A New Blended Learning Management System

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***Abstract*:** In this paper, we describe the challenges faced in the implementation of active learning methods in the subject of Computer Network & Data Communication. The experiences resulted in a blended methodology which combines collaborative and problem-based learning and flipped classroom with a learning management system. Popular apps and social networks were used to enhance the communication between students and teachers. A comparative study shows that the students' performance and the quality of the developed activities in the subject were improved under active learning in comparison to Traditional Lectures, and transversal skills could be developed, such as teamwork, leadership, self-confidence and autonomy in decision-making.

Keywords— Problem Based Learning, Learning Management Systems.

I. INTRODUCTION:

Most conventional teaching environments teachers use the limited class time for the transmission of new subjects and concepts. However, neither always this class period is enough for the students clarify your doubts[1],[2].

In addition to this limitation, studies show that in traditional Teaching (MTE), the majority of students do not involved in the learning process. Thus, the activities that they develop, are often summarized transcribe the content passed by the teacher. In some cases, they spend their time accessing social or sleeping during explanations[3],[4].

This lack of stimulation to the active participation of the students result in some aspects detrimental to the process of teaching/ learning, such as teacher dependence activities and the lack of interdisciplinary studies during the course[5],[6].

Active Learning (APA) emerged as an alternative to MTE. In APA, students are inserted into the learning process, being attributed to them the activities, analysis and discussion of the results obtained. In this way, they become responsible for learning, to do so, to read, write, discuss and engage in the problem solving[3],[6].

This insertion makes the practical activities adopted in the active methodologies able to develop desirable professional skills in students of technological courses, such as teamwork, leadership, self-confidence and autonomy in decision making[4],[7].

These characteristics led to the use of APA in the discipline of Communication in Computer Networks (CRC) of the technical level of Maintenance and Support in Informatics (MSI). The alteration of the curriculum of the discipline arose due to the high failure rate, lack of interdisciplinary aspects and lack of student motivation. The methodologies adopted in the research, which consider the characteristics of ApA, were Problem Based Learning (ABP) and Inverted Class (AI). This work aims to present the relevant aspects of the adaptation of teaching methodologies applied to the CRC discipline and to detail the process of developing a hybrid learning model adjusted to the needs of professional education. The methodologies used were evaluated based on student achievement and a qualitative analysis of students perspectives regarding the discipline and teaching methodologies used. The rest of the paper is organized as follows: Section II introduces the characteristics of the subject and presents the evolution of the methodologies adopted in the research, including the justification of the use of each one. Section III describes the evolution of the CRC curriculum. The results obtained with each methodology are presented and analyzed in section IV. Finally, Section V presents the conclusions of the research.

II. METHODOLOGIES OF TEACHING-LEARNING IN DISCIPLINE:

The discipline of CRC is part of the third and final module of the course and aims to train professionals capable of performing the configuration of equipment and services of networks and understand basic concepts of traffic analysis. During this period it was observed that many students haven't shown much interest.The reasons were almost always related to the students' need to work during the class period or to disinterest in the discipline. The disinterested ones usually evaded after the first evaluation, since they realized that the probability of approval was low due to the unsatisfactory scores. The evaluation criteria adopted were written tests and exercise lists. According to the students, this low income was mainly related to the high volume of theoretical content associated with the low amount of practical activities. In addition, lack of communication between disciplines was another factor that impaired learning, since contents that were prerequisites for CRC were usually not taught. Based on this information and the perspectives of the students and the teacher, it was observed that the following aspects should be worked on to improve the teaching-learning process in the discipline: The MTE prioritized theory, leaving the discipline lacking practical activities; The few practical activities that students performed were to replicate what was presented; The students were dependent on the teacher to perform the practical activities, proving themselves incapable of searching for alternative solutions or correcting any flaws; The interdisciplinary and cross-cutting aspects inherent in vocational training were not explored.

A. Problem-Based Learning As suggested in [8], significant learning outcomes are a consequence of a process that contains a set of activities, being discussed by a group of students and mediated by a facilitator.

In this context, the characteristics reported in the literature on active teaching methodologies [6] and [7]came from the problems identified in the first CRC classes and, for this reason, the development of an applicable active learning model the discipline.

According to [9], the activities developed in the BPA promote a collaborative environment that has as its starting point the presentation of a real, poorly structured problem for which students should seek a solution. This makes learning self-directed in the teaching environment provided by the teacher who assumes the role of facilitator and counselor. Thus, students are encouraged to seek the information needed to solve the problem presented and to question whether the proposed solutions lead to satisfactory results [9].

These planned pedagogical actions are important in motivating students to participate in the learning process by integrating study groups and research practices [10]. In addition, it has been reported in [2] ,[5] and [11] that interdisciplinary aspects and transversal skills such as self-confidence, teamwork, leadership and autonomy can be developed. Due to these characteristics, the BPA started to be used in the discipline and was evaluated for three consecutive semesters. However, punctual adjustments were necessary between one semester and another, including improving students' adaptation to the new methodology._The adoption of ABP has made the discipline more practical and attractive for students. In addition, the interdisciplinary aspects of the course began to be explored and related content disciplines were integrated, developing the habit of periodic teacher meetings to define activities and communication strategies between curricula. However, a relevant aspect perceived in the BPA was that with the large amount of information currently available, especially on the Internet, students' searches sometimes resulted in the use of unreliable sources or of ready-made, specific clarifying the concepts involved in the solution. Thus, many of them were able to present a solution to a problem, but could not explain how it was obtained. It became clear, then, the need to monitor the sources of information used by students. However, checking all the references presented in each activity would require a lot of time. Instead, it was decided to develop the study material provided to students as a way to minimize the use of unreliable sources.

B. The Inverted Class In order not to reduce the responsibility attributed to the students to the BPA, nor to experience their dependence again with the MTE, as of the second semester of 2014, part of the CRC discipline was adapted to the Inverse Class methodology (AI)[12],[13].

AI is a comprehensive instructional model that includes instruction, research, practice, and formative assessment and allows teachers to reflect and develop quality learning that involves opportunities and options for internalization, and content application [14].

AI's goal is to get the student to study the theoretical content outside of the classroom and to use face-to-face meetings to carry out activities. For this, it is up to the teacher to prepare or select supporting materials. The model was called "inverted class" because the activities that used to be presented in face-to-face classes were intended to be done at home, and the homework exercises, which used to be "homework", are now solved in the classroom of class [14].

C. The Learning Management System to optimize the changes in the discipline, the teaching-learning process with the active methodologies was supported by a Learning Management System (SGA) [15],[16].

The definition of SGA can be understood as any digital resource that assists the educator in the construction of knowledge. These tools have specific functions and are adaptable to the learner's cognitive style[17]. The SGA adopted in the CRC discipline was the Moodle (Modular Object-Oriented Dynamic Learning Environment)[18], which has interactive resources that can be exploited for mixed learning, such as content sharing and repository, evaluation and support environment to the development of dynamic activities[19]. In addition, applications such as Whatsapp, YouTube and Google Apps served as support for the construction, sharing of material and communication between facilitator and students.

III. STRUCTURE AND ACTIVITIES OF DISCIPLINE CRC:

Applying active learning methodologies require much more than simply changing the way of delivering the content. In the second half of 2011 and in 2012 the MTE was used in the learning process. The flow of developed activities can be observed in Fig.

Traditional Method of Teaching (MTE) - (2011 / 2-2012):

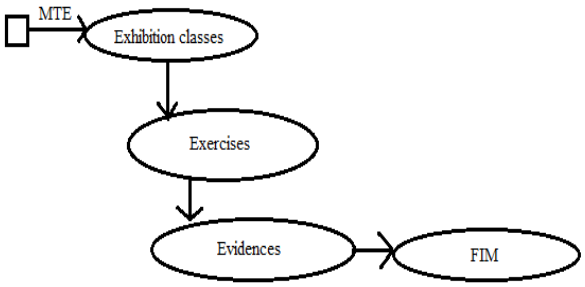

Figure 1. Flow of MTE activities in the CRC discipline.

From 2013, the use of active learning began. Two methodologies were used in this period. During the year 2013 and the first half of 2014, the BPA was adopted as the active teaching methodology. From the second half of 2014 the hybrid method was used.

Before the execution it was necessary to carry out a study on what contents could be adapted to the characteristics of the active methodologies. It was observed that the evaluations of the CRC discipline were centered in three well defined areas: theoretical revision, use of simulators of computer networks and practical activities with physical equipment

Thus, to take advantage of the active methodology, the discipline was divided into phases, so that each phase would be composed of the predicted content in one of the mentioned areas. For the complete training of the student, the content of the discipline was distributed between the phases in order to allow the development of theoretical concepts, the specification and dimensioning of equipment, the use of simulation tools and the configuration of physical equipment.

Phase 1 sets the transition environment for active learning. In this phase a theoretical revision of the basic concepts and relevant aspects related to computer networks is carried out. It is dedicated 24 hours to the activities of this phase, whose objective is for the student to understand the differences between network assets and to know how these equipment are organized in an organizational structure. By being theoretical, this content is inappropriate for the use of BPA and, therefore, it was taught based on the MTE.

Understood these concepts, in phase 2 activities are performed with network simulators. The idea of using simulation is to allow students to understand the functioning of a computer network, to rely on the help of these tools to verify if the solution proposed by them works and help in the identification and correction of problems. In this way, it is possible to focus on the configuration of equipment and allow students to visualize their solutions, without the need to make physical connections and without the risk of damaging physical equipment.

At phase 2, students perform activities involving static and dynamic routing techniques and practices aimed at network simulation. The workload for this phase is 42 hours. The results produced by the teams and the implementation stages of the proposed activities were recorded on video by students and posted on YouTube. In this way, the step-by-step implementation could be accessed by anyone, in a freeway.

At the time of posting students were instructed to standardize the title of the publication, including the abbreviation "CRC" and the name of the activity developed, including to facilitate the searches. These works were presented in a poster sample held in the last week of phase 2.In phase 3, students no longer use the simulators as a support tool and begin to configure physical equipment, such as switches, routers and servers appropriate for the installation and application configuration. All structured cabling organization is performed in the Hardware Laboratory (LH). To do this, they must be able to interpret diagrams developed in the previous phase and relate the aspects addressed in the simulations with the characteristics of the equipment.

Having configured the network equipment available in the Laboratory of Networks (LR) and established the communication with the internal network of the laboratory, some errors are generated in this environment and the students develop activities of analysis and correction of failures. This phase is composed of 54 hours and all the activities developed were based on the BPA.

In both methodologies, the contents in each of the phases were the same and in phase 1 the MTE was used. The difference was that with PBL, the contents of phases 2 and 3 were approached based on problems, while in the hybrid method in phase 1 the MTE was adopted, in stage 2 to AI and in phase 3 the PBA was used. In addition, the hybrid method includes the use of popular applications like Whatsapp and Facebook in the teaching process.

The structure of the discipline and the teaching methods adopted with the ABP method and the hybrid method are observed in Fig. 3 and 4, respectively. In the structures presented in Fig. 3 and 4 students are inserted into an environment where they can develop transversal skills, such as group work, leadership and decision making. For this, during all phases the structure of the discipline and the teaching methods adopted with the ABP method and the hybrid method are observed in Fig. 3 and 4, respectively. In the structures presented in Fig. 3 and 4 students are inserted into an environment where they can develop transversal skills, such as group work, leadership and decision making. For this, during all phases.

Problem-based learning (2013 to 2014/1)

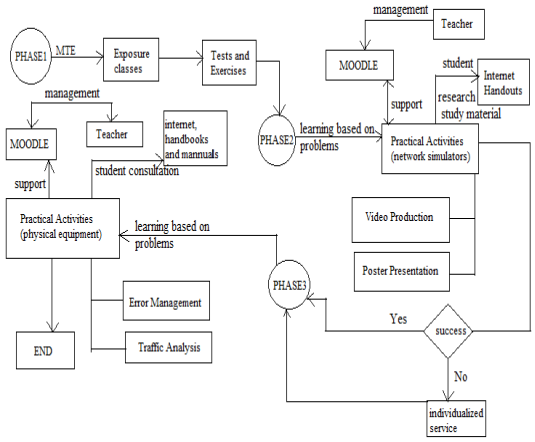

Figure3. Flow of activities of the ABP methodology in the CRC discipline.

Hybrid method (2014/2 to 2015)

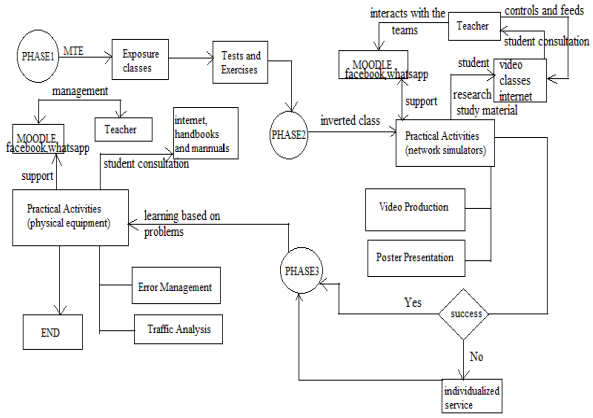

Figure 4. Activity flow of the Hybrid method of the CRC discipline.

All this process is carried out without the intervention of the teacher, which can be activated at any time in case of doubt, through the SGA tools, online consultations or in the classroom. During the development of the activities envisaged in each phase, the students undergo a process of Learning Verification, which can be composed of instruments such as tests, works, practical activities or seminars. These activities did not change during the research, in order to allow the comparison of results obtained with the use of methodologies.

During Phase 2 and 3, students used Google Apps tools to build and change files in real-time, making it easier for them to patch teams and teachers. Moodle was used as a repository for sending activities and for evaluations.

However, communication tools such as chat and forum were not productive, since many students spent days without accessing the platform, and when scheduling meetings to meet online, not all were available, as they needed a computer to access the environment.

Therefore, there was a need to improve communication. The solution found was the use of applications such as WhatsApp and Facebook. The use of these tools was directed to solving doubts, sharing information, sending reminders and exchanging files. In Whatsapp we used the features of user groups, sending videos and recording voice. On Facebook were created private groups and

communication by the chat. In these environments, the teacher acted as mediator, however, respecting the autonomy of the teams in decision making.

The versatility of these tools made learning dynamic. An example of this finding occurred when a team was having difficulty implementing an activity. After exhaustive attempts, they sent a photo of the error displayed on the computer screen and the teacher recorded an audio in Whatsapp teaching how they could overcome the difficulty presented and shared a link of a video on the subject in the Facebook group. With this support, in a few hours the problem was solved.

IV. RESULTS AND ANALYSIS:

The CRC discipline was monitored during the years 2011 to 2016 and 160 students were enrolled in this period. The classes were composed, on average, by 15 students per semester. Table I presents information about each class evaluated in the course, indicating the teaching-learning method used, the number of students enrolled, the average final grade and the drop-out rates and approval per class. In addition, the approval indexes and the average final grade per method are indicated.

ITEM ANALYZED	METHODS											
	MTE			ABP			HYBRID					
	2011/2	2012/1	2012/2	2013/1	2013/2	2014/1	2014/2	2015/1	2015/2	2016/1	2016/2	
Students	12	19	08	16	22	12	14	17	12	15	14	
Average	5,0	3,7	5,9	7,0	6,4	7,8	7,8	7,2	8,4	7,2	7,8	
Evasion (%)	46	43	44	11	13	8	14	6	7	7	15	
Approval (%)	56	42	43	83	80	78	81	83	87	79	86	
Approval / method	47%			81%			84%					
Average Overall	4,9			7,1			7,7					

TABLE I. GENERAL INFORMATION OF THE CRC DISCIPLINE

It can be noticed that the average performance of the classes was improved with the use of the active methodologies. The percentage of students approved in the course, which was low in the MTE, passed to 81% and 83% with the PBL and the hybrid method, respectively.

Student's grades are shown in Fig. 5. The dispersion of the grades of the hybrid method, whose standard deviation is 1.54, is lower when compared to the ABP methodology ($\sigma = 2.43$) and the MTE ($\sigma = 4.13$). The greater homogeneity of the grades obtained indicates a greater constancy and leveling of the students who developed the discipline with the hybrid methodology.

The average of the grades 1, 2 and 3 in the period from 2013 to 2014/1 (when PBL was in use) were, respectively: 8.0, 7.6, and 5.6 and in the period 2014/2 to 2016/2 (hybrid method): 7.9, 8.6, and 7.1, respectively. In stage 1, in both methods, the grades practically did not oscillate, this result occurred because the content taught and the teaching method adopted did not vary during the period of the analysis.

In phase 2, the average of the grades of the hybrid method was slightly higher than the BPA, indicating an improvement in the learning process promoted by the use of AI.

However, the improvements promoted by the use of AI are perceived more clearly in phase 3, when the average of the grades of the hybrid method is almost 30% higher than that of the BPA. The improvement can be attributed to the fact that students become accustomed to studying at home with the use of AI in phase 2. With the hybrid method, it was possible to perceive that, after the work done in phase 2, the students showed confidence and achieved perform the practical activities with greater precision and assertiveness.

In addition to student achievement, the effectiveness of active methodologies was analyzed based on the application of a questionnaire composed of objective and discursive questions at the end of each semester. With this, it was possible to evaluate students' perceptions regarding active methodologies. A total of 84 students participated in the research, with 34 of them studying the discipline under the ABP methodology and 50 under the hybrid methodology. The questionnaire was not applied during the period in which the MTE was in use.

A.Analysis of the objective questionnaire

The mean time for the questionnaire responses was 15 minutes. The questions were distributed in eight major areas: I) general questions about the discipline; II) information on the content available; III) appropriate use of SGA tools and communication; IV) information on the network simulator; V) use of physical equipment; VI) relevance and effectiveness of the exercises and evaluations; VII) proof of skills development; and VIII) self-evaluation. Possible answers to questions follow the liker's scale [20]: 1- strongly disagree; 2- disagrees; 3-indifferent; 4-agree; 5-strongly agree.

The students' responses to items I, IV, V, VI, VII and VIII in both methodologies converged: they were enthusiastic about the active methodologies, describing that despite the difficulties faced they approved the methods, and even suggested their use in other methods course (item I). The answers also make clear that both the network simulator and the configuration of physical equipment were useful and important for the development of practical learning (item IV and V) and that the exercises adopted in the discipline were adequate and according to the teaching plan , but that the students dissatisfied with the volume of proposed activities (item VI). In general, the active methodologies provided the students with the possibility of developing skills such as leadership, self-confidence and teamwork (item VII). In the self-assessment, the students considered themselves dedicated (item

VIII).The hybrid method allowed effective communication between teacher and students through the use of SGA tools and the content made available to the teams were developed according to the specificities of the activities. These characteristics reflected positively in the answers to items II and III. In ABP, these factors were not better evaluated because the communication was limited and the search for materials was totally attributed to the students.

B. Qualitative questionnaire analysis:

In addition to the objective fields, the questionnaire had a discursive space for suggestions, praise and criticism. These data were analyzed based on the principles defined by Barden. This technique of data analysis is developed through systematic and objective description procedures. Recurrent themes are grouped together to form an empirically defined category, which allows the interpretation of knowledge related to the research object. At categories were defined according to the semantic similarity that includes the contradictions and specificities of the themes described in the data collected for analysis. In this case, these data are the discursive responses presented by the students in the questionnaire. The names of the categories emerged after analyzing the contents established from the verification of the verbalizations. The verb verbalization is the faithful description of the answers presented by the students. However, sometimes during transcriptions it is necessary to perform orthographic corrections of these contents.

1) Problem-based learning: After analyzing the ABP methodology data, five categories emerged, as presented in Table II. The verbalizations were extracted from the discursive responses of the questionnaire and related to the respective students from the letter "E" and a number that identifies it.

2) Hybrid methodology: The hybrid methodology also had five categories, as can be seen in Table III. The qualitative questions enrich the questionnaire and help in the consolidation of the objective answers. In both answers (objective and discursive), several students demonstrated that the practical activities applied to the reality of the labor market and the materials adopted in the implementations were fundamental in the construction of knowledge and that, despite the challenges and difficulties they faced, the results obtained were rewarding.

TABLE II: RESULTS OF QUALITATIVE ANALYSIS (ABP):

CATEGORIES	VERBALIZATIONS –ABP
"The ABP methodology is time-consuming"	(...) "The ABP methodology consumes a lot of time, besides, I have to study hard to get the activities done". E7 (...) "I need to work and study, so meeting group members has become complicated." E10
"Learning from the PBL"	(...) "I developed activities that I previously thought were impossible." E19 (...) "Teamwork and the search for results without the help of the teacher helped me to consolidate theoretical and practical issues." E22
"Professional experience"	(...) "The exercises and evaluations of the discipline were heavy, but they were primordial for my learning and preparation for the job market". E1 (...) "The content worked on the discipline and the practical activities made me feel safe in seeking a job vacancy." E26
"SGA Tools"	(...) "Using Moodle made communication with the teacher easier." E11 (...) "I found Moodle a bit confusing at first, but I soon learned how to use the tools." E15
"Practical learning"	(...) "The equipment manuals helped me configure them, I almost did not consult the Internet to solve the problems". E21 (...) "Practical activities were essential for professional life". E29

TABLE III: RESULTS OF QUALITATIVE ANALYSIS (HYBRID):

CATEGORIES	VERBALIZATIONS - AI / ABP
	(...) "I had to adjust to studying at home, although it is more productive, it is not easy to reconcile time." E71 (...) "Without video-lessons it would be difficult to do the study at home". E68 (...) "In Whatsapp the

"Study outside the classroom"	teacher or team helped me to clear questions about the classes". E51
"Resolution of activities and exercises"	(...) "The revisions that the teacher makes in the first moments of the classes is very important for my learning". E47 (...) "The activities help in learning, but the amount of exercises is great" E65
"Using Moodle"	(...) "The teacher organized Moodle in a clear way, this helped me to follow the content of the classes." E43 (...) "The activities in Moodle are always available for consultation". E61
"Changing methodology"	(...) "I found the Hybrid method more productive than the MTE. Other teachers of the course could adopt this model. " E7 (...) "I learned a lot from the method the teacher applied" E69
"Towards the labor market"	(...) "I staged a company that focused on network support, I'll probably be hired. The practical activities of the discipline helped me in the job ". E42 (...) "I want to continue preparing in the area of networks and take certifications, because I will have a better chance of finding a good job." E49

C. Students perceptions:

The opinions of the graduates who participated in both the BPA and the hybrid method were relevant to the analysis of the methods. This is the case of the E7 student who stopped studying at the end of the 2013/2 school term for work reasons, failing to complete the last phase 3 and E57 activity that was not approved in 2014/1.

Both enrolled in the discipline in 2014/2. They were more interested in the discipline when given on the basis of the hybrid method and argued that studying at home and using face-to-face classes to solve exercises strengthened the consolidation of knowledge. According to them, the activities performed in the ABP method (phase 3) were better understood from the concepts presented according to the characteristics of the AI (phase 2).

Other students have realized that the MTE has limitations and that it can be replaced by active learning, such as the hybrid method. They pointed out that in traditional teaching the pace of learning tends to be slow and ineffective, since the relation between theory and practice generally does not converge, and content assimilation tends not to be lasting due to poor involvement of the student with the subjects taught.

It was verified, in some discursive answers and in dialogues between teachers, that students suggested the use of the method proposed in other disciplines. This fact allowed the research carried out in the CRC discipline to gain visibility among the teachers of the MSI course. Some were interested in active methodologies and were willing to make changes in the course. This was an important step in popularizing the proposed method.

D. Teacher Perception:

Challenges and Solutions: The process of paradigm shifting requires dedication, planning, and periodic adjustments in the discipline, in addition to addressing students' mistrust. In general, the main challenges faced in implementing the hybrid method were:

• In spite of attributing the responsibility of learning to students, the use of active methodologies takes time and dedication to activities such as the preparation of study material and practical activities related to the labor market, the correctness of the work, the attendance to the students and the organization of the laboratories.

• Introducing interdisciplinary aspects in the course requires the participation of at least part of the course teachers and depends on changes in the course plan, which is not always easy to do;

• Students need to be convinced of the need to play a leading role in the learning process and to carry out activities relevant to this role, such as studying at home;

• Communication between the teams and the teacher should be effective, so as to avoid the delay in responding to the students' queries and to maintain their stimulation in the development of the activities;

• The organization of the working groups should allow the balanced distribution of activities among students and allow their individual and collective evaluation.

The challenges have been solved in a gradual way. For example, to carry out the organization of the laboratory the teacher had the support of the IFB's computer technicians. The interdisciplinary communication was introduced in the course through successive meetings with the teachers of the disciplines correlated with the CRC and also through adaptations during the semester. The resistance and distrust of the students were overcome by constant dialogues and with the course of the course, after the good results achieved by them in practical activities.

The collective evaluation was carried out based on the participation of the team members in solving the problems and in the quality of the works produced. In order to follow the activities developed in each group, a work plan was requested, composed of a schedule of the activities to be carried out by each student and how often and how often they would meet to discuss the progress of the work. In this way, it was possible to follow the development of the activities and the individual contribution in the development of the solution. In

addition, a continuous evaluation model was constructed, in which the accomplishment of goals and the student's resourcefulness during the accomplishment of the practical activities. Thus, students were evaluated at all times, but the stress occasioned by marked evaluations was restricted to the presentation of the seminar and the poster. Individual assessments were also conducted in the form of exercises and oral questions on the topics developed.

This method of evaluation allows the student to be able to see if he or she is able to pass or not, given that the teacher reports periodically how his performance in the discipline is and what he needs to do to improve learning.

Thus, when the discipline was offered again, the challenges faced were smaller, because the experience acquired in the previous semester and the physical structure that was already set up facilitated the inclusion of the PBL. However, new adjustments were necessary, such as the training on Moodle, in order to minimize doubts about the platform, the adequacy of practical activities that were too numerous and incompatible with the course workload and the merger of activities that repeated throughout the phases.

Although the adjustments made the discipline more dynamic, after three semesters using the ABP it was noticed that some teams replicated solutions found on the Internet, mechanically without knowing the provenances and veracity of the information used.

For this reason, as of the second half of 2014, a hybrid learning method was adopted for the discipline, which aimed to improve the quality of implementations, improve communication within the discipline and optimize classroom instruction. However, new obstacles suggest: the dynamics of the classroom classes depended on the previous study that the students performed at home and the teacher needed to follow the evolution of the teams and solve doubts even at times other than face-to-face meetings.

Introducing the characteristics of AI in the daily life of the students was arduous. During the first encounters they were resistant and had to be aware that the evolution of the classes depended on them. Phrases such as "studying at home is not an option and if they do not study, they will be harmed," and private conversations with those who insisted on not contributing were necessary to change their posture. The problem related to the teacher's need to keep present outside the classroom was bypassed from the use of new SGA tools. Of that in this way, communication became effective and eventual doubts could be resolved with more agility and efficiency.

After the discipline was organized for the first time it was noticed that in the other semesters the hybrid method remained stable. However, besides these difficulties, some punctual adjustments were necessary, such as the renewal and updating of material. For example, it was necessary to change the duration of the video-lessons that have a maximum of 5 minutes. These smaller recordings were more productive because the students watched the videos until the end, and in addition, the transmission of content was less tiring for them.

E. Lessons learned:

During the process of implementation of the hybrid method it was found that the teaching methods with greater use in the area of computer networks were generally linked to the use of e-learning resources in face-to-face classes to the use of computer network simulation tools, as can be observed in the collection of articles presented in, or experiences related to the isolated use of ABP or AI methodologies.

However, the individual application of these methodologies was not sufficient for the adequacy of the CRC students' reality, which raised the need to create a new teaching and learning method that included both methodologies, ABP and AI, in a single discipline. The proposed method proved to be adequate to the reality of the course, since the student evolution was dynamic, the learning fast and the activities were executed with a better theoretical basis when compared to the PBL. The transversal skills were reinforced from the use of AI and ABP applied in different phases.

The organization of students in teams is something that requires attention, because there are those who have difficulty learning the content of the discipline and / or who strive little to solve the problems proposed. As a consequence, they may end up isolating themselves and leaving responsibility for the execution of the work to the other members of the group.

In this sense, it is important that students perceive the whole purpose of the discipline at all times and feel motivated. Part of this motivation is the work of the teacher, through constant guidance and guidance, advice on the development of work and the use of incentive phrases, for example: "you are doing well!", "There is little!" discourage! "," try another solution! ". In addition, practical activities are important to keep them always active.

An extremely useful application for this monitoring is WhatsApp. Because it is common among students, this tool was widely used to solve doubts and allowed the conflicts found to be circumvented with more agility. In addition to WhatsApp, Facebook was also an important application in teacher-student communication.

Due to the number of activities and the students' need to comply with the work schedules, the use of a management system is essential. Moodle has proven to be an excellent support tool to active methodologies, providing a practical, dynamic and organized learning environment.

The hybrid method is suitable for small groups of up to 20 students, since the teacher needs to guide the teams, motivate the students, follow the activities carried out in Moodle and provide individualized assistance with the purpose of minimizing conflicts and solving doubts. All these activities demand dedication and time from the teacher and therefore the application of the method in a class with a large number of students can impair learning.

The proposed method can be adapted to the disciplines of the area of computation as long as they contemplate practical activities. An adaptation of the method was tested by the teacher, in the second semester of 2015, in the discipline of Operational Systems of the Bachelor's Degree in Computer Science of the IFB and proved to be effective. The results still need to be consolidated for future publications.

V. CONCLUSIONS:

This research contributed as a contribution a new teaching model applied to the area of computer networks based on the ABP and the AI, detailing the main challenges and solutions found in its development. The method assigns students responsibility for developing both theoretical content and practical activities, homogeneously improving their performance and developing transversal skills.

The application of the developed method requires a reorganization of the discipline and the separation of the contents in phases. In addition, it was necessary to establish in the structure of the discipline a transition phase from MTE to APA. After this phase, the students felt comfortable in the active learning environment. The EMS played a fundamental role in the development of activities, serving as data repository, exchange of experiences and evaluation. Popular communication tools such as WhatsApp and Facebook help in the process of communicating between teacher and student, proving versatile when the purpose is to send out reminders or communications.

A limitation of the proposed method is related to the number of students per class, due to the great amount of activities of responsibility of the teacher, even with the students becoming protagonists in the learning process.

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