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Strengths, Limitations and Challenges in the Implementation of Active Learning in an Undergraduate Course of Logistics Technology*

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Teaching strategies have been used by several Higher Education Institutions to improve learning rates. In this context, international surveys have identified Active Learning as a methodology that provides students with the ability to be co-authors of their own learning process in which they occupy the central role. Professors also play an important role of process mediators through this methodology. Thus, strategies such as problem-based learning, collaborative learning, peer assessment, flipped classroom, among others, have been identified by experts as Active Learning approaches that increase learning rates. It so happens because it improves autonomy in reading, self-learning, discussions in pairs, information sharing, researches and discoveries. Despite the foregoing, Active Learning implementation in a higher education course is not an easy task, thence this research seeks answers to the following question: ''What are the main strengths, limitations and challenges to implement Active Learning in a higher education institution?''. In order to answer such a question, this paper aims to present a case study on the implementation of Active Learning in a higher education program. The object of this research is an undergraduate course in Logistics Technology of a Brazilian institution, with emphasis on its implementation actions, feedback from students and professors and experiences obtained from the discipline of Statistical Methods, which is considered as pilot project. In order to better understand its theory, a literature review of Active Methodology is going to be presented in the first and second sections, the third section is going to highlight some international experiences, its methods are going to be presented in the fourth section, and discussions of the case study and research conclusions are going to be shown in the fifth and sixth sections, respectively.

Keywords: active learning; strengths; limitations; challenges; implementation; higher education; logistics

1. Introduction

The search for teaching strategies that maximize students learning rates is one of the challenges posed to Higher Education Institutions (HEI). Many efforts are being channeled in order to motivate, attract and engage students in their learning processes [1, 2].

Traditional teaching methods such as oral presentations, writing and learning exercises have been questioned by educators [1] and their effectiveness are under discussion.

Students' knowledge acquisition is the main feature of a theoretical framework called as Constructivism, in which human intelligence is not considered solely as an innate process. It is also a result of an interaction between individuals and their surrounding environment, in which they act in response to external stimuli, thus building up and organizing their own knowledge [3, 4].

Some constructivist theories emerged from the use of Active Learning (AL) [5] and surveys indicate it as a tool to ensure a closer relationship between theory and practice, since it provides students with the ability of being co-authors of their own learning process in which they occupy the central role. Another important feature of AL is that professors play the role of mediators [2].

AL implementation in HEI is a difficult task, thus project implementation planning and curricular restructuring actions are needed. Thereby, the present research question is: ''what are the main strengths, limitations and challenges to implement AL in a higher education undergraduate course?''

To answer such a question, this research is aimed at analyzing AL implementation in a Brazilian Higher Education Institution.

Hence, a case study research has been conducted in an undergraduate course of Logistics Technology. The results reveal the need to create a specific environment for collaborative teaching, structure the course curriculum, change the culture among

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students and professors, increase the professors' capacity, use the Information and Communications Technology (ICTs), have institutional incentives, among other factors that are just a few of the challenges yet to be faced.

For setting its theory, a literature review about AL will be presented in the second section, international items of research will be highlighted in the third one, methods will be shown in the fourth section, and the fifth and sixth sections will present the research discussions and conclusions, respectively.

2. Active Learning as learning methodology

The use of teaching strategies that more effectively explore the relationship between theory and practice has been pursued by educators and educational institutions that seek a more substantial graduation that is focused on the development of skills and competencies necessary for future professionals [6]. In order to do so, students need to be involved in their own learning, which must be one of the professors' main responsibilities [7].

Students must be encouraged to understand the basic concepts and relations of a particular theory and learn to use them in order to solve problems [1]. Their challenge yet to be faced is to learn how to interact with others, to voice and accept criticism, to listen and understand alternative points of view, which are also some of the premises for future professionals [1]. In addition, a major challenge for universities is not to provide students with thorough in-depth knowledge, but to help them build it up through their own experiences[7].

It is in this context that AL emerges as a methodology which is based on student-centered education and skills development, which is usually defined as any type of instructional approach (activity) that engages students in their own learning [7, 8]. Among these activities, there is reading, writing, group work, peer discussion, seminars, debates, case studies, simulations, etc.

Unlike traditional classes in which students end up being passive spectators of information sharing and the professor is the central and dominant knowledge holder [7, 9, 10], AL is no longer focused on information transmission and knowledge acquisition.

Some teaching approaches based on AL are: PBL-Problem-based Learning [3, 6, 7, 11, 12]; PBLa-Project-based Learning [13–15]; CL-Cooperative Learning [6, 11, 16, 17]; CLA-Collaborative Learning [8, 18–20]; Flipped Learning [21]; Peer Assessment and Peer Instruction [1, 20, 22], so that students are encouraged to work in small groups with real-world problems and professors occupy the fundamental role of facilitators in the teaching-learning process [4].

3. Active Learning implementation experiences

Some AL implementation experiences will be presented in this section as a basis for the results discussion.

[23] reported a description of its implementation experience and PBL model refinement in an undergraduate course of Pharmacy in the University of Mississippi within a period of ten years. A few important highlights of this research are:

- There was an outright rejection of the traditional education model;
- A group of professors was formed to identify barriers in the transition between PBL and the traditional teaching model;
- The course curriculum and assessment needed to be systematically modified (group and individual assessments, and problem-solving skills);
- Initially, there was no consensus among students as for the new educational proposal acceptance;
- Concern about the new methodology effectiveness has created the need for some additional lectures to be held in order to ensure content acquisition;
- After five years of implementation, there was a need to refine the project due to concerns about PBL effectiveness;
- After restructuring the objectives, curricular changes and project assessment templates completed ten years of implementation with substantial gains.

[1] point out that the lack of suitable educational materials for using AL is, more precisely PBLa and Peer Instruction in Engineering courses, one of the main barriers to its implementation, and the development of exercises is one of the most challenging tasks to be faced by students. Furthermore, it is interesting to use real problems in groups of two or three students to increase peer motivation and collaboration. Surveys with students have confirmed the importance of collaboration.

Still regarding engineering education, [7] asserts that before adopting AL practices, professors should familiarize themselves with its literature, particularly on various teaching strategies. By doing so, they can come to a conclusion about "what works" and "what does not work". The author presents three ways for implementing PBL:

- Micro level: PBL is applied to some specific topics in one or two disciplines;

Table 1. Profile of participants surveyed in 2014

	Quantitative	Male	Female	Average Age
Professors	11	9	2	46.9
Students	26	15	11	25.2

- Macro level: PBL is applied to two or three modules of the third or fourth course year;
- Mega level: PBL is applied to every third or fourth course year.

According to this author, some reasons for its implementation are:

- Students' knowledge acquisition;
- Contextualized learning through real problems;
- Development of group work dynamics;
- Achieving higher understanding levels;
- Socialization skills and knowledge building.

The challenges to be faced are:

- Assessment models should be amended;
- Patience during problem-solving skills acquisition by students who were only accustomed to traditional education models;
- Institution commitment to learning systems deployment;
- Faculty members' availability; availability of resources and support services;
- Forming a main implementation committee in order to share experiences and introduce the PBL gradually and properly;
- Educating students and professors about the methodology effectiveness and sharing best practices.

[6] emphasize that the success of students in AL, with respect to a traditional engineering course methods, is due to greater student dedication to a particular subject, and that a challenge to be faced by them is hour load increase. [4], also as regards engineering education, comment that the main challenges will be an increase in college professors' availability and academic resistance to change.

[21] conducts a literature review on twelve articles that study the effects of Flipped Learning in a Chemistry course. Among the author findings, it can be highlighted the use of screencasts, quizzes, clickers and readings as extracurricular activities, more time for group discussion and seminars, and problem-solving in the classroom. [21] also highlights some strengths, which are:

- Increased students dedication to a particular theme;
- Opportunities to learn at their own pace;
- Possibility of introducing a pedagogically wholistic curriculum.

The items surveyed by [21] indicate a nearly unanimous consensus among students that this type of approach is better than the traditional one. Notwithstanding, some students have made negative remarks about the difficulty in organizing extracurricular time with everyday activities, which indicates their preference for traditional classes. In some articles, students reported that they had several difficulties in adapting to the new methodology, and that its adaptation took a considerable amount of time. It was also observed a need to lengthen professors' planning time, which should be three times longer than the usual time to prepare traditional lessons. Finally, the author emphasizes that even though there is no single way to implement such a methodology for teaching Chemistry, the research was still remarkably consistent.

4. Methodology

A case study was conducted between 2013 and 2014 with an undergraduate course of Logistics Technology of a HEI located in Rio de Janeiro, Brazil. This undergraduate course lasts two years and is divided into four academic semesters. In the year of 2014–1, the course had 102 students, divided into three classes: the 1st period is equivalent to the first semester, the 3rd period is equivalent to the third semester and the 4th one is equivalent to the fourth semester of the college year. At that time, there were no 2nd period classes.

To implement AL strategies in this course, the HEI in question suggested the following actions:

(1) Two theoretical courses to train all professors of the institution in the year of 2013 for them to become familiarized with this type of approach;
(2) A project to build a Collaborative-Room (CR) mediated by ICTs in 2013;
(3) PBL, CL and FC courses in the CR to professors in 2013–2 and 2014–1;
(4) Implementation of AL in two units of the course plan of three disciplines by using the Micro level approach [7];
(5) Implementation of AL in the discipline of Statistical Methods by using the Macro level approach [7]. It should include the use of tutoring sessions, peer assessment, team-based learning, problem-based learning and flipped classroom.

Data collection was based on a qualitative approach by conducting surveys with 11 professors, Table 1, including three open questions about strengths, limitations and challenges of AL implementation. In addition, the five-point Likert scale (anchored by totally disagree and totally agree) was used in 19 questions asked to 26 students of the 3rd period of the Statistical Methods course, Table 1, besides the three open questions asked to professors. All analyses were qualitative. There was no interest in conducting quantitative treatments and population inferences.

4.1 Implementation steps

As pedagogical training at the beginning of 2013, the HEI invited a professor who is an expert at implementing the AL methodology to speak about this approach, describe its future prospects and the national and international scenario. The HEI objectives were to encourage a reflection about the traditional way of teaching and its implications on students training, present AL as an alternative teaching approach that can increase students learning rates, and encourage professors to be restlessness and motivated so as to break their paradigms.

The HEI and the Logistics Technology course coordinators decided to design an environment room for collaborative studies mediated by ICTs, which seats 50 students. This room was equipped with IT and furnished for collaborative studies. New trainings took place in the second half of 2013 in order to teach professors on the use of Active Learning, more specifically about PBL, CL and FC techniques, and also to suit them to use the CR. The figure of a ''facilitating professor'' was created during the project implementation. The idea was to place this professional as the one responsible for organizing trainings, analyzing teaching plans, monitoring room use and teaching techniques. At the beginning of the academic semester of 2014, the use of Active Learning approaches in the course has been initiated. In the disciplines of ''Project Integration'', ''Modeling and Simulation'' and ''Logistics Information Technology'', the implementation occurred only in one or two units of the course

Table 2. Some professors' and students' quotes about AL Strengths

Some quotes about Strengths	Condensed quotes	Interface with theory
Professors		
''When I applied the methodology in a Project Integration class with Logistics students, I realized that it is more objective and straightforward than traditional practices, so understanding the class goals is faster and more efficient. In addition, the collaborative room along with AL meets the requirements of the discipline, especially through audiovisual resources that are prepared for any type of school and group dynamics.''	• AL is more efficient than traditional practices.	[3], [6], [12], [16], [19], [21], [23]
	• CR along with the AL meets the requirements of the course.	[19]
''Students become autonomous with the central and active responsibility for their own learning; they learn how to work and solve real-world problems and, even in their native region, the model is more participatory, attractive and focused on skills acquisition. In the collaborative room, students use many media that are part of their daily lives, where knowledge is built up, and not only transmitted.''	• It helps the development of an autonomous individual.	[3], [6], [7], [13], [16]
	• They learn to work and solve real-world problems.	[1], [3], [7], [11], [13]
	• Use of CR and ICTs resembles real-world situations.	[8], [19]
''With a prior reading of the class material, we could optimize time management to solve real-world problems, supported by using the internet, electronic spreadsheets and group discussions. Despite my interventions in a few moments, the majority of students were able to understand the statistical techniques in a more autonomous way.''	• The previous activities optimize time management in class.	[6], [21]
	• The group discussion optimizes real-world problem solving.	[1], [4], [11], [13], [14], [17], [21]
Students		
''This course encouraged us to keep always practicing. We were given the same scope as professors. Learning made me truly understand the reason for each calculation and its application. We learned through daily contexts of personal and professional life.''	• Constant practice.	[1], [11], [21]
	• We saw daily contexts being used in personal and professional life.	[1], [4], [8], [13]
''Collaborative room classes helped my understanding. In my view, I could grasp more of their content with this method.''	• Better understanding.	[3], [7], [8]
	• It is possible to develop real solutions and analyses.	[4], [7], [8]
''Through problem-based learning, it was possible to develop real solutions and analyses. It produced better integration and teamwork, in addition to several results in different situations.''	• Better integration and teamwork.	[1], [7], [11], [13], [17], [21]
	• Day-to-day experiences.	[7], [8], [21]
''The discipline provided me with greater knowledge and learning experiences daily.''	• Learning technologies and practices.	[8], [14], [19]
''It was nice because I learned a lot more by practicing with technologies than by having lectures.''	• Learning with previous activities and teamwork.	[6], [14], [21]
''The professor involved us with current knowledge. I learn a lot more when I read at home. The learning group was significant.''		

plan. AL approaches were more thoroughly used in the discipline of ''Statistical Methods''.

5. Results analysis

In this section, some quotes from professors and students are shown, as well as their concerns about the studied theory. For such a purpose, three tables that highlight the strengths, limitations and challenges described by participants will be presented.

5.1 Data analysis of strengths

As regards the AL Strengths, Table 2 presents the perception of some professors and students.

In summary, the following strengths featured by professors and students can be highlighted: major efficiency at learning in relation to traditional teaching; the CR importance to desired goals; improvement in developing the students' autonomy; class time management optimization; constant action; applications of concepts in real-world scenarios; teamwork; socialization and group discussion; a better understanding of the studied concepts; learning improvement with previous activities and technology use.

5.2 Data analysis of limitations

As regards AL Limitations, Table 3 presents the perception of some professors and students.

As regards its limitations, the following can be synthesized: longer time to plan classes; constant guidance to students; lack of consensus among students about previous activities; an increase in cognitive load may generate stress; lack of dedication and distraction by some students; more hours in class and difficulty in using ICTs by some students. It is important to highlight that there is little emphasis on the limitations of its implementation among all studies found in literature, which places greater emphasis upon the potential of AL.

5.3 Data analysis of challenges

As regard the Challenges posed to using AL, Table 4 presents the perception of some professors and students.

With respect to its challenges, the following can be synthesized: institutional support for investing in technology, policies and human resources; constant training; professors' expertise in the method; curriculum restructuring; creation of new lesson materials; engagement of all actors; good planning development; resistance to change; perfect relationship between theory and practice; time optimization in class and a conciliation of daily activities with previous ones.

5.4 Data analysis closed questionnaire

As regards the questionnaire applied to students at

Table 3. Some professors' and students' quotes about Limitations

Some quotes about Limitations	Condensed quotes	Interface with theory
Professors		
''I observed that it takes longer for planning and for the class itself. Thorough understanding is required by students who must also be constantly trained and redirected as regards philosophy and methodology tools.''	• More time for planning.	[4], [7], [21]
	• Constant guidance to students.	[19]
''It was very difficult to convince students that out-of-class reading and group discussions are important. Some of them did not prepare the extracurricular tasks and said they preferred traditional classes instead. Culture change is essential.''	• There was no consensus among students about previous activities.	[21], [23]
	• Increase in cognitive load of students can lead to stress.	[6]
''Some examples of its limitations are: an increase in students' cognitive load may cause stress; unprepared professors; lack of concern regarding the results formalization; planning is much more careful than in traditional classes.''		
Students		
''(...) in my view, I realized that sometimes I might not have been dedicated enough for further development because sometimes I could not attend all lessons for personal reasons.''	• Lack of dedication by some students.	[21]
	• Distraction of some students.	[21]
''Many students work and had no time to read at home. The students' group was large. Students often got distracted.''	• More hours in class.	[4], [7]
	• The use of ICTs by some students.	[8], [21]
''Due to the rush of everyday life, I could not perform reading tasks in advance, then I had to read while some students were already ahead of me, who were also distracted which particularly bothered me.''		
''The low hour load offered to teach the methodology. Its duration could be extended.''		
''At the beginning, I had more difficulty in accessing the Google Drive, but once I learned how to use this tool, I had better performance.''		

Table 4. Some professors' and students' quotes about Challenges

Some quotes about Challenges	Condensed quotes	Interface with theory
Professors		
"For professors, the main challenge is the support from the institution, course coordinator and group dynamics professor for using this methodology. For students, I believe it lies on understanding the importance of this strategy for their professional skills development. For HEIs, it is the investment in technological tools, implementation policy institutionalization, investment in skills, lectures, workshops, trainings, technical visits to a group of distinguished professors."	• Institutional support. • Investment in technology, policies and human resources. • The quality of human and material resources. • Maintaining the training quality. • Method expertise. • Curriculum restructuring. • The creation of new lesson materials. • Engagement of all actors. • Development of good planning.	[7], [8] [7], [8] [7], [16], [21] [7], [8], [16], [21] [7], [16] [1], [7], [21], [23] [1], [21] [7] [4], [7], [16], [21]
"Planning should be improved by professors and course plans need to be restructured, class materials need to be created, successes and mistakes must be shared among professors, the institution should invest in training, and professors need to be committed with the academic proposal."		
"For all those involved with the methodology, the greatest challenges are: to know the method very well, understand the technique and its goals, push the idea forward, embrace its philosophy and practice, and always reevaluate it in a continuous improvement cycle for being one of the best educational options at the time. In addition, the professor's main challenge is to prepare a good lesson, and the student's is to be more active, participative and an element of change. For the institution, it is to maintain the quality of its trainings, professional resources and materials after deployment, and then to seek improvements."		
Students		
"Institutional resistance, teaching culture change and students' fixed ideas."	• Resistance to change. • Perfect relationship between theory and practice. • Time optimization. • Conciliating daily activities with previous ones.	[4], [7], [23] [1], [8], [13], [14] [6], [21] [6], [21]
"Teaching in a flipped classroom was a challenge because I had to conciliate other everyday tasks with the texts to be read."		
"The subject application in problems using real data and the use of programs."		
"Being able to optimize the subject to be taught in order to be increasingly productive and have a more practical purpose for Logistic studies use, if possible."		
"The greatest challenge of the professor is to make these lessons interesting enough in order to have no distraction. And the students' challenge is to adapt to the new teaching method."		
"For the professor, it is to organize the class and make students concentrate. For the student, it is to read beforehand, even though many of them do not have enough time to do so due to their job, family issues, etc."		
"In my opinion, the main challenge for students is to be the protagonist of their own learning process, and the professors' is to encourage their students to reach their goals and face the challenges of their learning process."		

the end of the Statistical Methods course, a better understanding of the methodology and study environment could be acquired. In the analysis below, where it shows "agreed", it means how often respondents "totally agree" (TA) in which "partially agree" (PA) was added, whilst where it shows "disagreed", it means how often the respondents "totally disagree" (TD), in which "partially disagree" (PD) was also added.

5.4.1 Perception about the methodology and future knowledge acquisition

Table 5 presents the relative frequency of the first six issues of the present research instrument. In question 1, 85% of students agreed with the need for completing classes by using Active Methodologies with lectures, which has led to the conclusion that, despite the collaborative environment, learning and motivation generated by AL, these students still do not feel autonomous enough to play the leading role in their own learning process. Nevertheless, there is some dependence on the professor as the sole holder of knowledge.

69% of students disagreed that classes with AL are poor, cause drowsiness and distraction. In question 2 which is about expository lessons, there was 62% disagreement. In question 3, although a larger group has considered that lessons with AL are good, there is still a large group that likes expository lessons. Thus, although students have accepted the new education strategy well, they are not ready to accept a radical change of methodologies yet. In question 4, 69% of students disagree that the level of difficulty of problems presented by professors was

Table 5. Perception about the methodology and future knowledge acquisition

	Assertive	TD	PD	I	PA	TA
Q1	I believe that the lessons with AL and CR should be complemented by lectures-based learning.	8%	4%	4%	15%	69%
Q2	Classes with AL are bad. I got very distracted and sleepy.	50%	19%	23%	0%	8%
Q3	The lectures are dull. The professor is talking while I am just copying.	27%	35%	27%	12%	0%
Q4	The level of difficulty of the problems presented by professors was hard. We could not solve them without their help.	35%	35%	12%	15%	4%
Q5	I believe I am ready to use the knowledge learned in Statistics in my daily and professional activities.	0%	0%	19%	27%	54%
Q6	I am not able to use the knowledge of statistics in my everyday and business life.	54%	19%	15%	8%	4%

too overwhelming, which means that, since they are working in groups, the perception of difficulty was not severely aggravated. In question 5, 81% of students agreed that they are prepared to use the knowledge gained in everyday and professional activities and, in question 6, 73% disagreed that they cannot use this piece of knowledge on a daily basis. Thereby, it is understood that, in their perception, there was great statistical knowledge gain.

5.4.2 Perception about the flipped classroom

As regards the use of strategies in the flipped classroom, as shown in table 6, 50% of students agreed that the out-of-class readings have developed their independent study techniques. However, 46% said that they were indifferent to such a development. This percentage similarity leads to a reflection on the acceptance of this type of strategy by students that have a working profile, i.e. students that work during the day and study in the evening are not exclusively devoted to studying. In question 8, 54% of students agreed that the extracurricular study generated significant learning gains, freeing up more time to answer questions in class, while 35% were indifferent about it.

In question 9, 69% of students disagreed that even after extracurricular study and practical classes, knowledge acquisition was low. Thus, it is concluded that, for this group, flipped classroom activities generated better performance in knowledge acquisition.

In question 10, which describes the change in culture among students as they were not prepared for extracurricular reading and group discussion yet, the response percentages were rather similar: 38% disagreed and 46% agreed that there should be such a change. Despite the closeness of relative frequency, most students considered that such a change is necessary.

As regards the availability of reading, in question 11, 38% of students agreed that readings should be carried out in the classroom because they did not have enough time for such at home, 27% disagreed with this statement and 35% were indifferent. Similarly, 31% disagreed that daily commitments prevented them from performing the extracurricular readings, against 31% who agreed and 38% who said they were indifferent. These answers were rather similar, thus satisfactory conclusions are impossible to be reached.

Table 6. Perception of the flipped classroom

	Assertive	TD	PD	I	PA	TA
Q7	Previous activities, prior readings and readings in class developed my independent study techniques.	0%	4%	46%	27%	23%
Q8	With AL, learning is more significant because a previous reading of the content at home provides us with more time to answer questions in class.	4%	8%	35%	27%	27%
Q9	Even though we had previously read and done the group exercises, we still had difficulties. We learned very little.	50%	19%	12%	8%	12%
Q10	There must be a change of culture among us. We are not prepared to perform extracurricular reading and carry out group discussions in class.	23%	15%	15%	23%	23%
Q11	Readings should be taken in the classroom. We do not have time to perform extracurricular readings.	19%	8%	35%	31%	8%
Q12	Because of my daily commitments, I could hardly ever do the readings in advance.	23%	8%	38%	19%	12%

Table 7. Perception about the use of ICTs and collaborative learning

	Assertive	TD	PD	I	PA	TA
Q13	I believe I had a better grasp of the Statistical content because learning by using tablets, notebooks, spreadsheets, etc. is like working in a company.	0%	0%	12%	50%	38%
Q14	I have not grasped the Statistical content because I prefer to learn through exercises from the book. I do not like to use tablets, notebooks, spreadsheets, etc. in class.	38%	12%	19%	19%	12%
Q15	It was great to have all classes' material stored online on a web cloud, so I always had access to what was being studied.	0%	0%	12%	19%	69%
Q16	With AL, learning is more significant because, with a group discussion, students help one another.	0%	4%	12%	23%	62%
Q17	With AL, I believe that I have retained more knowledge of statistics because, besides reading the concepts, there was a group discussion in class and the teacher answered questions from each group.	0%	0%	15%	19%	65%
Q18	When I am explaining a principle to a colleague, it seems as though I am learning more.	0%	4%	12%	23%	62%
Q19	When I explain a particular subject, I end up distracting myself and learn very little.	69%	12%	8%	12%	0%

5.4.3 Perception of using ICTs and collaborative learning

With respect to the use of ICTs and collaborative learning, Table 7 shows us that 88% of students, question 7, agreed that they had had better knowledge acquisition when using tablets, notebooks, spreadsheets, the internet and the collaborative classroom itself, which would be available items of equipment as if they were in a company.

In addition, 50% of participants, question 14, disagree that they do not grasp the concepts of Statistics, do not like the use of ICTs and prefer book exercises. In turn, 31% agree with this. In question 15, 88% agreed that it was good to have the classes' material available online on web clouds. Thus, it can be concluded that the students' perception, as well as ensuring a better grasp of concepts, the use of ICTs and collaborative classroom is well accepted and simulates real life scenarios.

In questions 16 and 17, 85% agree that the learning process is more significant with the AL methodology because group discussions enable students to help one another. In addition, there was a prior reading of the concepts, with later collaboratively research for solving problems with the professor working as mediator. In questions 18 and 19, the exchange of experiences between students can be emphasized, since 85% of students agreed that, when they were explaining a given subject to a colleague, they were apparently learning more effectively, and 81% disagreed that the exchange of ideas between colleagues generated evolution and concept acquisition. In conclusion, collaborative learning had provided good acceptance among students, and some of the goals of this strategy have been achieved through the present work.

6. Conclusion

From the discussions in sections 3 and 6 of the present study, it is found that AL implementation is not a simple task, and that not all individuals involved in the process have totally accepted it. To achieve success in its implementation, not only a culture change, but also breaking paradigms between institutions, professors and students is necessary. The belief that a mere construction of a collaborative learning environment is enough to engage students and professors is doomed to frustration. Having greater commitment to the contents to be studied (extracurricular activities and in class) is one of the main challenges to be faced by students.

There is a need for a structural change in the project: the course curriculum, assessment method, planning, professors' workload availability, appropriate teaching materials development, professors training, collaborative study environment maintenance and formation of a central committee for its implementation.

Regardless of the challenges yet to be faced, it is proven that AL provides future graduates with a better development of their professional skills, moreover, it allows the construction of collaborative knowledge and provides them with greater autonomy. It also promotes socialization, and enables them to experience real issues so as to relate theory with practice more closely. In addition, this research reveals that, despite the challenges faced during its implementation in a Logistics Technology undergraduate course, most students and professors have accepted this practice well.

As suggestions for further research, a longitudinal study ought to be conducted with the aim of

implementing the AL in other institutions and offer more courses with other students and professors. Knowledge Management tools should also be used to share best practices and shortcomings during implementation processes.

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