

CBT SYSTEM (COMPUTER BASED TRAINING) OF THE AIRCRAFT A-37B, USED IN THE EARTH COURSE OF THE COMBAT AIR COMMAND NO. 3 (CACOM-3) OF THE COLOMBIAN AIR FORCE (FAC).

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ABSTRACT

This article shows the implementation of an integrated and updated education system in the Combat Air Command No.3 as a school of the A-37B team, to give theoretical and virtual practice instruction optimizing strategic processes, increasing productivity, reducing operational and administrative costs in order to promote the commitment and development of human capital to crewmembers of the A-37B team; At the same time, promote technological development and innovation in the personnel that make up the Unit.

In this work, the importance of the use of ICT in the educational field and the great contribution it presents in the Colombian Armed Forces is made known.

Keywords: *Design, Production, Software Engineering, CBT, Virtualization, Colombian Air Force (FAC), Combat Aircraft A-37B, Combat Command No. 3 (CACOM-3).*

1. INTRODUCTION

Initially, the training was based on traditional face-to-face teaching, in which the teacher and the students met in a specific classroom. Subsequently, distance training was present, through courses through correspondence, where the supply of information was delayed given the limitations of distance and time. With the passage of time and the exponential evolution of technology, computer-based learning or CBT (Computer Based Training) appears.

The CBT has evolved towards Web-based learning, WBT or IBT (Web / Internet Based Training), also called on-line learning, where learning it is done via Internet, intranet and / or extranet.

As ICTs or Information and Communications Technologies become more relevant in the field of

education, the military field should not be alien to this event, given that the implementation of these lead to a high benefit when minimizing costs and expanding coverage. teaching.

Thus, this article is divided into 8 sections, being the first introductory to the subject. The second, third and fourth sections of the work focus on the conceptualization and importance of CBT, e-learning and the use of Information Technologies in education. Subsequently, it will go to a fifth section where the function of the Colombian Air Force is denoted and the reason for its high relevance. The sixth section discloses information from Plane A-37 with which virtualizations and application were made. final, the last one shows the methodological development on which the research was based. Section 8 shows the results achieved to finally finish with the conclusions of this work.

This article is part of the development of the project "Implementation of a support system for the teaching of the management of the CBT aircraft", which was financed with resources from Colciencias in Colombia.

This article is organized as follows: First, relevant conceptual information is provided regarding the use of information technologies, second it is contextualized about the history of the Colombian Air Force, where the project was developed, third the process is shown of implementation of the different technological components in the organization and finally the results are shown.

2. CONCEPTUAL INFORMATION

The use of information and communication technologies has proliferated throughout different applications to various sectors of the economy [1]. Different applications have been developed that allow, using sensors, to identify activities of the daily life of individuals suffering from neurodegenerative diseases [2,3].

In the organizational scope, different works have also been developed to support platforms that support business management and that support a faster return on investment in the investments made by this type of organization [4].

In the same way, different data mining techniques, both supervised and unsupervised, have been used to support the identification of both cardiovascular diseases [5] and fertility problems [6] and applications have been developed to determine the presence of intruders in computer network operation activities. [7]

CBT stands for "Computer Based Training" and consists of a computer program that presents information using multimedia resources (text, audio, images, animations, music and video). Computer-based training is aimed at achieving two objectives: to achieve the learning of new concepts and to develop skills and abilities to achieve better performance. [8]

It is important to note that a CBT is a learning experience where the frequent evaluation of the topics is considered one of the fundamental pillars for the appropriation of knowledge, this allows the training time to be reduced by 50% or more, the training costs diminish up to 64%, the assimilation of the topics increase up to 4 times more, given that the retention of the material is 60%, unlike 15% of a traditional class with a teacher.

It allows to experience situations before going to the real world, without risk or waste, providing greater security. There is instructional consistency since the staff is trained with the same information, doing the same exercises and practices; this contrasts with the traditional training system, whose performance often depends on circumstances not associated with the course, such as fatigue, inconsistency when teaching lessons, etc.

The quality of teaching is maintained, given that we always have the knowledge of the best teachers and experts and incorporate the best practices of the respective industry. Privacy is maintained, as each student interacts individually and avoids embarrassing group work situations.

The student can review the information as many times as needed without delaying his classmates, he learns at his own pace and has absolute control of the application. The material is available 24 hours a day, all year.

It offers greater control, since it is possible to access the information of the people who enter the program in order to measure individual and group results and keep track of the users' performance. Facilitates the geographical expansion of the courses, since the student can take it no matter where they are [9]

E-Learning is the provision of educational programs and learning systems through electronic means. E-Learning is based on the use of a computer or other electronic device (for example, a mobile phone) to provide people with educational material. Distance education created the bases for the development of e-Learning, which comes to solve some difficulties in terms of timing, synchronization of agendas, assistance and travel, typical problems of traditional education. [10]

E-learning is presented as one of the training strategies that can solve many of the educational problems that can arise, ranging from the geographical isolation of the student from the centers of knowledge to the need for constant improvement that is introduced by the society of knowledge, without forgetting the calls made about saving money and time, or the magic of the interactive world in which it is introduced. [11]

Virtual teaching or e-learning is undergoing a process of constant expansion, which will continue in the coming years, according to the estimates made by the large consulting firms. Virtual teaching is emerging as a solution to problems that

traditional teaching can not answer. Likewise, we could place it in the last stage of distance learning, in which Information and Communication Technologies are applied to education. Despite the great rise of e-learning, we must not fall into the false idea that it is the panacea, since it does not guarantee a higher quality or a faster or more effective learning on its own. However, e-learning allows the application of tools such as learning styles with which a more effective learning is achieved, a tool that is difficult to apply in the traditional class. [12]

Information and communication technologies (ICTs) currently exert an increasing influence on scientific education, both in secondary and university education, not only in terms of improving science learning on the part of students of such levels, but also play a growing role in the initial and permanent training of teachers. [13,20]

A changing environment such as the one that has been forged in the process of globalization requires constant updating in the domain of knowledge and skills. As a result, it is necessary to have a training that is not limited to a period, in which the elementary skills necessary to develop in perpetuity in the social and labor field are learned, but a continuous training throughout life that employs technological tools as the main input to enrich the understanding of the knowledge imparted. [14,23]

We are facing a technological revolution; We are witnessing a planetary diffusion of computers and telecommunications. These new technologies pose new paradigms, revolutionize the world of school and higher education. There is talk of revolution because through these technologies you can visit museums in cities around the world, read books, take courses, learn languages, visit countries, get in touch with people from other cultures, access texts and documents without having to move from a chair, etc., through the Internet.

Education is an integral part of the new technologies and that is so much so that an increasing number of universities around the world are demanding electronic literacy as one of the requirements in their entrance and graduation exams, considering that it is an essential objective to prepare future professionals for the digital era in the workplace. [15]

Information and communication technologies (ICT) can contribute to universal access to

education, equality in instruction, the exercise of quality teaching and learning and the professional development of teachers, as well as management and more efficient administration of the education system. [16]

The use of information and communication technologies has become a fundamental aspect in solving different problems of society. Artificial intelligence and data mining provide a set of solutions that support the automatic processing of many organizational requirements, among which are:

- Proper handling and use of information [17, 18, 19]
- Telemedicine applications [20,21]
- Implementation of information quality [22].

In this work we tend to work in an application framework using interactive technologies to take advantage of the different ways of learning of end users.

3. BRIEF REVIEW OF E-LARNING APPLICATIONS.

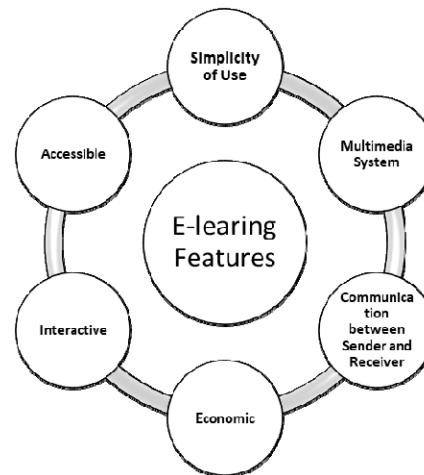


Fig 1. Feature of E-learning.

E-learning is a training system whose main characteristic is that it is done through the internet or connected to the network. The meaning of e-learning comes from “electronic learning” or electronic learning, in English, being used as a synonym for training or use of the internet for education. Through this online learning methodology, the user can be interactive with different computer tools available on the Web. Many of these applications focus on children, but

this article will focus on applications made in the business sector [23]. According to the previous definition we can list a series of basic feature of e-learning, see figure 1

Similarly, the advantages of the implementation of E-learning can be highlighted:

- **Reduction of the cost of the training:** while the investment is initial and maintenance, we avoid the expenses of transfer, accommodation or didactic material that are required when the training is face-to-face. This is especially important when we talk about large organizations with different locations across the globe.
- **Immediacy:** Once connected, any type of communication can be carried out quickly and quickly, both by students and students with tutors.
- **Flexibility:** while face-to-face training requires closed calendars, the online one enjoys the flexibility that allows us to connect at any time, provided the internet is available.

The arrival of e-Learning has also changed the roles of student and teacher, incorporating unknown professional profiles in teaching so far. Let's see some of these changes below:

- The student is at the center of the training process (mass classes disappear with a single teacher addressing 20, 30 or 100 students equally).
- It promotes self-training and avoids the direct dependence of the student on the teacher.
- Although collaborative dynamics already existed in traditional training, group work is encouraged with e-Learning.
- Among the different professional profiles that have appeared thanks to e-learning, we have, for example, designers (both content and activities).
- Although they know classical pedagogy, the formats have changed. What was previously expressed in two pages of a textbook is now a video or an infographic; it is necessary that people with capacities can disseminate the information in the different current formats.

When we talk about Learning Management Systems, or Learning Management System (LMS), we refer to a type of software, normally installed on a web server, which allows the creation of a virtual campus for online training. Although their technical name is that, they are commonly known as e-learning platforms

The e-learning platforms are used in universities, training centers and companies to manage users, provide teaching materials, monitor the learning process, prepare reports, etc. As in all cases, there are endless possibilities on the Internet. To manage e-learning platforms, the possibilities are also very wide.

There are three large groups: free or open source e-learning platforms, and commercial platforms, within the latter several payment options can be distinguished.

Open source e-learning platforms, that is, when we say open source, we mean a type of software that is designed to be distributed and developed freely. The license of an open source software is part of the public domain. One factor to consider is that, although its use and distribution are free, costs may arise afterwards for the maintenance of the platform, which is necessary to hire qualified personnel, etc. Among the most used open source are Moodle, Canvas, Chamilo, Sakai or LMS for Wordpress, among others.

Pay-per-use e-learning platforms (in the cloud): it is one of the alternatives that is being used most recently. In these cases, the subscriber pays based on the use that will be given to the platform. For example, depending on the number of students active on the platform, by courses, modules, etc.

E-learning platforms for license payment: they do not have the free code, so you must pay for the use license. In these cases, a certain time is paid, which can be from one month to one year. During the time you have the license, you can use the platform for an unlimited number of people and teach as many courses and modules as you need. Within the commercial e-learning platforms, the best known and used is BlackBoard. But there are others such as: eDucativa, FirstClass, Saba or NEO LMS.

In the application review analysis, the following tools that have enhanced the use of the internet to improve teaching-learning processes can be highlighted.

1. **Moodle** [24]: First, we must talk about Moodle, the best known and used open

source LMS platform. It is the most prestigious platform worldwide, being chosen both by universities and by training centers or companies

The number of Moodle users worldwide today reaches 79 million users, more than enough data to justify it being one of the most famous e-learning platforms worldwide. The biggest advantage of Moodle is its simple interface that makes this platform an easy learning system for both teachers and students.

2. **Canvas LMS** [25]: What differentiates Canvas from other open source LMS is that it works 100% in the cloud, that is, it does not need to be hosted on any server. Canvas works in a very visual and intuitive way. It has a version more focused on the business sector, Canvas Network, and, a free option for teachers.
3. **Chamilo LMS** [26]: On the Chamilo website, they themselves highlight the number of companies that use their training platform. The Chamilo project, born in 2010 from the hand of the homonymous non-profit association.

Despite its short life, Chamilo is present in more than 80% of the countries of the world, in order to bring education to developing countries. Chamilo is an e-learning platform that, like Moodle, also has a simple and easy-to-use interface [27].

4. **Sakai** [28]: is an LMS platform, which arises from the Sakai Project, created among several American universities, in order to offer another alternative of open source E-learning platform such as Moodle.
5. **LMS Wordpress plugin, LearnPress** [29]: The website developed with WordPress, does not have to be a problem to create your e-learning platform. In WordPress you can install a plugin that will turn your website into a platform for learning, there are many types of plugins and many possibilities: LearnDash, Good LMS, LearnPress, etc.

Among the Learning Management systems, which are not free code (Commercial LMS), you can find:

1. **Blackboard LMS** [30]: The software company that created Blackboard Learn, was founded in 1997. What makes, with its years of experience, Blackboard is the most prestigious and best LMS platforms (commercial category, that is, it is not designed with free code).
2. **eDucativa** [31]: it is a simple platform to manage courses through the internet. Its services are used by all types of companies and institutions, not just schools and universities. It is an accessible commercial LMS alternative. The website is in Spanish and they have their support in Spain, which is very advantageous for any question or doubt that may arise in this regard.
3. **FirstClass** [32]: It is an e-learning platform, offered by the Open Text company. Installation on the server is not necessary, it can be used in the cloud and adapts to all types of devices. It is used in both educational and corporate environments. It is designed for professionals because of its cost and the technical characteristics it requires.
4. **Saba** [33]: is the name of this e-learning platform, specific for the development of learning activities on the web. It can only be used under license. It is a very complete LMS platform that allows you to track learning, in order to help the student, improve programs with personal monitoring, use surveys, facilitate assessments, etc.
5. **NEO LMS** [34]: is designed for all types of public and educational sectors. The platform is used from primary school students, even university students. It is very simple to use, does not require installation, or programming knowledge.
6. **Google Classroom** [35]: There is an alternative to these 10 eLearning platforms that works in the cloud, it is Google Classroom. It is within G Suite for Education, it is free and can be used by training centers, private users who have Gmail accounts or non-profit organizations.

Four profiles in Classroom are distinguished: teachers, students, tutors and administrators each with different

permits or types of functions. For example, the teacher can create and manage classes, assignments and notes and the tutors receive a summary of the students' work by email. It can be used in the web version, being compatible with the main browsers or through mobile applications for Android and IOS®.

4. COLOMBIAN AIR FORCE (FAC).

The Colombian Air Force FAC is the military air arm of the Colombian Republic governed by articles 216 and 217 of the Political Constitution of Colombia, through which it establishes the permanence of a Military Forces to guarantee its defense, its independence, its integrity of the territory and the constitutional order itself.



Fig 2. Logo of the Colombian Air Force [35]

In such virtue, it is the function of the State through its Military Force, especially the Air Force, to exercise unrestricted sovereignty in the Colombian airspace, in which it is valid to include a segment of the geostationary orbit, which is defined as a geosynchronous orbit (geocentric orbit that has the same orbital period as the period of sidereal rotation of the earth) directly above the terrestrial equator with a zero eccentricity and that is part of a space whose exploitation is carried out according to what is authorized by the International Union from Telecommunications of the Organization of the United Nations [36]. Among its main functions are:

1. Organize, train, equip and provide forces to conduct combat operations in the air, forces to defend the Colombian nation against an air attack, must gain and maintain air superiority, defeat the enemy air force and control vital areas.
2. Organize, train, equip and provide forces for air defense and airspace control.
3. Organize, train, equip and provide forces for strategic attacks.

4. Given the importance of training, equipping and providing forces for air defense is essential to have a CBT that allows you to minimize training costs and in turn optimize the teaching of the aircraft A37 to new pilots.

5. E-LEARNING IN THE COLOMBIAN AIR FORCE FAC

The e-learning in the Colombian Air Force, is being carried out with the implementation of the Blackboard platform, which is used as a virtual space to share basic courses of the Aircraft, but the lack of interactivity, its little didactic material and the low levels of use, have made this a little optimal tool to deliver the virtual courses of the different aircraft, as a solution to this problem the FAC chose to acquire the training courses provided by the manufacturers of aircraft as is the case CBT of the A-29B, although it is true that it presented a higher didactic and interactive level, the high costs of these and the lack of support with multimedia resources such as animations, made this solution alternative be set aside.

Unfortunately, they have resorted to a traditional teaching system, where little use is made of technological tools, taking into account that the use of bibliographic resources is highly prioritized where the didactic and technological component is not reflected, as well as the high turnover of the personnel from its history, has not allowed to consolidate all the contributions and experiences so that they are of knowledge to the new generations [37].

In addition, the high workloads of crewmembers in their respective areas of work, in most cases does not allow an educational program to be carried out dynamically and continuously at set times, making it difficult for part of the staff not to receive the corresponding updates or feedback at the appropriate time, becoming an administrative and personal wear and tear [38].

For this reason, the Combat Air Command No.3 as the only operator in Colombia and the Colombian Air Force of the Warplane A-37B, being the oldest combat fighter squadron and pilot school 33 years ago, has allowed together with the University of Costa CUC perform a CBT for the modules of normal and emergency procedures that meet the training needs exposed.

This aircraft also known as Dragon Fly, made its first flight on May 3, 1968, 10 years later Colombia acquired a fleet of aircraft A-37B becoming the flagship of the Combat Air Command No. 3, Malambo, Atlantic.

In 2000, the modernization process was started, which consisted of the general check and complete disarmament of the aircraft, structural and corrosion inspection, destructive tests, inspection of all systems, total adaptation of the cabin and its exterior lights for flight with night vision, integral avionics change, among others [39].

Currently, the Dragon Squadron of CACOM 3 is comprised of 07 aircraft that have participated in successful public order missions throughout the country, and as the National Navy in international training such as Unia Operations, increasing the capacity of defense and attack of vessels military in tactical operations on the sea. It is projected that this versatile aircraft specialized in the fight Counter - Insurgency, COIN, will remain in service until 2015[40,41].

The research carried out is of an experimental type, because it is intended to establish cause and effect relationships by manipulating unverified experimental variables in strictly controlled conditions, through a software or platform that allows to design and load all the indispensable requirements for module 2 and 3 of the ground course of the A-37B team.

For the methodological development of this work five (4) phases were designed, these include specific activities proposed with the objective of carrying out a logical order of execution of the project, the phases and activities are delimited as follows:

TABLE 1: DEVELOPMENT METHODOLOGY

Phases	Activities.
Analysis	Study and collect relevant information from the normal processes of the A-37 team
	Study and collect relevant information from the team's emergency processes A-37
Design	Apply Software engineering environments
	Incorporate the documentation required to carry out the designs of the software components.

Development	Diagram and Vectorize the images of the aircraft A37 keys for the coding of the modules.
	Encode the corresponding software requirements of the Normal Procedures Module.
Implementation	Encode the corresponding software requirements of the Emergency Procedures Module.
	Join the coding of the 2 modules in a virtual academic environment application of Aircraft A-37

To carry out this methodology, continuous visits were made to the Combat Air Command No. 3 located in the municipality of Malambo, Atlántico.

The results of the software implementation were measured in the learning and improvement processes of the pedagogical theories before and after the prototype implementation and are shown in the following graphs described below, considering the skills: argumentative, propositive and interpretive developed in the pilots:

TABLE 1: SKILL DEVELOPMENT USING THE SOFTWARE IN PILOTS

Skills	Before	After
Argumentative	40	90
Purposeful	50	85
Interpretive	60	95

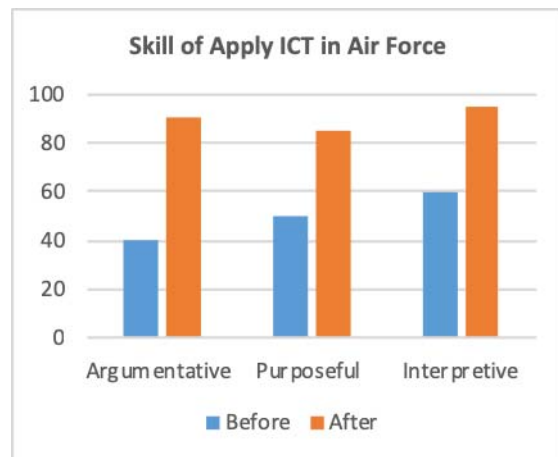


Figure 3: Skill of Apply ICT in Air Force.

6. RESULTS

In the analysis and design phase, the respective visits were made to the CACOM 3 located in Malambo, Atlántico, and meetings were established with the lieutenants who supported the project and collaborated directly in the successful completion of the project

In each of the visits made, images of the aircraft were obtained to later perform the vectorization of these, under the technology of Adobe Illustrator and professional Adobe Flash, as they are denoted in Figures 4 to 11.



Fig 4. Vectorization of the Aircraft Batteries

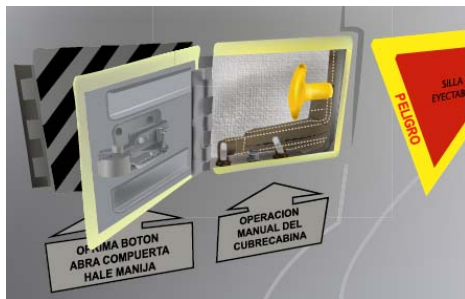


Fig 5. Cockpit Gate Vectorization



Fig 6. Gas gate vectoring



Fig 7. Vectorization External part of the Aircraft

Once the images of the aircraft were obtained about normal and emergency procedures, they were grouped together and an application was created using e-learning so that pilots could access it whenever they wanted, within the facilities of the aircraft. FAC, the extension application .swf is totally portable, which allows the pilots to interact with the simulation of the aircraft before starting their preparation on the real A37 plane accelerating the learning process.



Fig 8. Main image of the application

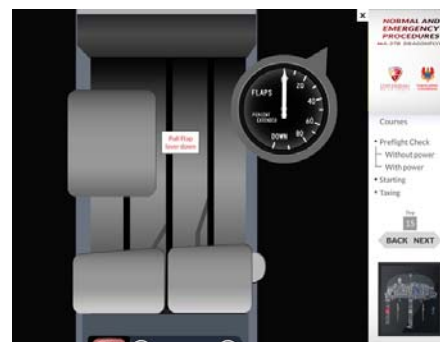


Fig 9. Screenshot of the lever handling section



Fig 10. Screenshot management of the Aircraft's direction



Fig 11. Screenshot Full cabin Aircraft

7. CONCLUSIONS

From the perspective offered by the experience in the development and exploration of platforms or ground courses of the different aircraft in CBT (Computer Based Training) systems, these undoubtedly represent another type of methodological guidance for apprentices. On the other hand, it is noteworthy that its use is of a formative nature, such as non-face-to-face training that, through this technological platform, makes access and time in the teaching-learning process more flexible and adaptable to the skills, needs and availability of each crewmember, in addition to guaranteeing collaborative learning environments.

The implementation of the CBT system in some Air Force Bases for a certain aircraft purchased from the manufacturer, have high costs, the union of efforts between the FAC and the CUC, developing science, technology and research, exploits the best capabilities of each one of the parties, achieving a product with results superior to those known in the market at a much lower cost.

With the realization of this project it is expected to generate a great impact at a Regional, National and International level, as an important development engine in the Colombian Caribbean Region,

because it is one of the pioneers in Colombia and one of the few countries in South America in developing technology applied in specialized virtual education of combat aircraft, based on a CBT (Computer Based Training) system, combining knowledge of Colombian Air Force personnel and technology with the development of research groups in the Colombian Caribbean region, thinking of Some time and depending on the different bilateral agreements of Colombia, sell the service to neighboring countries such as Peru, the Dominican Republic, Honduras, among others, for the use and training of their pilots and crew on land.

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