measure), our study indicates that students who attend class are more satisfied; there was also observed to be a positive

relationship between the perceived usefulness and motivation derived from the use of IBL and their own satisfaction. These results are similar to those reported by López-Pérez, Pérez-López, and Rodríguez-Ariza (2011), who concluded that there exists a relation between the perceived utility of the teaching method, the motivation generated by the learning process and the satisfaction derived from this process.

An especially significant finding was that the students who attend class achieve the highest grades and derive the highest levels of satisfaction. We believe this may be because students who attend class are more interested in the subject and are more committed to learning about it. The students taking part in the present study, moreover, had a positive perception of IBL. Most of them took a very positive view of the performance of research tasks in the subject accounts analysis 1, stating that it enhanced their interest in the subject and facilitated their comprehension and knowledge. These results are consistent with those obtained in previous research, according to which students learn more and obtain better results if they conduct research projects and work together on learning activities (Barron and Darling-Hammond 2008).

Finally, students' dissatisfaction may be related to certain negative aspects associated with IBL, such as the anxiety that may arise from the active role they are called upon to play in the learning process, or difficulties in dealing with the dynamics of the group (Plowright and Watkins 2004).

We believe that the examination grades and the students' assessments reflect the improvements achieved through the combined use of IBL and conventional methods. The results obtained can guide teachers who wish to modify their teaching practices in order to improve student performance.

The main limitation of the present study is that we did not have access to information on student satisfaction during the pre-IBL period, which would have enabled interesting comparisons. Furthermore, the study was carried out with respect to one subject in particular and did not take into consideration other variables that might account for students' dissatisfaction.

Future research should aim to determine how the application of different types of IBL might strengthen the student learning process and seek to evaluate the performance and perceived satisfaction produced by each such approach. In addition, it would be of great interest to examine, in a qualitative study, why students consider IBL to be more satisfactory.

AQ3

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