Information Systems as Support for Competency-Based Assessment Process

M S Contreras

e-Soluciones, Faculty of Engineering, School of System Engineering, Universidad de Cartagena, Colombia

mcontreraso@unicartagena.edu.co

Abstract. Possessing enough and timely information about a process or product and being able to organize and display it efficiently, is a determining factor for decision making in organizations. Educational institutions are not alien to this principle and use different strategies to manage it. Nowadays, the Information and Communication Technologies (ICT) are commonly used to support the evaluation process by competences, to identify strengths and weaknesses and to analyze and report the results, in order to monitor student performance and apply improvement plans.

This paper shows an analysis of some influential factors in the development of academic reports for basic education institutions, through the implementation of an Information System that provides global and sectional statistics, extracts relevant information on the individual and group performance, simplifies reading and analysis of the data provided, allows the presentation of data in numerical, qualitative and graphical form, highlights the points that move away from the average, among other useful functions.

1. Introduction

An Information System (IS) is a set of interconnected components that support organizations in the decision-making process, through information management. This management includes functions such as collecting, storing, processing, comparing, analyzing, deploying and distributing information [1] [2]. The IS also support the creation of new products and the general control of the organization. Besides, they allow saving time in the development of the tasks and provide added values [2].

One of the most used tools by managers is technology, that has been linked as a dimension of the IS. The Information Technology infrastructure includes the combination of software, hardware, networks, telecommunications and Internet [2]. These elements allow the management and display of information in real time.

Educational institutions, like organizations, have also seen in the information systems an alternative to support their processes in the handling of the large amount of information that they generate daily, making this task easier, faster and more effective. This kind of IS is known as Academic Information System (AIS) [3]. Among the most relevant processes that are developed in the AIS is the assessment of the evaluation and generation of reports that allow a correct monitoring of student performance, in order to implement timely improvement plans and effectively support learning.

One of the ways to measure a student’s performance is through the competencies that he/she has developed in the area of study. The term “competence” is related to behaviors, actions or skills that a person can demonstrate in a specific context [4].
This paper presents a customized Information System for a non-formal education institution that supports schools in the competency-based assessment process and the challenge of generating quality statistical information.

2. Literature review

2.1. Academic information system

Academic Information System (AIS) is a software tool that allows processing all data of an academic institution quickly [5]. Among the services that are commonly offered in these systems are those related to financial and academic processes. These systems must be built according to the needs of the users [6] and the objective is to achieve the goals of a quality, agile, efficient and accurate service. For this, it is necessary that the information resulting from the AIS be accessible, reliable, consistent, easy to read and relevant [7] [8]. Thanks to Information Technologies (IT), educational institutions have been able to increase their productivity and improve their processes in general [9]. A quality AIS directly provides a competitive advantage [8].

2.2. Software quality attributes

As a part of the development and implementation of any type of software, it is vital to evaluate its quality and performance, for which it is necessary to consider the measurement of 8 attributes (to see their descriptions in Table 1): functional stability, efficiency, compatibility, usability, reliability, security, maintainability, and portability [10]. All these features determine the user experience and the satisfaction level in the use of the system [9].

Table 1. Software quality attributes description.

| Attribute       | Description                                                                                                                                 |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Functional stability | The extent of change in his functions [11].                                                                                           |
| Efficiency      | The relationship between the yield obtained and ideal performance, considering the resources used in a given moment [6].                   |
| Compatibility   | The ability of a software application to run on different platforms without having to change its structure or format [12].              |
| Usability       | Ease of use which a user has can interact with a system, through its interface [13].                                                      |
| Reliability     | Be available when needed and behave as expected [11].                                                                                   |
| Security        | Only allow access to information and functions to authorized users [6].                                                                 |
| Maintainability | Ability to correct errors or necessary changes to the interface, documentation or code of an application [13].                            |
| Portability     | Ability to run components or the entire system in an environment for which it was not initially designed [14].                            |

2.3. Competency-based assessment

In Colombia, the specialized entity that offers education evaluation services in all levels (basic, media, technical and professional education), and supports the Ministry of National Education (MEN) in
carrying out State tests and research about the educational quality is the ICFES. Currently, the MEN states that education is aimed at the development of competencies, that is, the know-how in context and, they must be evaluated [15].

Competencies can be classified as generic, specific or transversal. Generic competencies are common to all individuals, regardless of occupation and are related with the necessary abilities to learn, innovate and create [16]. On the other hand, specific competencies are related to private teaching subjects [17]. Finally, transversal competencies are abilities that transcend a specific field, are transdisciplinary competences [18].

3. Methods
This work was developed using the incremental approach or prototyping and was tested in a non-formal education institution that supports the competency-based assessment process in basic and middle education institutions in Colombia, with the purpose of preparing for the State tests at the different levels. Each module was developed according to the general requirements of the evaluated schools, and improvement plans were developed based on the observed results. In addition, the evaluation models were governed by the guidelines given by the ICFES and the MEN. The prototype obtained has been the result of several years of development.

4. Results and Discussion
To support the management of the information resulting from competency-based assessment process in educational institutions was implemented an Academic Information System, called SIAGREC, that contains several modules, described in Table 2.

| Module                          | Description                                                                 |
|--------------------------------|-----------------------------------------------------------------------------|
| Creation of groups and students| Entry of personal information of students, such as full names, ID number, School and grade. This process is done before you start to qualify. |
| Creation of tests              | Entry of information on each test, such as evaluated subjects, number, and order of questions, correct answers. This process is done before you start to qualify. |
| Reading and processing response sheets | Scanning of the response sheets and processing of the resulting image, to compare the answers given with the correct ones, according to the applied test. |
| Generation of individual and group reports | In the individual’ reports, the score obtained by the student in each evaluated area and its total accumulated is shown. The information is presented in a quantitative and qualitative form. In the group’s reports, more detailed and comparative information is presented, by thematic axes and competences, both of the individual scores and of the global averages. In addition, a graphic report is generated that is easier to read and analyze. |

Figure 1 shows the flow diagram of the qualification process, once the students have been registered and the information on the applied exam has been entered.
Main subjects evaluated are critical reading, mathematics, natural sciences, social sciences, and English. The type of question is a multiple choice with a single answer and the sheet format corresponds
to a templated adjusted to each test, where the student fills in an oval manually, according to the chosen option. Figure 2 shows a fragment of the answer sheet.

![Figure 2. An answer sheet fragment.](image)

Reading process is part of the information system but it is done before the qualification process. The most important factor for the correct reading of the leaves is the filling dark’ level and background.

### 4.1. Generated reports

As mentioned, the efficient and timely management of information is a very important factor for decision making and the fulfillment of goals in any organization. In educational institutions, whose purpose is to carry out efficient processes that promote learning and the development of skills, this process takes on more weight.

However, one drawback faced by institutions of this nature is the amount of information that needs to be stored daily, as a result of the application of different tests, especially when the number of students increases. In addition, it is necessary to obtain the results in a short time, in order to achieve improvement plans. In this case, the use of an Academic Information System is an excellent option, and if it is tailored to the institution, much better.

In the present project, a set of reports were developed, some focused on students and others at the institution.

#### 4.1.1 Individual reports.

Figure 3 shows the main data included in this report.

| Personal information | General information | Specific information |
|----------------------|---------------------|---------------------|
| • Full names         | • Average           | • Average by subject|
| • School             | • Standard deviation| • Performance level  |
| • ID number          | • Position in the group| achieved in each competence. |
| • Grade              |                     | • Performance level achieved in each theme. |

![Figure 3. Main data included in the individual report](image)
In addition to the numerical or qualitative data (performance categories), it was found that a very influential factor to understand the results is to indicate the weaknesses detected in each evaluate subject.

4.1.2 Group reports. Table 3 shows the different group reports generated in the system and the variables that were considered.

Table 3. Group reports generated in SIAGREC.

| Group Report                          | Variables                                                                 |
|--------------------------------------|---------------------------------------------------------------------------|
| List of individual score             | Full names, ID number, school, score by subject. Total Average and total standard deviation. Scores are organized from highest to lowest to appreciate the two extremes of the data set. |
| Performance level list by competency | Full names, ID number, school, performance level by competency.            |
| Performance level list by theme      | Full names, ID number, school, performance level by level.                 |
| Percentage of correct answers by the question at the group level | The number of each question, subject, the percentage of students that selected each answer option, correct answer, subject evaluated by each question, the percentage of correct answers. This report shows the tendency of success per question and highlights the weaknesses. |
| Graphic statistical report           | Present previous group information but graphically, adding comparisons between subjects, identify the maximum and minimum scores and the performance scenarios relative to the average and standard deviation. |

4.1.3 Observed results in the implementation of the SIAGREC system.
The educational institutions that have applied qualified evaluations with the SIAGREC system have obtained outstanding information on the performance of their students, detecting, among other situations, the topics that are most difficult for the students and where it is necessary to reinforce at the group and individual level, the most outstanding students and those who require more support, a continuous record over time that allows them to follow up their processes and develop improvement plans. In addition, they receive specific recommendations on the performance of the competencies by subject. The sum of all information has allowed, over the last 9 years, to feed, improve and adapt the system to align the evaluation process with the standards given by the National Education Ministry.

In terms of the use of the SIAGREC application by the person who performs the qualifying process, an improvement in processing times was achieved. Before implementing the sheet scanning function, an average time of 3 hours and 30 minutes was used to process the tests of 30 students (standard group), measured from the receipt of the sheet pack until they were ready by printing. After the implementation of this function (scanning), the same process was finished in 15 minutes on average. If you consider that, on a date with a large volume of exams, you can get up to 90 groups, it is a considerable saving.

In addition, with the current government policies, the number of grades has been increased in which state assessments are made (previously only eleventh grade and professional students were evaluated, odd grades, technical career students, technology students and professionals are currently being evaluated). This implies that the institutions need to apply pilot evaluations, to prepare themselves, measure their performance and, if necessary, carry out improvement plans.

Finally, we can highlight the improvement in terms of points obtained in the state tests of supported institutions. Although, the results do not only depend on the evaluation process carried out by the
application, the opportunity to carry out the improvement plans on time and the given recommendations on specific topics show that they represent a considerable help.

5. Conclusion
Academic Information Systems are a great tool for educational institutions, who can store, process and display relevant information to make decisions about an optimal teaching process, adapted to each group of students, according to their particular needs.

Grouping the information by specific topics and by competence allows identifying with greater ease and dynamism the performance of the students. Besides, with the help of technology it is possible to analyze this information easily and generate different reporting models, in different formats (graphs, qualitative and numerical), through an application that possesses the main attributes of an information system, such as usability, efficiency, reliability, security, maintainability, among others.

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