# An Integrated Approach for Fighting Dropout and Enhancing Students' Satisfaction in Higher Education

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## ABSTRACT

Dropout and student's learning satisfaction are challenges that every higher education institution is facing all over the world. Each university conducts researches for comprehending the essentials of what determines student's dropout on one hand, and on the other hand, what determines student's learning satisfaction. Such endeavours provide great management insights into developing effective strategies that allows universities to create new opportunities and value for their students and instructors.

This paper presents an integrated approach achieved within a pilot center for educational and professional development called CADEP. The CADEP acronym comes from the Spanish ***C**entros de **A**poyo y **D**esarrollo **E**ducativo y **P**rofesional*, and has been setup in Bogota, Colombia at the Francisc Jose de Caldas University in the framework of the ACACIA project. The CADEP pilot represents a best practice example for fighting dropout and enhancing student's learning satisfaction in universities.

## CCS Concepts

**• Applied computing → Education → Computer-assisted instruction.**

## Keywords

Affective computing, dropout, student learning satisfaction, emotional state detection, student counselling.

## 1. INTRODUCTION

Cultural and social backgrounds of students may strongly influence the educational process and often lead to marginalization and social exclusion of certain students from meaningful participation in learning activities and community life. Such exclusion further reduces students' perspectives to learn, grow, and develop. Adapted educational systems facilitating the modern level of knowledge and skills are crucial components of positive change and successful development of the society. The use of technologies is not the only requirement of the new century. Educational planning and policy-making are also of great importance. Any educational policy must be able to meet diverse challenges and enable everyone to find his/her place in the community, which they belong to, and at the same time be given the means to open up in other communities [1].

Inclusion is concerned with learning, participation, and equal opportunities for all with a specific focus on the groups that are vulnerable to marginalization and exclusion from society life. These groups are usually excluded from the mainstream education. Therefore, education for them requires special approaches and techniques. The main goal of this research is to contribute to the dissipation of that exclusion, discrimination and marginalization by disparity or inequality.

In this context, several the goals have been set forth:

- Recognize HE Institutions as social and political means to develop inter, multicultural and multilingual education programs matching the several real educational needs;
- Strengthen teaching staff qualification;

- Use ICT as a tool to complement teaching processes and learning;
- Propose new forms of institutional organization to promote the integration of groups that combine efforts and resources to the solution of problems previously mentioned.

Organizations today are looking beyond the automation of traditional training models to new approaches to knowledge transfer and performance support that are better aligned with business goals and deliver measurable results. By focusing on the specific business objective, rather than the learning technology, the proposed integrated approach gives the opportunity to fundamentally re-think how we design and deliver learning programs. This re-thinking also allows us to break free from the concept of a "*course*" and consider approaches that provide a continuous learning process with active participation by the entire organization in sharing, teaching and mentoring mission-critical knowledge. Such approach may lead to student's greater learning satisfaction.

Learning satisfaction is the sum of student feelings and attitudes that result from aggregating all the benefits that a student hopes to receive from interaction with the CADEP pilot. Perceived value is defined as the degree to which a person believes that using a particular system would enhance his or her job performance and perceived ease of use is defined as the degree to which using the technology will be free of effort.

This paper is organized as follows: Section 2 presents an overview of the CADEP pilot model, section 3 presents a general description of the CADEP framework, section 4 presents the CADEP pilot validation methodology, section 5 summarizes main conclusions and future work.

## 2. CADEP Pilot Model

The CADEP- Pilot is a new institutional tool to detect study and solve problems, which cannot be faced and solved in isolation, within a department, a faculty or a vocational training program. CADEP is justified and made viable by the benefits that it brings to the university on multiple levels:

• *Social*, as a help center that guides and improves academic and socio-affective conditions, supporting the permanence in the university;

• *Academic* in terms of support for adaptation of accessible learning practices using resources created for this purpose;

• *Economic* for the support to the effective use of resources and for the income to be received for external services.

The CADEP is an institutional university body created to Support, Cultivate, Adapt, Communicate, Innovate and Accept academic and professional practices. It is based on concepts such as respect, affection, acceptance of the difference and inclusion of the academic and administrative community, through an integrated system of related modules intra- and inter-institutionally.

## 3. CADEP Pilot Framework

The CADEP pilot is located in Bogota, Colombia. The university has five faculties (engineering, technology, science and education, environment and arts) located in different sectors of Bogotá and enrols about 27. 000 students. The CADEP is an alternative to define strategies that allow decreasing the desertion and exclusion. The first stage for the implementation of CADEP was the definition of the design framework of CADEP Pilot.

This framework offers a general view on the CADEP components. Each element has been defined and a conceptual model has been generated (Figure 1).

The second stage for the implementation was the definition of the conceptual model. The conceptual model develops each part of the CADEP and represents an implementation guide for each part and element of CADEP (Figure 2).

The third stage represents the implementation of CADEP and application of the conceptual model in the Francisc Jose de Caldas District University. The CADEP has technological platforms to support its operation such as: case management system, cooperative work system, learning management system and knowledge management system. It has also four modules with objectives, functions, services and products. The modules work cooperatively to offer alternatives to the community. The CADEP has four working spaces: CADEP office, innovation laboratory, service points (virtual and physical).

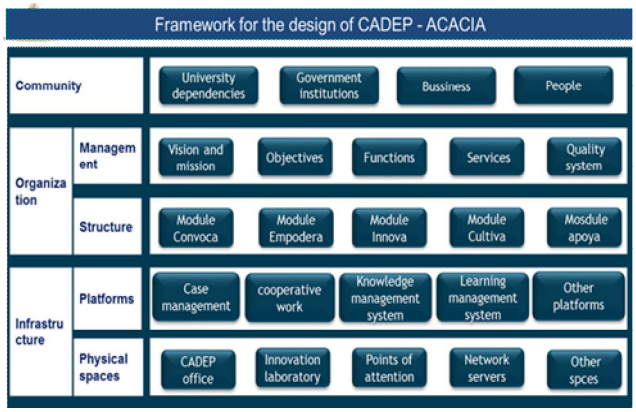


Figure 1. General framework of the CADEP pilot

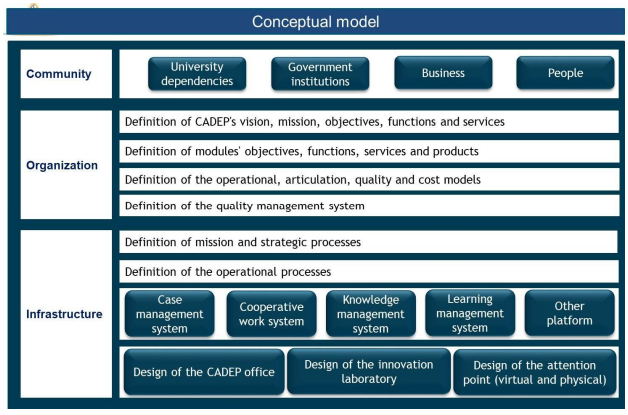


Figure 2. Conceptual model of the CADEP pilot

***Services offered***

1. System of laboratories for the creation and use of accessible didactic educational technologies, and systems for the detection of emotions;

2. Resources for professional updating in learning processes of vulnerable populations and the development of an innovative and unique professional profile in the region;
3. Design, management and appropriation of new accessible learning environments;
4. Innovation and creation of devices and applications to facilitate access to knowledge and to meet the educational needs of populations at risk of university exclusion;
5. Face-to-face and virtual courses in innovation, inclusion, teaching environments for vulnerable populations, in the detection and management of emotions and the use of devices.

Services are designed by taking into account affective computing systems and techniques. Such techniques can create different scenarios that help and improve educational conditions. A system for identification of emotions can for example detect signals of frustration during the learning process or lack of understanding during the study of concepts and definitions. Applications include tracking of emotional trends in groups, detection of emotional interactions, and detection of anxiety or depression patterns. With such identification at the beginning of processes, the educational staff can start individual psychological assistance for students, avoiding future problems that interfere in the learning process, and even more, in their lives.

## 4. CADEP Pilot Validation

In terms of organization, as a result from the analysis of multiple theoretical approaches that addresses the problem of student retention and learning satisfaction the CADEP Pilot went through a validation process. A validation process determines the conditions under which set forth results can be obtained. It also determines the limitations of the technique or procedures. It's a process that intends to establish an analytical procedure to provide proofs of the object to be analyzed. The results of any validation can be used to judge the quality, reliability and consistency of analytical results, and it's an integral part of any good analytical practice [2].

The CADEP has integrated systems of modules (*Empowers, Innovates, Cultivates, Supports, Convene*) which act together in order to: (i) monitor students at risk; (ii) training and support the academic, technical and administrative staff; (iii) use new strategies for university teaching and innovative use of ITC in practical scenarios by stimulating the entrepreneurship between students and professors.

*Empowers:* It provides training in e-learning standards, accessibility and usability; it is in charge of the knowledge base maintenance; it supports the creation of accessible educational contents and their necessary adaptations(e.g. Interpretation of sign language);

*Innovates*: It boosts the creation of applications and devices to cover special educational needs and diversity (e.g. through 3D printing);

*Cultivates:* It defines and develops models, systems and necessary contents in the production of accessible didactic areas; creates accessible educational designs that incorporate the emotional dimension of the professors and the students in different educational scenarios;

*Supports*: It detects, monitors and supports the emotions of students in critical family situations through both action strategies and advanced automatic systems (e.g. System of automatic detection of emotions) to improve the academic level and to avoid dropouts.

*Convene:* It organizes and manages the activities; from the physical to the technological and communication infrastructure, necessary for the proper functioning of the CADEP and its internal and external articulation with other universities, entities and other CADEPs (e.g.. space, physical and technological resources, institutional rules).

The evaluation was defined mainly from the execution of the pilot to the end-users allowing an investigation of the various needs for technology deployment into real working environments. This allowed identifying key usability issues and further user requirements, from which developers could work to bridge any gaps between company/team expectations, the actual performance of the system and any technical constraints.

In accordance with [3] namely the '*DECIDE*' framework that guides evaluation, the following checklist has been observed:

- Determine the overall goals that the evaluation addresses;
- Explore the specific questions to be answered;
- Choose the evaluation approach and methods which are appropriate to answer the questions;
- Identify any practical issues which may impact on the evaluation methods used, for example, selecting participants;
- Decide how to deal with any ethical issues with regards to the evaluation process, for example, privacy and confidentiality issues;
- Evaluate the system, collect and analyse the data and interpret and feed back the results clearly and in a manner appropriate to the interested parties.

To evaluate both technical and business features of the pilot, two methodologies and one mechanism have been defined (Figure 3):

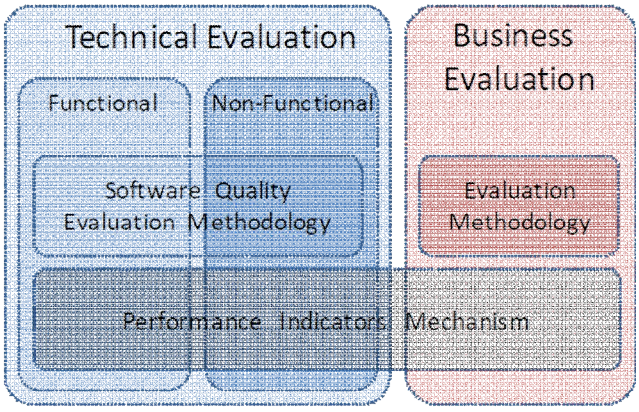


Figure 3. Pilot Evaluation Methodologies and Specification Areas

Software Quality Evaluation Methodology; Qualitative Evaluation Methodology and Performance Indicators Mechanism have been designed according to [3]. The software quality evaluation methodology is focused in the technical evaluation of the pilot, while the Qualitative Evaluation Methodology focuses only on the validation of the pilot from a business point of view. By other side, the performance indicators mechanism evaluates the pilot addressing transversally both areas.

The Software Quality Evaluation Methodology intends to evaluate the pilot from a technical point of view addressing respectively

functional and non-functional characteristics of its system software. This methodology is based on the Software Product Quality Evaluation Reference Model, the ISO/IEC 25040 [4]. To evaluate software quality, first it is required to prepare the evaluation, establish the evaluation requirements, specify, design, execute and finally, report the evaluation.

The Qualitative Evaluation Methodology intends to evaluate from a business point of view if the stakeholders will accept the system.

The Performance Indicators Mechanism's main objective is to define and measure the progress toward a specific goal. The performance indicators are defined based on the overall project objectives and against the pilot scenario steps. In this phase such indicators represents good mechanism to evaluate if the initial identified objectives were reached or not.

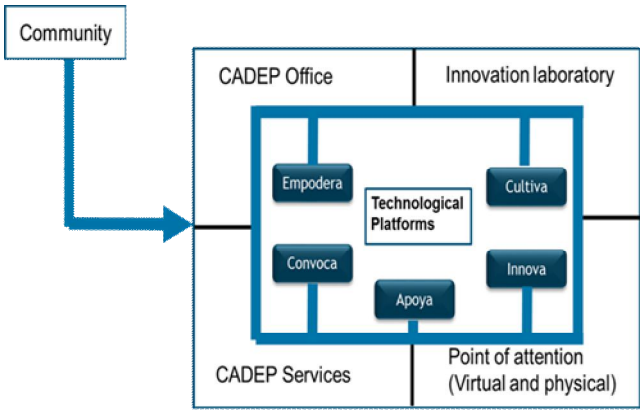


Figure 4. Implementation scheme of CADEP Pilot

The main goal of this environment was to create an enhanced learning and teaching environment. Our process was designed to identify the necessary improvements that will have an immediate positive impact, manage efficient implementation of those improvements, and regularly communicate progress and results to all stakeholders.

The fundamental issue in a ubiquitous learning environment is how to provide learners with the right material at the right time in the right way. Context aware adaptation was therefore indispensable to all kinds of learning activities in ubiquitous learning environments.

The software quality evaluation process is part of the assessment procedure for the technological infrastructure developed.

ISO (International Standard Organization) 9126 [5] has provided a generic definition of software quality based on six characteristics. These are functionality, efficiency, maintainability, reliability, portability and usability. Almost all of the quality model designed until now have covered all the six basic characters.

Software Quality models set some characteristics based on which we can design a quality software. According to [5] the software can be defined on the basis of the fulfilment of the requirement, meeting the expectation of the customer and meeting the requirement specification. The quality of the software is measured in terms of its capability to fulfil the needs of the users and also its ability to achieve the developer's goals. Quality is mainly studied by quality models. The quality model describes the set of characteristics, which are the basis for establishing the quality requirements and for evaluating software quality. The characteristics of software quality can be also classified on the basis of the end users. They can be classified as below in Figure 5.

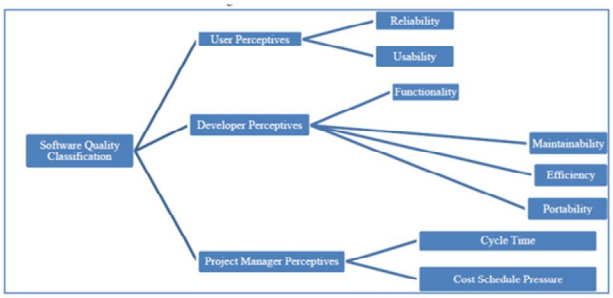


Figure 5. Software quality classification

A number of factors affect the reliability, like number of defect found, failure recovery rate etc. The characteristic of reliability is further defined and quantified into sub characteristics based on which be an evaluate reliability ISO 9126 has defined [5] the sub characteristics as follows:

- Maturity: describes the frequency of failure of the software by faults.
- Fault Tolerance: evaluates the robustness of the software. It describes the software attributes that describe the ability of the software to maintain a specified level of performance in cases of software faults or the violation of its specified interface.
- Recoverability: describes the capability of the software to re-establish its level of performance and to recover the data directly affected in case of failure and the time and effort needed for it
- Reliability Compliance: determines whether the software adheres to the compliance standards of reliability or not.

Software reliability is a set of attributes which that the software been designed is according to the requirement and is capable of handling the fault and failure [6].

For the construction of our questionnaire we relied on a theoretical framework of user experience [7]. The framework assumes that perceived ergonomic quality and perceived hedonic quality describe independent dimensions of the user experience. Ergonomic quality and hedonic quality are categories that summarize different quality aspects. The focus of ergonomic quality is on the goal oriented or task oriented aspects of product design. High ergonomic quality enables the user to reach his or her goals with efficiency and effectiveness. The focus of hedonic quality is on the non-task oriented quality aspects of a software product, for example the originality of the design or the beauty of the user interface.

Thus, it is assumed that persons perceive several distinct aspects when they evaluate a software product. The perceived attractiveness of the product is then a result of an averaging process from the perceived quality of the software concerning the relevant aspects in a given usage scenario.

According to this assumption the constructed questionnaire should contain two classes of items:

- items, which measure the perceived attractiveness directly,

• items, which measure the quality of the product on the relevant aspects.

Quick assessment: Generally, questionnaires are a particularly efficient method to apply and analyze. The application of some questionnaires may nevertheless be rather time consuming when the absolute amount of time is considered. With the SUMI questionnaire [8] the users have to decide on their level of agreement with 50 statements on usability. The long version of IsoMetrics [1] requires ratings for 75 different items. In these cases, the goal is to achieve a comprehensive usability evaluation including detailed descriptions of particular usability problems, on the sole basis of the questionnaire data. This is not what our questionnaire aims at. Rather, it is supposed to be an efficient tool to enhance the results from expert evaluations or usability testing.

Simple and immediate: How does the interaction with the product feel? Which were the most striking features of the product and of the interaction? The user should be enabled to give his rating about the product as immediately and spontaneously as possible. A deeper rational analysis should be avoided. The questionnaire should not force the user to make abstract statements about the interaction experience or remember details that are likely to be forgotten or had been overlooked in the first place. Experts are able to evaluate user interfaces in detail. Detailed data can also be gained from the observation of a user when interacting with the product.

Thus, a user questionnaire can lay its emphasis on criteria which are accessible immediately: the user's subjective perception of product features and their immediate impact on the user him/herself.

We developed the Software Quality Evaluation for CADEPs based on the following pylons:

1. information quality of the software
2. career development process evaluation,
3. user interaction,
4. technical aspects of the software
5. support services.

For each applicable criterion, rate the program:

5 = Outstanding 4 = Good 3 = Satisfactory 2 = Poor 1 = Unsatisfactory

### 1. Information quality of the software

The information criterion covers the following aspects of the program: relevance to the audience, appropriate language, organization of the information, and information quality.

**Table 1. Quality of information**

| Crt. No. | Statement | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| 1 | The information is clear, concise, and informative to the intended audience. | | | | | |
| 2 | The language is non-discriminatory. Content is free from race, ethnic, gender, age, and other stereotypes. | | | | | |
| 3 | The content is free from spelling and grammatical errors. | | | | | |
| 4 | Updated information is distributed promptly, at least yearly. | | | | | |
| 5 | In a program using off-line or computer-administered assessment instruments, those instruments conform to accepted standards of validity and reliability. | | | | | |
| 6 | Statements made in one component are consistent with those made in other components of the program. | | | | | |

**Table 2. Career Development Process Evaluation**

| Crt. No. | Statement | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| 1 | The program motivates individuals to develop their own career plans. | | | | | |
| 2 | The program fosters self-knowledge relevant to work and learning. | | | | | |
| 3 | The program helps individuals to integrate and develop their values, interests, abilities, skills, and goals. | | | | | |
| 4 | Using the program broadens an individual's awareness of current options for employment and education. | | | | | |
| 5 | The program supports informed decision making by helping individuals generate ideas, obtain necessary information, and evaluate alternatives in responsible and personally relevant ways. | | | | | |
| 6 | The program encourages the user to get appropriate counselling and advice in making long term decisions. | | | | | |
| 7 | Using the program integrates planning with previous experiences. | | | | | |
| 8 | The user, not the program, controls the decision making. | | | | | |
| 9 | The program is appropriate for individual use. | | | | | |
| 10 | The program is appropriate for small group use. | | | | | |
| 11 | The program provides information that can be useful in instruction. | | | | | |
| 12 | Using the program contributes to a person's career development. | | | | | |

This criterion covers the user's interaction with the program, the objectives and features of the program, and analysis of it.

**Table 3. User Interaction**

| Crt. No. | Statement | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| 1 | The purpose of the program is well defined and clearly explained to the user | | | | | |
| 2 | The organization is clear, logical, and effective, making it easy for the intended audience to understand | | | | | |
| 3 | The language in the program and in the user's guide is clear to the intended audience | | | | | |
| 4 | User materials are easy to use, appealing to users, and readily available | | | | | |
| 5 | Prerequisites are identified and instruction is provided in the software or in the user guides so individuals can run the program and understand its results | | | | | |
| 6 | The individual has the choice of going directly to desired information or using a structured search to identify relevant topics | | | | | |
| 7 | The individual can operate the program independently, creating his or her own sequence of presentation and review | | | | | |
| 8 | The program acknowledges input. Feedback on user responses is employed effectively | | | | | |
| 9 | Invalid commands are handled constructively. The program tolerates variations in command formats (e.g., upper or lower case, extra spaces, etc.) | | | | | |
| 10 | Individuals can easily start and exit the program. It is easy to back up, change answers, and give commands | | | | | |
| 11 | If there are "help" and "hint" messages, they are easy to access | | | | | |
| 12 | The program is attractive and interesting. It motivates users to continue using the program and exploring career options | | | | | |
| 13 | The program is demonstrably effective with the intended audience, including people of varying abilities and experiences | | | | | |
| 14 | The program can be used by various cultural groups | | | | | |
| 15 | The program achieves its purpose | | | | | |

The following criterion cover aspects of the computer hardware and programs.

**Table 4. Technical Aspects of the Software**

| Crt. No. | Statement | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| 1 | The system uses standard equipment that is reliable, widely available, and applicable to a variety of uses | | | | | |
| 2 | Computer capabilities such as graphics, colour, or sound are used for appropriate instructional reasons | | | | | |
| 3 | If the program requires special equipment, the requirements are minimal and clearly stated by the developer | | | | | |
| 4 | The program is reliable in normal use. Software is bug free | | | | | |
| 5 | Printouts are clear and well organized. The printouts are dated | | | | | |
| 6 | Updates can be loaded easily into the system | | | | | |
| 7 | If any processing in the program is based on assessment scores, course grades, or other client records, the program explains to the user how the records are being used | | | | | |
| 8 | If the program creates a permanent record for a user, that record is secure and confidential. There is provision for erasing the record when the information is no longer valuable in providing services | | | | | |

The next criterion covers aspects of support for professionals who implement the program: written materials, staff training, service, and cost

**Table 5. Support service**

| Crt. No. | Statement | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| 1 | The site coordinator's manual explains the content and process for updating information | | | | | |
| 2 | Print or computer materials explain the content and effective use of the program to local site coordinators | | | | | |
| 3 | Training on appropriate and effective use of the program is provided | | | | | |
| 4 | There is a system of communication between user sites and the system developer which | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | may include newsletters, telephone assistance, and annual evaluations | | | | | |
| 5 | On-site technical assistance is available for effective program use | | | | | |
| 6 | Evaluations of the program's effectiveness are available to site coordinators | | | | | |
| 7 | The cost per user makes it feasible to serve most clients who can benefit from the program | | | | | |

A summary score is constructed. Summation of the points assigned is achieved and division of the total points by the number of items rated is performed. The overall numeric score is used only as a guide. If an essential criterion is rated unsatisfactory, one may decide to reject the program even if some of its features are attractive.

## 5. CONCLUSIONS AND FUTURE WORK

The goal of CADEP pilot is to contribute to prevention of student dropout caused by a variety of factors including emotional factors, academic, economic or social marginalization.
This paper proposed an example of best practice that examines the determinants of student learning satisfaction and dropout in CADEP environment. The research model will be tested using the questionnaire survey with 200 participants. Confirmatory factor analysis (CFA) will be performed to test the reliability and validity of the measurements. The partial least squares (PLS) method will be used to validate the measurement and hypotheses. The empirical findings indicate that computer self-efficacy, performance expectations, system functionality, content feature, interaction, and learning climate are the primary determinants of student learning satisfaction with CADEPs. The results also show that learning climate and performance expectations significantly affect learning satisfaction. Computer self-efficacy, system functionality, content feature and interaction significantly affect performance expectations. Interaction has a significant effect on learning climate. The findings provide insight into those factors that are likely significant antecedents for planning and implementing CADEP to enhance student learning satisfaction.

The CADEP Acacia proved to improve the degree of engagement of students, the academic level, the professional level of teachers and technical and administrative staff. Follow-up, so that action can be taken to prevent desertion, taking into account its causes in each case.

After three months of implementation, the CADEP has the following results: Three work teams offered training on the design of accessible content for faculty professors. Supply software (jaws and magic) have been provided to improve the accessibility of all computers in computer labs. Two points with sign language translators to support deaf people have been implemented. Translators are accessed through the website (relay center). These technologies have been achieved with resources of the CADEP Pilot. Students, teachers and the community have participated in the design of these technologies. In the CADEP office, 15 specific business cases have been received.

The CADEP offers its services and collaborates with the Ministry of telecommunications, Local City Hall of Ciudad Bolivar, Institute of deaf people of Colombia (Insor), Institute of the Blind of Colombia (Inci) and with 40% of the departments of the university.

Future work will accomplished by the technical evaluation of the referred framework and the test of the scenarios in the CADEP Pilot..

## 6. ACKNOWLEDGMENTS

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