Learning about the economic analysis of inequality through team-based learning

Aprendizaje del análisis económico de la desigualdad a través del "Team-based learning"

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Abstract

Introduction: We seek to describe how students' conceptual knowledge about the economic analysis of inequality and their ability to apply it changed through a contextualized team-based learning (TBL) process carried out in the Bachelor's of Business Administration and Management program at the University of Barcelona.

Method: Data was collected in 2018-2019 from a sample of 318 students distributed in five groups. Data was collected three times, using an initial individual test (Ci), a test carried out in teams during class time (Cg), and a final individual exam (Pfa). Percentages of students who passed and mean scores were analyzed quantitatively, and we compared changes overall, within groups and between groups.

Results: We observed a clear positive change for the whole sample and for each group between Ci and Cg, for both conceptual knowledge and its application. The mean scores improved by 49.8%, while passing percentages grew by 30%. In contrast, this positive trend was reversed between Cg and Pfa in the application of knowledge, although we found substantial intergroup differences, attributable to differences in the Pfa.

Conclusion: The TBL process contributed to students' conceptual knowledge of the economic analysis of inequality, suggesting that teamwork favors the learning

of elementary cognitive processes such as remembering and understanding. In contrast, while a certain degree of reversal between Cg and Pfa was expected, intergroup differences in knowledge application suggest that, despite what the literature has sometimes suggested, group tests for knowledge application in TBL should be identical, rather than merely comparable.

Key words: team-based learning, flipped classroom, higher education, quantitative analysis, business administration education, economic analysis, economic inequality, learning.

Resumen

Introducción: Esta investigación persigue describir y comparar cómo, a través de una propuesta contextualizada de "Team-based learning" (TBL), varió el conocimiento del análisis económico de la desigualdad (a nivel conceptual y de aplicación de dicho conocimiento) entre estudiantes del Grado de Administración y Dirección de Empresas en la Universidad de Barcelona.

Metodología: El estudio, desarrollado durante 2018-2019, contó con una muestra de 318 estudiantes distribuidos en cinco grupos. Los datos fueron recogidos en tres momentos utilizando una prueba inicial individual (Ci), una prueba en clase en equipos (Cg) y una prueba final individual (Pfa). Estos datos fueron analizados cuantitativamente –atendiendo a porcentaje de aprobados y calificaciones promedio– y comparando su evolución global, intragrupal e intergrupal.

Resultados: Se dio una clara evolución positiva para el total de la muestra e intragrupalmente entre Ci y Cg, tanto a nivel conceptual como de aplicación del conocimiento. En este sentido, la variación porcentual en la calificación promedio para el total de la muestra fue de un 49,8%, mientras que el porcentaje de aprobados creció cerca de un 30%. En cambio, en términos de aplicación del conocimiento, dicha evolución positiva se revirtió completamente entre Cg y Pfa para el total de la muestra, si bien con sustanciales diferencias intergrupales debido a matices en las actividades planteadas.

Conclusión: La propuesta analizada, fruto del trabajo en equipos, contribuyó positivamente al conocimiento conceptual del análisis económico de la desigualdad, evidenciando cómo este favorece el aprendizaje en procesos cognitivos elementales como recordar y comprender. Por otro lado, pese a cierta reversión esperable en los resultados entre Cg y Pfa, las diferencias intergrupales en la aplicación del conocimiento sugieren que, en contraste con lo que en ocasiones apunta la literatura, las actividades de aplicación que realizan los grupos durante el TBL habrían de ser idénticas, no solo comparables.

Palabras clave: aprendizaje basado en equipos, aula invertida, educación superior, análisis cuantitativo, enseñanza de administración y dirección de empresas, análisis económico, desigualdad económica, aprendizaje.

Introduction

We describe the outcomes of a process of team-based learning (TBL)–a tool of the flipped classroom–in economics higher education. We tried to understand how a TBL activity–which we modified to adjust it to the context and content–altered the knowledge of the economic analysis of inequality of 318 students from five groups from the Bachelor's of Business Administration and Management (ADE) of the University of Barcelona. This objective is divided into two sub-objectives:

- Describe how–in terms of the percentage of passing students and the average scores–knowledge about the economic analysis and inequality (both in conception and application) changed overall, within groups and between groups from the initial individual test (Ci) and the same test taken later in groups (Cg).
- Describe how this knowledge and its application changed–in terms of the percentage of passing students–overall, within groups and between groups from the Ci to the final individual course exam (Pfa).

The flipped classroom

The flipped classroom is a model of teaching and learning (Prieto, 2017) that consists of altering the sequence of "teach-study-evaluate," traditional in higher education (Medina, 2016), to "study-evaluate-teach-evaluate." The first references to the flipped classroom (or similar techniques) appeared in the United States in 2000 when, in the context of higher education, Lage, Platt and Treglia (2000) wrote of the "inverted classroom" and Baker (2000) of the "flipped classroom." These seminal studies point to the flipped classroom as a way of serving different learning styles and contributing to a more active type of learning. The popularization of the flipped classroom occurred largely thanks to the visibility of the work of Bergmann and Sams (2012) in secondary school. These authors have sometimes been identified as the founders of the flipped classroom movement (Prieto, 2017), even though they themselves referenced the work of Lage et al. (2000), which had been developed in economics education at the University of Miami (Ohio).

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Through the flipped classroom, the instructor selects course material for the students to work through on their own outside of class before it is taught in the classroom. In this way, class time is intentionally freed up for learning activities for which the presence of the instructor is essential. In this sense, the flipped classroom is marked by a constructivist approach (Bergmann, Overmyer, & Willie, 2011), in that classroom teaching comes after prior (guided) study by the student and the (formative) evaluation of the outcome of this prior study. Through a process of aligning classroom teaching with the understanding that the students have developed through prior study activities (Medina & Jarauta, 2013), the flipped classroom makes it possible for the content delivered in the classroom (related to the development of competencies and the achievement of learning results) to become more meaningful for each student. In this way, the flipped classroom shuns mechanical and reproductive instruction (Bergmann & Sams, 2012) and facilitates alternative uses for course content–problematizing it, practicing it, reflecting on it, discussing it, working on it in groups, etc.–through activities that allow students to formulate informed judgments and analyze and reformulate their knowledge in light of its practical derivations and theoretical coherence. In short, the flipped classroom seeks to help students develop higher-order cognitive processes (O'Flaherty & Phillips, 2015), thus maximizing their learning opportunities.

Over the past two decades, the flipped classroom has gained international popularity, as the research reports positive outcomes. Recent literature reviews of the flipped classroom in higher education have shown how the approach contributes to improving students' learning outcomes, attitudes, motivation and satisfaction with the teaching and learning process (Akçayır & Akçayır, 2018; O'Flaherty & Phillips, 2015; Thai, De Wever, & Valcke, 2017). Given these impressive results, for the past 20 years we have seen the flipped classroom emerge in various disciplines, including economics, both outside (Butt, 2014; Lage et al., 2000; Roach, 2014) and inside the Spanish university context (Abío et al., 2019; Hernández & Pérez, 2016).

In parallel with the popularization of the flipped classroom, related approaches have also emerged, including "first exposure" (Walvoord & Anderson, 1998), "peer instruction" (Mazur, 1997), "just-in-time teaching" (Novak et al., 1999) and TBL (Michaelsen et al., 2002). We analyze a

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process of TBL–adjusted for reasons related to time and content–carried out within a flipped classroom.

Team-based learning

The idea of TBL emerged in the late 1970s (Michaelsen et al., 2002; Sweet & Michaelsen, 2012) and was developed as a strategy during the 1990s. L.K. Michaelsen developed it in response to his experience teaching in business schools. He felt dissatisfied that he did not know what his students were thinking during his lessons (because the number of students in his classrooms had grown). Moreover, he wanted to create more opportunities for his students to address in class problems that they would have to handle in their future work (Parmelee et al., 2012). Michaelsen's proposed solution was TBL, a useful strategy for working with large classes, helping students develop conceptual and procedural knowledge (Michaelsen & Sweet, 2008) and critical thinking skills, and building high-performance learning teams (Sweet & Michaelsen, 2012).

In its most standardized form, the TBL sequence consists of three main phases that combine face-to-face and distance learning (through targeted study) (Michaelsen & Sweet, 2008; Michaelsen & Sweet, 2011; Parmelee et al., 2012):

- Preparation: pre-classroom learning activities that students perform individually based on study materials.
- Readiness assurance process: class work–generally in a face-to-face session–to diagnose the students' learning stage and provide feedback to prepare them for subsequent work with more complex problems. This phase includes:
  - Initial individual test about key ideas, usually in the form of a multiple-choice test.
  - Conducting the same test in teams that must reach consensus before responding.
  - Immediate feedback from the instructor that makes it possible for the team to discuss and defend their responses.
  - Brief explanation by the instructor to clarify points related to incorrect responses.

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- Application activities: performing, in one or more sessions, teamwork activities oriented to the practical application of previously addressed content. At this stage, the various teams seek to respond to significant problems and also receive feedback as quickly as possible so that, if necessary, they can again defend their responses (Parmelee et al., 2012).

Properly (and successfully) implementing this TBL sequence requires several elements. First, permanent work teams must be created strategically (Michaelsen & Sweet, 2008; Michaelsen & Sweet, 2011). Second, students must take responsibility for their individual and group work (Michaelsen & Sweet, 2008). And finally, students need to receive early feedback (Michaelsen & Sweet, 2008; Sweet & Michaelsen, 2012), which can sometimes draw on peer evaluation (Michaelsen & Sweet, 2011; Parmelee et al., 2012; Sweet & Michaelsen, 2012).

Positive learning outcomes (Gast, Schildkamp, & van der Veen, 2017; Fatmi et al., 2013; Sisk, 2011) have led to TBL being extended to a range of disciplines (especially health sciences). However, its origin within the framework of business schools continues to be reflected in current studies that, like ours, demonstrate its use for teaching and learning in economics and business (see, for example, Abío et al., 2019; Espey, 2012).

Method

Context and proposal of the TBL process

The study was carried out during the 2018-19 academic year in five groups of students from the Bachelor's of ADE of the Faculty of Economics and Business of the University of Barcelona, in the second-year compulsory course World Economic Environment. The course objective was for students to increase their knowledge of how the world economy operates and improve their analytical and critical capacity.

The disciplinary content addressed by the TBL was the economic analysis of inequality from 1980 to the present. This topic is one of the first on the syllabus and is a central issue in the course, reappearing when students learn about the growth model during the years of neoliberal capitalism and the causes of the global financial crisis of 2007/08. As

such, students' learning of this topic at its first introduction conditions the remainder of the course. We adjusted the standard TBL structure according to the characteristics of the material at hand to include two phases: preparation (including conceptual and applied work) and learning assessment (also including conceptual and applied work).

During the preparation phase, the students conducted the pre-study guided by two texts by the Serbian-American economist Branko Milanovic (2011; 2014), a renowned specialist in issues of global inequality. The first text met the requirements of both accessibility and rigor, conditions not always easy to meet in economics. This text was complemented by a second text by the same author that addressed more specifically one of the topics of the first text: how globalization has affected the unfolding of inequality internationally. Each student had to devise a summary outline that would be the only material he or she could use during the next phase; the aim was to encourage prior preparation in order to enhance understanding and reflection.

The second phase, which took place face-to-face in the classroom (at exception of the initial test), had four steps:

- Individual response to the initial test (Ci) that addressed both conceptual knowledge and its application (thus advancing the application stage of the TBL). The conceptual questions allowed us to detect whether the students had comprehended key ideas and analytical tools for the economic analysis of inequality. The application questions allowed students to demonstrate their competence by interpreting the economic indicators that measure inequality, as well as its causes and economic and socio-political impacts, in order to verify their reflexivity and critical perspective.
- Team response to the same test (Cg). To this end, teams of four students were randomly selected, and they agreed on their answers to the conceptual and application questions. At this time, the students could only make use of the summary outlines they had drawn up individually before class. During this stage, the instructor interacted with the groups, seeking to maintain a balance between their autonomy and their need for assistance.
- Immediate feedback on Cg and the opportunity to defend responses in the large group. Students remained seated with their work teams and group participation was encouraged.

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- Brief explanation in which the instructor answered questions and offered the main conclusions to ensure that students had understood the material.

Sample

The TBL process was carried out with a total of 318 students distributed across five second-year class groups of the Bachelor's of ADE: G1 (n=84), G2 (n=81), G3 (n=53), G4 (n=59) and G5 (n=41) selected through intentional convenience sampling. The five groups were taught by the same teaching team. Their personal information was anonymized according to ethics protocols. The groups had been formed following an enrolment process according which the student with the best academic record has first choice and the groups are gradually filled until they reach the enrolment maximum. The groups with a more attractive timetable end up with a greater number of students. Given this enrolment process, the order of enrolment and the order in which the groups filled serves as a rough proxy for the average academic record of the students in each group. G1 and G2 had the strongest academic records, while G3, G4 and G5 had average academic records that were similar to each other and weaker than those of G1 and G2.

Data collection and analysis

We collected data at three different times and through two tests (Ci and Cg) and the final course exam (Pfa). Ci and Cg were identical and consisted of 17 questions about the economic analysis of inequality. Five of these questions were related to conceptual knowledge and 12 were related to the application of that knowledge. Ci and Cg were conducted following the TBL process: individually before class and then in class in teams that had to reach consensus on their answers.

The Pfa, carried out at the end of the course, incorporated an application activity related to the notion of inequality. The application activity in the Pfa was identical for three of the groups (G1, G4 and G5) and incorporated a slight change in the other two (G2 and G3). We included this difference to reduce the possibility that students taking

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the exam earlier would inform other groups of the questions. This protocol is acceptable in TBL, according to which questions should focus on the same type of problem and generate the same type of decisions (Michaelsen & Sweet, 2008).

We conducted a quantitative statistical analysis separately for conceptual knowledge and its application, comparing average scores and passing rates overall (across the five groups as a whole), within groups and between groups. The minimum passing score 5 out of 10.

According to the statistical significance of the Moodle questionnaires, the basic statistics for each sample confirm their validity, with a low standard deviation for both Ci and Cg. This low standard deviation indicates the narrow dispersion of the data around the average, as well as a value of around -1 for the asymmetry coefficient, which meets the discrimination requirement between scores (Table 1).

TABLE I. Sample statistics

	G1		G2		G3		G4		G5	
	Ci	**Cg**	**Ci**	**Cg**	**Ci**	**Cg**	**Ci**	**Cg**	**Ci**	**Cg**
Average	6.83	9.60	5.70	8.70	6.30	8.50	5.00	8.50	5.10	8.30
Standard deviation	14.43	4.24	16.64	8.21	15.75	9.25	15.71	13.94	16.05	7.94
Median	6.8	9.4	6.0	8.7	5.9	8.5	5.2	9.3	5.3	8.3
Asymmetry coefficient	-0.3	-0.6	-0.6	-0.2	0.5	-0.2	-0.2	-0.2	-1.3	-0.6
Number of cases	84	84	81	81	53	53	59	59	41	41

Source: Authors

Results

The first objective of this research was to describe how–in terms of the percentage of students passing and their average scores–knowledge about the economic analysis and inequality (both in conception and application) changed overall, within groups and between groups from the initial individual test (Ci) and the same test taken later in groups (Cg).

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With regard to overall change for the total sample, the data presented in Table II show clear growth between Ci and Cg, whether we differentiate conceptual knowledge and its application or analyze them together. This fact is reflected in the average score and its increase by nearly three points (out of a total of 10).

TABLE II. Percentage of passing students and average score

	Average five groups		
	Ci	**Cg**	**Pfa**
% passing, conceptual knowledge	39.1	80.0	n/a
% passing, application	67.1	90.4	66.6
% passing overall	58.9	87.3	n/a
average score	5.89	8.82	n/a
% change in average score (Ci to Cg)	+49.8		n/a

Source: Authors

This positive development is also reflected if we analyze the intragroup data from the five groups, an important step considering the intergroup differences in the academic record of the enrolled students. As Table III shows, and as was the case overall, all groups show clear growth between Ci and Cg, for both conceptual knowledge and application (taken separately or together) when we examine average scores and their percentage change.

TABLE III. Percentage of students passing and average score per group

	G1			G2			G3			G4			G5		
	Ci	**Cg**	**Pfa**	**Ci**	**Cg**	**Pfa**	**Ci**	**Cg**	**Pfa**	**Ci**	**Cg**	**Pfa**	**Ci**	**Cg**	**Pfa**
% passing, conceptual knowledge	53.4	90.7	n/a	36.4	82.6	n/a	35.4	62.9	n/a	30.9	85.9	n/a	31.8	66.4	n/a
% passing, application	74.3	97.8	83.5	67.2	88.8	57.8	71.8	85.8	58.9	57.7	86.6	60.7	59.5	90.0	67.4
% passing overall	68.2	95.7	n/a	58.1	87.0	n/a	61.1	79.1	n/a	49.8	86.4	n/a	51.4	83.1	n/a
average score	6.83	9.60	n/a	5.70	8.70	n/a	6.30	8.50	n/a	5.00	8.50	n/a	5.10	8.30	n/a
% change in average score (Ci to Cg)	+40.6			+52.6			+34.9			+70.0			+62.8		

Source: Authors

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These positive results demonstrate the influence of group work on the learning outcomes of students for both conceptual knowledge and its application. However, as reflected in Table III, the starting point in the percentage of students receiving a passing score for conceptual questions was always lower than that of students receiving a passing score for the applications. This pattern generated, in turn, a greater change in the percentage of passing scores for this type of questions in Cg (with the exception of G5 and, especially, G3).

The extreme cases illustrating this trend in the results between Ci and Cg are represented by groups G3 and G4. G3 is the group showing least growth group between Ci and Cg, with 27.5% more passing in conceptual issues, 14% in application, and 18% in the combination of both. It is also the group in which the score between Ci and Cg improves the least, although this smaller improvement is enough to place the average score at 8.50. A deeper analysis of how this group solved the questions shows that this smaller increase has to do with the fact that a particular question, both in Ci and Cg, had few correct answers (it was answered correctly by 10% of students in Ci and by 7% in Cg).

At the other extreme, we find the case of G4, which showed the greatest increase between Ci and Cg. The score in this group increased by 70% and the percentage of passing scores combining conceptual and application issues increased by 36.6%, an increase that is also seen in the percentage of students passing in conceptual knowledge (55% more) and its application (28.9% more, behind only G5).

Our second objective was to describe how this knowledge and its application changed–in terms of the percentage of passing students–overall, within groups and between groups from the Ci to the final individual course exam (Pfa). With regard to the overall change for the total sample (Table IV), we find no improvement between Ci and Pfa for application (in fact, overall, there is a slight decline in the percentage of passing scores related to application). However, analyzing the intra- and intergroup level (see Table III and Table IV) serves to highlight how this lack of overall positive changes does not occur in all groups.

TABLE IV. Percent change in application of knowledge between Ci, Cg and Pfa

	G1	G2	G3	G4	G5	Overall
Change in passing scores, application between Ci and Cg	+23.5	+21.6	+14.0	+28.9	+30.5	+23.3
Change in passing scores, application between Cg and Pfa	-14.3	-31.0	-26.9	-25.9	-22.6	+23.8
Total change in passing scores, application Between Ci and Pfa	+9.2	-9.4	-12.9	+3.0	+7.9	-0.5

Source: Authors

As can be seen in Table IV, the percentage change of passing scores for application issues between Cg and Pfa is negative for all groups. However, while this decline does not reverse the growth experienced between Ci and Cg in the case of groups G1, G4 and G5, for G2 and G3 the decrease between Cg and Pfa completely reverses their previous growth and, moreover, reverses the overall increase for the total sample (although by only 0.5%).

Discussion

The data gathered in relation to our first objective suggest that the TBL process enabled an overall improvement for the five groups in terms of percentage of passing scores and average score. As noted in the results, the immediate impact of the teamwork was better test results; this happens whether we look at the total sample (see Table II) or within groups. Thus, the results of this research are consistent with previous literature about the effect of peer discussion and teamwork on student learning (Allen et al., 2013; Willett, Rosevear, & Kim, 2011; Zgheib, Simaan, & Sabra, 2010; Zingone et al., 2010).

The data also show that the impact of teamwork is present for both conceptual knowledge and its application. The impact was especially strong for conceptual knowledge, which started from a lower percentage of passing scores, thus showing that teamwork also serves to improve basic cognitive processes such as remembering and understanding (Anderson & Krathwohl, 2001). Interestingly, students passed at a higher

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rate on application questions than conceptual ones, both on Ci and Cg, in all groups (see Table III). This finding–a subject for further study–suggests that even with superficial or incipient conceptual knowledge, the student may already be able to successfully answer questions related to its application.

Continuing with this first objective, intra- and intergroup analysis showed that the two extreme cases in terms of the change between Ci and Cg were G3 and G4. For G4, the positive change is explained by the fact that the group started with the lowest scores and passing rates on Ci. This low starting point made it possible for its scores and passing rates to increase more than those of the other groups, although, in absolute terms, the rating of this group is the second lowest (equal to G3 and ahead only of G5). This type of significant growth in students with lower scores has been found in previous studies on TBL (Koles et al., 2005). In contrast, the same argument, inverted, is not applicable for the case of G3. In this case, this is not the group that started with the lowest scores and passing percentages (in all cases, G1 is higher), which could explain its lower relative growth. A more detailed analysis of how this group answered the questions, as noted in the results, shows that the smaller increase in this group was due to a misconception that remained unresolved in Cg. This finding underscores the importance of the brief post-group explanation for resolving doubts and ensuring learning (Parmelee et al., 2012; Sweet & Michaelsen, 2012).

We had a second objective related to the change in scores for knowledge application between Ci and Pfa. Overall, we observe that the positive development observed between Ci and Cg, the result of teamwork, is reversed–partially or totally–when students later had to respond to an application question on their own on the Pfa. Unlike what we observed for conceptual knowledge, the TBL does not appear to have had a positive impact on more complex cognitive processes, unlike what other authors have previously suggested (Allen et al., 2013; Imazeki, 2015).

The fact that, some time later and in the context of a final individual exam, the percentage of passing scores is lower than what we found within a team-based test conducted in the classroom is not surprising, and this outcome has also emerged in previous studies about TBL (Espey, 2018). However, our intergroup comparison allowed us to observe that

the change between Ci and Pfa differs between, on the one hand, G1, G4 and G5, and, on the other hand, G2 and G3.

For G1, G4 and G5, we observed a positive change between Ci and Pfa. For G4 and G5 the percentage increase may be attributed to the fact that these groups started from a lower percentage of passing scores on application issues (see Table III). However, this reasoning cannot apply to G1, the group that started with the highest percentage in Ci and which nevertheless showed the most improvement. This change highlights the characteristic of this group that we noted when describing the sample: G1 (along with G2) was made up of students with the strongest academic record, a feature that also manifests itself in the higher average scores and percentage of passing scores that this group obtained (see Table III). In this sense, the results are consistent with Espey's (2018) observation about the impact of the average scores of the participating student on learning results during the TBL.

However, while we have pointed out for G1 should also apply to G2, the results reflect that this group experienced a remarkable setback in the percentage of passing scores, something we also observed in G3. We attribute this outcome to the fact that G2 and G3 received a slightly different Pfa (to prevent students from sharing the questions across groups). TBL theory permits slightly different application activities. Michaelsen and Sweet (2008) suggest that all students should resolve comparable problems so that they have to make decisions of a similar nature and therefore their results can be compared. In later work, these authors (Michaelsen & Sweet, 2011) specify that the problems addressed must be the same. Our results show that comparable but not identical problems can result in different learning outcomes and scores, suggesting that knowledge application work should be carried out with questions that are identical and not merely similar.

Conclusion

We sought to uncover how a group of students from the Bachelor's of ADE progressed in relation to their knowledge (both in concept and application) of the economic analysis of inequality through TBL. On the one hand, we observed that TBL enabled positive developments in relation to conceptual knowledge of the economic analysis of inequality

in all groups, mainly as a result of teamwork. We have pointed out the importance of the teacher offering a brief explanation at the end of the TBL to clarify doubts that may have remained even after teamwork.

On the other hand, we have shown that for the application of knowledge about inequality, there is a reversal in the percentage of passing scores between the results obtained through working as a group and the results subsequently obtained individually. What set apart the groups that maintained an overall positive change from those did not was the activities carried out for the Pfa. Our analysis suggests that comparable–but different–application activities might have impacted learning outcomes. This leads us to suggest that applied work in TBL be carried out with identical activities and that the practical matter of how to prevent cheating be resolved in a different way.

Finally, this research has some limitations that future work could address. First, the context in which the students take Ci, Cg and Pfa is different, and future research should address how different aspects of the context (related, for example, to emotions or time) affect the data collected. Second, this research offers a quantitative analysis that would be enriched by a qualitative analysis of, for example, how group work proceeds or what students perceive about their own learning during TBL and the instruments used. Finally, we have pointed only tangentially to a new dimension of study regarding whether and how students with superficial conceptual knowledge can accurately respond to questions related to the application of this knowledge.

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