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**COOPERATIVE AND AUTONOMOUS LEARNING IN ARCHITECTURE  
AND ECONOMICS: AN EXPERIENCE IN THE SUBJECTS OF  
ARCHITECTURAL DESIGN AND ACCOUNTING IN SPAIN**

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**ABSTRACT**

The implementation of cooperative and autonomous learning was analysed for the subject Architectural Design, which is part of the bachelor's degree in Architecture and the subject Financial Accounting, which is part of the bachelor's degree in Accounting and Finance. These disciplines are very different. Although they are both taught in the classroom using a similar pedagogical method involving a combination of group and individual work, it is distributed in a different way in each subject. The academic results obtained in both subjects were very satisfactory. We can conclude that cooperative work helps to improve the final results of the course.

**Keywords:** cooperative learning, autonomous learning, individual learning, interdisciplinary teaching, lecturing in accounting, lecturing in architecture design.

**1. Introduction**

The objective of this research was to analyse the results obtained when cooperative and autonomous learning methods were used in the subjects of Financial Accounting and Architectural Design, both in Spain.

The study consisted of applying the same learning method to two markedly different subjects, in terms of the percentage of theoretical and practical classes in each one. Theory predominates in Accounting, and workshop classes predominate in Architectural Design. However, both subjects more or less coincide in the percentage of cooperative work that is carried out. Despite the differences between the subjects, the results were very satisfactory, due to the interaction between cooperative work and autonomous learning.

## 2. Literature Review

Cooperation means working together to achieve common goals. In a cooperative situation, individuals seek to obtain results that are beneficial to themselves and to all other members of the group. This approach contrasts with competitive learning, in which each student works against the others to achieve goals such as a mark of "10" at school that only one or a few students can achieve; and individual learning, in which students work on their own to achieve learning goals unrelated to those of other students<sup>1</sup>.

According to Johnson & Johnson (1992), some basic elements are essential to achieve cooperation within a small group.

1. **Positive interdependence.** In this situation, what each group member learns depends on the actions of all the other members.

2. **Face-to-face interaction.** Members of a group should work together face-to-face at some point in the process. This encourages students to try harder to form committed relationships within the group, and to improve their adaptation and social competence.

3. **Individual responsibility.** No member of the group can succeed solely on the success of others. Therefore, each member is responsible for one part of the work, and the success of the other members will depend on each person's individual work.

4. **Interpersonal skills and small group sharing.** Students must learn some skills to achieve common goals, such as meeting the other members of the group, communicating effectively, supporting each other, and resolving conflicts constructively.

5. **Group processing.** For a cooperative group to work properly, its members should reflect on their way of working. Thus, in group processing, group members discuss: the scope of their

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<sup>1</sup> Johnson David W., Johnson Roger T., Holubec, Edythe J. El aprendizaje cooperativo en el aula. P 14

objectives, the effectiveness of their working methods, and relationships between group members. That allows them to analyse what went well, to reinforce each other's work and to improve their own.

Authors who have studied cooperative learning, such as Johnson, Johnson and Holubec, Stainback and Shepherd, have shown that the cooperative organization of learning activities is clearly superior to competitive and individual organization, in terms of participants' performance and productivity.

Individually structured learning activities can supplement cooperative learning through a division of labour in which each student learns specific material or skills that are subsequently used in cooperative activities. Learning facts and simple skills to be used in subsequent cooperative learning projects increases the perceived relevance and importance of individual efforts. The more important and relevant students perceive the learning goal to be, the more motivated they will be to learn. The goal must be perceived to be important enough for a concentrated effort to be made to achieve it. Contributing to the cooperative effort is what makes individual goals important.

Within individual learning situations, the teacher is the main source of assistance, feedback, reinforcement, and support. Students should expect periodic visits from the teacher, and a great deal of teacher time may be needed to monitor and assist students.<sup>2</sup>

Learning architectural design is a continuous process throughout the career of architecture. Its scope is general, and a range of disciplinary knowledge is covered that is always aimed at creating a unified design. A statement by William Amancio is particular relevant: when we are faced with new problems, we must find new solutions. Density, location, environment, voids or spaces of indeterminacy and organizational skills all constitute design strategies.

In the teaching of architectural design, there is no orthodoxy of design. This is a subject that requires long-term learning, despite the need for clear and innovative ideas when addressing and developing a design.

The practice of architecture is often not supported by theory. Instead, imagination and creativity tend to be inspired by other designs or existing buildings.

Learning in the field of architectural design should be based on continuous observation and analysis of architects' work; this leads each student to acquire their own criteria and architectural

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<sup>2</sup> Johnson, David W., Johnson, Roger T. Learning Together and Alone. Cooperative, Competitive, and Individualistic Learning. P.153-154

language. The knowledge leads to the production of architecture, and giving it a use and a form. The specific process starts from the abstraction that characterizes the mere fact of designing, although basic theoretical criteria must be applied by novice designer to obtain acceptable results.

The design process does not follow a predetermined sequence. Instead, the designer must constantly jump through different aspects of the project without a specific order or precise deadlines, and is sometimes forced backwards to revise or simultaneously solve several aspects. Designing is cyclic. Undertaking a project consists of uniting elements by establishing meaningful relationships. The layout serves as a catalyst for teaching and learning design methodology. Each space must reflect the function that will take place in it.

As the plan is gradually determined, it acquires the shape of the building. Simultaneously, this process is often accompanied by a preconceived image that the designer uses as a support, which helps to solidify the design idea. That image is in the mind of the designer long before he or she begins the painstaking design process, in which drawings and models are brought together, to start shaping the form. This is where the initial plan of the building is decided, a crucial and difficult stage of the project, in which uncertainty prevails. This stage is most intimidating to the trainee designer.<sup>3</sup>

As Peter Fawcett states, the act of designing ranges from rational analysis, on one hand, to deep creative thinking, on the other, which leads to the creation of form by addressing all organizational and technological issues.

The best design decisions are made at the start of a project, which is why it is important for students to have conducted a thorough analysis of the site, and to have undertaken previous cooperative work in order to generate better ideas and solutions, and to initiate and develop the project successfully.

The location is one of the few constants in any architectural programme. A programme or budget can change during the design process as the project advances, but the site is a fixed element with which the designer can determine the interaction between the design layout and its location in the early stages of the project.

We need to learn about a town, its fabric, its climate and its history to be able to respond to the place appropriately and give it meaning. We need to preserve large trees that provide shade and maintain the topography of the site for the building's section layout. We must think how the building's shape will respond to the weather or if it will modify it, and whether we will keep the

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<sup>3</sup> Fawcett, A. Peter. *Arquitectura. Curso básico de proyectos*. P. 22

views from the site or turn them to the building. We must decide where the access to the building and site will be, with respect to surrounding streets and pedestrian areas. All these parameters must be addressed from the site. We must draw the site and contour of the buildings to scale, to adapt further to the size of the site, and the building or buildings must be designed with respect to those in the surrounding environment, to create harmony from the beginning of the project.

As the project progresses from the original diagram, it is essential to maintain its clarity and continue to check the validity of the layout. The hierarchy of circulations or routes have an important role in helping to understand a building, and increase the clarity of the functioning of the floor plan. The diagram of paths can be compared to a tree, in which the main route is the trunk and the secondary circulations are the branches. It is essential that some singular circulation spaces are included in these routes, for example lobbies and spaces of confluence that act as nodes and help to relate interior and exterior spaces.

Marc-Antoine Laugier stated that technique was the prime cause of architectural expression.

Students must arrive almost naturally at the inseparability of form, space and structure. They must consider what kind of structure will best suit the type of floor plan or structural diagram for the building in question.

The structure creates the rhythm and order of the building, with a primary repetitive system that can establish the order of secondary subsystems, so that the flexibility of the system allows the designer to add or subtract spaces to the primary structure without diluting its clarity.

Once an appropriate structure has been created, the structural expression must be addressed and how this relates to the building skin.

The type of structure adopted has an effect on the formal outcome of the building. A clear structural and functional plan facilitates understanding of the design, and the secondary and tertiary elements that form part of it contribute to the interpretation of the initial project ideas, and make the initial plan coherent.<sup>4</sup>

The building enclosures, including the roof and the layers of the façade, can significantly influence the appearance of a building. The roof may be more or less visible. The façades contain the openings required for access, lighting, ventilation and views, and must have satisfactory connections to the roof.

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<sup>4</sup> Op. Cit. P. 69

Although drawing and three-dimensional modelling computer programs have reached a high level of perfection, the best tools for the first attempts at creating form are still the soft pencil, the eraser and transparent paper. To design by drawing is the most efficient way to carry out initial explorations of the project, although this may seem obvious.

The evolution of form can be checked using transparent paper and the required changes can be made. Sketches could be accompanied by models and axonometric perspectives, for example, as a design cannot be verified until it is drawn to scale, and different scales need to be used depending on the stage of the design: as the design advances, the scale resolves more details.

The course design is based on cooperative work in small groups of three people during the first month of the course. Students of Architectural Design are from the 4th and 5th year of the architecture degree, i.e. from semesters 7, 8, 9 and 10. The group distribution is stratified, because the leader must be a student from semester 10, i.e. the most advanced level. Apart from the educational level of the group leader, the students are free to form the groups as they wish. These are formal cooperative groups (as defined by Johnson and Johnson), as they are active during the initial period of the course. The goal is to increase educational resources (to stimulate discussion of the analysis of the exercise, and to bring together the ideas and knowledge of the three members of the group), in order to successfully complete the individual exercise that students must carry out during the rest of the course. The cooperative assignment that students submit and present in class for discussion with the lecturers and other students is assessed. Cooperative work counts towards the final grade, but to a much lesser extent than the final presentation, since the objective of this stage of the course is to acquire work tools for use in the subsequent exercise. This approach reflects the fact that each student's individual work should demonstrate all the concepts that have been learned.

Members of the group follow the stages described below:

1. Students think individually about the subject.
2. Then, they present their views to the group in turn, and allow others to request clarification or additional information.
3. The team reaches a consensus that represents everyone's opinion of the subject.
4. This is presented to the class.
5. A debate is held among all class members.

This structure is designed for students to practice free speech, to consolidate views and reach a consensus, even when their opinions differ.

The subject “Financial Accounting” is designed for students in the second year of the bachelor’s degree in Accounting and Finance.

Teaching is structured, with a gradual progression from the introductory and most basic subjects to the more complex ones. Numerous examples and practical case studies are used throughout.

The General Accounting Plan must be addressed on the course, as it is a useful tool in the study of Financial Accounting. The Plan’s method is gradual, systematic and follows a logical order from a pedagogical perspective, taking into account who it is aimed at.

The first division of accounting was made in the 1950s by Professor Mattesich. It is based on dividing economic units (macro-economic and micro-economic), to distinguish between macro-accounting and micro-accounting.

Micro-accounting deals with the application of accounting to economic production units, in other words, businesses and economic units of consumption, represented mostly by families. In corporate accounting, a distinction must be made between the private sector and the public sector.

Accounting for enterprises in the private sector, which is simply known as company accounting, is the most developed area of accounting, and part of this study is dedicated to it.

Macro-accounting deals with the accounting systems of macro-economic units, that is, national and supranational units. The first practical difficulty that these units encounter is in gathering data, which technically cannot be carried out in the same way as in business accounting by registering all transactions, and is instead approached using statistical estimates. A single accounting system cannot be defined for macro-economic units, as a range of independent accounting figures are used: national income, inter-industrial transactions, balance of payments, and financial and monetary flows.

To carry out its activity, a company demands and obtains a number of factors from the external world, such as workforce, raw materials, machinery or electricity. In return, the company generates a set of individual equities for those who provide factors, for their collaboration in the development of the productive activity. These include employees’ salaries, and payments to suppliers of raw materials, among others. Part of the income that the outside world receives is used for consumption; the other part is converted into savings. The money that is saved up, except for the part allocated specifically to savings, is used for investments in the equities

market, in shares for example, or lent to others in exchange for interest. Investment is a source of funding for the company. The company goes to the equities market to obtain the necessary means to finance their investments. With the investments that it makes, it carries out its production process, leading to the creation of products, and launches its products on the market, where they are purchased by consumers.<sup>5</sup>

The cycle is repeated successively, resulting in the dynamic behaviour of the company within the general, national and international economic system.

Accounting serves as the main source of information for decision-making. This approach emphasizes the usefulness of accounting information. The American Accounting Association conceives accounting as the process of identifying, measuring and communicating economic information, which allows its users to make informed judgments and decisions.

Within this programme, the lecturer Cañibano considers that accounting is a science of an economic nature, which aims to produce information to understand the past, present and future of the economic reality in quantitative terms at all organizational levels. This is achieved by means of a specific method, supported by sufficiently verified bases, in order to facilitate the adoption of external financial decisions and those of internal planning and control.

Accounting is known to be the language of business. In recent years, given the increasing globalization of the economy, the need for information has increased. Information needs cross borders and national boundaries and have a truly international dimension. Consequently, financial information must be standardized, so that it can be interpreted and compared in different geographic and economic areas that act in an interrelated manner and often together, simultaneously and interactively.

Accounting is an economic science that studies the systems responsible for understanding, processing and communicating useful information for economic decision-making on behalf of a group of internal and external users, who relate to the agents or units acting in an economic system.

In functional terms, accounting should be understood as an information system and should be named as such. It constitutes a mechanism that is designed, ultimately, to provide useful information so that users can make economic decisions in appropriate conditions resulting from information transparency and the adaptation of mechanisms of data preparation and presentation.

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<sup>5</sup> . Lázaro Rodríguez; María Victoria López. Contabilidad General.P 16

Therefore, as an information system, accounting transforms data into information. That is to say, it collects data that is normally associated with economic transactions, and relates them by assigning the corresponding economic valuation.

The course design is based on lectures for students, in which the theory is explained. These are accompanied by practical exercises, which make it easier to understand the theory. In the final three weeks of the course, general cooperative classes are replaced by a cooperative project in which students should apply knowledge previously acquired in class to practical exercises performed on a computer.

The cooperative groups are small, heterogeneous and comprised of 3 people. The lecturer forms groups by putting students together in alphabetical order. Groups comprised of students with different interests and ability allow students to access different perspectives and problem-solving methods, and produce greater cognitive imbalance, which is required to encourage students' learning and cognitive development. Heterogeneous groups tend to promote deeper thinking, more exchange of explanations, and a greater tendency to adopt views during the analysis of the material, all of which increase students' understanding, reasoning and long-term retention.<sup>6</sup>

The pedagogical objective is for students to solidify the knowledge acquired in previous classes taught during the course.

The evaluation of cooperative work is a very small percentage of the total grade for the subject compared to the final exam, given that the exam is where all the knowledge acquired is checked and consolidated.

To carry out these pedagogical processes, lecturers must have the following qualities: commitment, discipline, knowledge of languages in order to teach foreign students, leadership, and the ability to tutor students. There must be strong coordination between the subject's teaching staff, and lecturers must know how to conduct the class. They must communicate knowledge with enthusiasm and clarity, to motivate students and make the subject more attractive.

In every class, the lecturer should organize a debate in which the students report to the class what they discussed in their groups. The lecturer's role in the group's process consists of:

- Checking that each student and group receives (and give) feedback on efficacy in the undertaking of tasks and teamwork.

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<sup>6</sup> Johnson, David W.; Johson, Roger T., Holubec, Edythe J. El aprendizaje cooperativo en el aula. p 41

- Checking that students and groups analyse and reflect on the feedback they receive.
- Helping individuals and groups to set objectives, in order to improve their work.
- Encouraging students to celebrate the performance of their groups.

### **3. Description and work method**

After explaining the task to the students, the lecturer must create a climate of cooperation between them, by establishing positive interdependence within the class.

The two steps which are necessary to establish positive interdependence in learning groups are:

1. Formulate goals to establish positive interdependency.
2. Supplement and reinforce positive interdependence with respect to goals by incorporating additional forms of interdependence (relating to material, prizes or festivals, roles, identities and others).

Interdependence between groups extends the positive results of cooperative learning to the whole class, since it set class targets, in addition to individual and group goals. One way to establish this interdependence is by giving additional points to each member of the class if all meet certain criteria of excellence. When a group finishes the assigned task, its members must look for other groups who have also finished it, to compare and explain their answers and strategies, or other groups that have not finished it, in order to help them do so<sup>7</sup>.

The curriculum of the bachelor's degree in Architecture, includes a workshop for each semester, called the Architecture and Design Workshop (TAP).

The first cycle is comprised of 1- 6 four-month periods, and the second cycle by 7-10 four-month periods. The workshops in the last four four-month periods are called letter workshops; this means that each workshop has a letter that identifies it.

Students must attend workshops (1-6) chronologically in the first cycle. However, no order is determined for the letter workshops (7-10): each student can choose which one to take, and link it to the preferred four-month period of the second cycle. The existing offer of workshops gives students the opportunity to decide their own academic curriculum, according to their preferences.

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<sup>7</sup> Johnson, David W.; Johnson, Roger T., Holubec, Edytbe J. El aprendizaje cooperativo en el aula. P 73-78

The composition of the workshops is interdisciplinary: each one is coordinated by a lecturer in architectural design, and lecturers from other departments also collaborate, but with a reduced teaching load.

In each workshop, a task is carried out on a different specific theme, so that students acquire optimal training.

### TAP PTEf Case Study

This is a mandatory four-month course with an academic load of 12 ECTS credits in the curriculum of the 2010 bachelor's degree in Architecture. It is in the second cycle, and therefore students who are enrolled on the subject are in their last two years, that is to say in the 4th and 5th year. A maximum of 50 students can participate. The theory classes are conducted in a single group, and the workshop classes are split into 2 groups of 25.

The capital letters of the subject refer to the departments that collaborate in it: the Department of Architectural Design (P), the Department of Architectural Construction I (T) and the Department of Architectural Structures (E). The lower case letter refers to the workshop (f). Of the 12 total credits, 8 are given to the Department of Architectural Design, 2 to the Department of Architectural Construction I, and the 2 remaining credits to the Department of Architectural Structures.

The theme that is examined is the relationship or existing interaction between a building or public facility and the public or urban space. The end result of the course is that each individual student must submit a proposal to develop a new building located in an urban context. Students start off from a real site, with a programme suited to the type of public building to be designed, which is always linked to local needs. A site visit takes place during the beginning of the course in order to observe its characteristics.

Four individual assignments and three group assignments are submitted. The most important assignment for the final grade is the last one to be handed in, which represent 60% of the final grade. Of the group assignments, two are submitted during the first month and the third during the third month. The mark given for these assignments represents 10% of the final grade, as two of them are submitted in the early stage of the course. Very satisfactory results are obtained in this phase, which proves that cooperative work is an extraordinary ingredient in the proposal and development of the design.

The subject is divided into 20 h of theoretical classes and 132 h of workshop classes. Theory classes are chronologically linked to the different phases of development of the design. Additionally, one or two sessions are given by external lecturers, who are usually also external to

the university. This gives students the knowledge to be able to develop the architectural design properly.

The following paragraphs outline the cooperative and autonomous learning that is being developed in the subjects of accounting and finance:

Financial Accounting is a subject taught in the Business Department, Faculty of Economic Sciences, as part of the bachelor's degree in Accounting and Finance Degree in its 2010 study plan. It is taught during the first semester of the 2nd year, is awarded 6 credits and is compulsory. It has a total of 90 students enrolled, split into three groups of 30 students. To take this subject, students must have passed the "Introduction to Accounting" and "Financial Mathematics" subjects.

Financial Accounting Case Study

Students comprehensively analyse the implementation of the General Plan of Accountability and develop other accounting records for each module. Finally, the entire accounting cycle is computerized and financial statements are presented. The evaluation is as follows:

Activity description	Progress Evaluation	%
Partial exam	Evaluates the contents taught up to the exam date. The exam consists of a test of 10-20 questions.	20
Computer task	Evaluates a general exercise carried out using accounting software	20
General exam	Evaluates the entire contents of the subject. It has two parts: a theoretical part with true/false questions or test questions with only one answer, and a practical part comprised of accounting cases.	60

This subject is divided into nine different themes. When half of them have been taught, students will be given an individual test which is worth 20% of the final grade. At the end of each module, 10 true/false questions or 10 test questions with only one answer are posted on the Moodle platform for students to complete, self-correct and check. This is a voluntary exercise that does not count towards the final grade, but is a very useful pedagogical tool for students' autonomous learning and to highlight the knowledge acquired in the subject.

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This exercise is worth 20% of the final grade. If it is not handed in, the student cannot recover the marks.

Sixty per cent of the final grade is awarded for an individual exam which is taken at the end of the four-month period, during the exam session established by the Faculty. In the exam, students must demonstrate that they have acquired theoretical and practical knowledge of the subject. This exam consists of 10 test questions which comprise 30% of the exam mark, and 5-10 practical exercises which are equivalent to 70% of the exam mark, to be carried out in 1 hour 30 minutes.

To continuously improve the processes of learning and assessment, students need to work through eight steps. *First*, they must form teams. Quality learning is not possible without cooperative learning groups. *Second*, team members must analyse the assignment and select a learning process for improvement. *Third*, members must define the process they need to improve, usually by drawing a flowchart or a cause-and-effect diagram. *Fourth*, team members must engage in the process. *Fifth*, students must gather data about the process, display the data, and analyse it. *Sixth*, on the basis of the analysis, team members must make a plan to improve the process. *Seventh*, students must implement the plan by engaging in the learning process in a modified and improved way. *Finally*, the team must institutionalize changes that do in fact improve the quality of the learning process.

According to Johnson, Johnson and Holubec, teachers should outline a diagnostic plan for each of their classes based on the following points:

1. Learning process. If the teacher manages to improve learning processes, he/she also improves the quality and quantity of student learning. This is known as total quality learning.

To implement total quality, we must form groups of students who are responsible for the quality of the group's work. In Architectural Design, a leading role is established in the group. The leader must be a student from the last four-month period, which indicates that he/she will have acquired more knowledge than other group members.

2. Learning outcomes. The teacher should directly measure the quality and quantity of student performance to determine how much they have learned in class. In Architectural Design, each group must present the assignments on paper and orally to the class in a presentation that is the same length for all groups. After the presentation, there should be a debate on the solution adopted each year with the rest of the class.

In Financial Accounting, the practical exercises solved on the computer must be presented, and will be assessed directly whether the solution is correct or not.

3. The area in which the assessment is made. The real assessment requires students to demonstrate the practices or the desired procedures in a "real life" context.

In both Architectural Design and Financial Accounting, the lecturers prepare simulated real-life exercises. In Architectural Design, public administrations participate as if they were real clients, and the heads of technical, cultural and political services teach one or two classes to students at the beginning of the course, explaining the characteristics of the population, and the needs for the public building that they must design for the municipality or the corresponding city. In Financial Accounting, all financial data on the exercises that students carry out come from real companies, which are small, medium-sized and large enterprises.

#### **4- Results and/or conclusions**

Cooperative learning in the Financial Accounting and Architectural Design subjects described above led to better grades for students' work. This confirms that cooperative learning leads to the acquisition of more skills and better results, although the period in which collaborative work is used is completely different in the two subjects. In the Architectural Design course, cooperative work takes place in the initial stage of the course for students to gain tools to continue their work individually. In Financial Accounting, cooperative work takes place in the final stage of the course, during which all the theory taught in the course must be applied to practical exercises, as a basic tool to consolidate knowledge through the interaction of all members of the group. The five basic elements described by Johnson and Johnson (1992) and explained above were present in the cooperative work that was undertaken, that is, for cooperation to exist in a small group one has to establish positive interdependence, face-to-face interaction, individual accountability, interpersonal skills exchange, and group processing. One of the world gurus of cooperative learning, Spencer Kagan (2009), stated that "The sum of the parts interacting is greater than the sum of single people."<sup>8</sup> This definition was also justified in the study

The subjects are designed to motivate students, so that they can succeed in exercises that are initially beyond their capacity. They are based on the simple concept of peer learning, by which individuals can do more and expand their horizons to a greater extent with support (mediation) than they can alone. This is a method known as Team-Pair-Alone or Alone-Pair-Team, in which there is no difference in success regarding the timing of the application. This method was supported in the two subjects: cooperative learning was used in the most suitable period to extend and consolidate knowledge of each subject.

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<sup>8</sup> Kagan, Spencer; Kagan Miguel. Kagan cooperative learning

Students' results confirm that it is an effective teaching method, as the percentage of students who fail the course is very low and ranges from 10% to 14%. Top marks (A's and B's) are obtained by between 20% and 30% of students, which is clearly higher than the percentage of students who fail the course.

In Financial Accounting only an average of 12.5% students failed the course. Fifty per cent of students obtained A and B grades, which shows that this method was useful and effective for them. Cooperative work was equivalent to 20% of the overall grade for the course, and the remaining 80% corresponded to the two individual tests.

The results clearly show that an educational system that involved a combination of cooperative and individual work had a positive influence on the final results in both subjects.

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