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Evaluation by Competencies: Proposal for an Integral System for Higher Education

Claudia Alejandra Rosero Noguera, Gladis Helena Vásquez Echavarría, José León Henao Ríos.

Research Professor, Faculty of Engineering, Politécnico Colombiano Jaime Isaza Cadavid, Medellín, Colombia.

Research Professor, Faculty of Engineering, Politécnico Colombiano Jaime Isaza Cadavid, Medellín, Colombia.

Research Professor, Faculty of Engineering, Politécnico Colombiano Jaime Isaza Cadavid, Medellín, Colombia.

ABSTRACT: This paper presents an innovative proposal for competency-based assessment in higher education, addressing the limitations of traditional numerical grading systems.

A comprehensive evaluation format designed for the Integrating Pedagogical Project (PPI) is developed, which allows validating basic, specific and transversal competencies. The proposal includes the design of a software that facilitates the systematization and real-time monitoring of the competencies acquired by the students.

The system is based on evaluation criteria that reflect the competencies to be developed, using a rating scale ranging from "Deficient" to "Good or Excellent". This approach allows for a more objective and formative evaluation, aligned with national higher education policies in Colombia.

The implementation of this system promises to optimize resources, improve assessment accuracy and provide continuous feedback to students and teachers. The potential impact of this proposal is significant, as it benefits all actors in the educational process, facilitating detailed monitoring of the development of competencies throughout the academic year and better preparing students for their professional future.

KEYWORDS: Competencies, Competency assessments, Software

I. INTRODUCTION

Competency-based assessment in higher education represents a complex but necessary challenge in the current educational context. This paper addresses the problem of traditional assessment based on numerical grades and proposes a more comprehensive and formative approach. "It is that the new generations are more aware of many things in the world around them than past generations have been. Therefore, school cannot be built on how it was before, regardless, whether that model worked or not." [1]

For the above reasons, an innovative proposal is presented that seeks to validate basic, specific and transversal competencies through an evaluative format designed for the Integrating Pedagogical Project (PPI). This proposal not only includes a new evaluation system, but also the development of a software that allows the systematization and real-time monitoring of the competencies acquired by the students. The objective is to provide a tool that facilitates teachers and students the understanding and monitoring of the learning process, in line with the national policies of higher education in Colombia and the current trends in educational evaluation.

II. RELATED WORK

1. Evaluating Competencies

Assessing for competencies is something more subjective but should be valued; Valverde et al. state that "Assessment needs to be considered as a process of collecting evidence (through learning activities) and formulating evaluations about the extent and nature of student progress, according to expected learning outcomes." [2, p. 53] At the Institución Universitaria Politécnico Colombiano Jaime Isaza Cadavid the current evaluation scheme is numerical, in grades ranging from 0.0 being this the lowest and 5.0 as the highest. But this

does not allow the development of learning processes, on the contrary, it interrupts such processes and does not allow the complete achievement of the objectives proposed at the beginning of an educational stage. At the same time, grading stops the development of competencies and decreases the students' learning level because it is focused on obtaining results regardless of the learning pace. [3, p. 3]

Given the above, this evaluation proposal is proposed in which an evaluation format was designed to validate the basic, specific and cross-cutting competencies that are evident in the methodological strategy of the Integrating Pedagogical Project - PPI. As Rodriguez and Acosta [4, p. 62] refer to it the evaluation process is not only carried out in the students' r.a., but it is a systematic set of units, guiding the development of competencies and skills in the students, as well as evidence of the quality processes of the programs and their resources.

But to achieve this, it should be noted that the evaluation process is “a constituent part of the teaching and learning process, so it should be incorporated in an intentional way in the different moments in which it is developed, becoming a strategic pedagogical tool for the achievement of student learning.” [5, p. 3]

The evaluative issue is something complex nowadays, since by national policies at the level of Higher Education in Colombia these must be comprehensive, which is why authors such as Urbano and Vanegas refer that one way to comply with this is by means of rubrics that are considered as “the evaluable aspects that will allow validating the evolution in student learning throughout the process and that the teaching team must define according to the objectives of the program and the institutional identity.” [6, p. 240]. However, in this proposal, some evaluation criteria are proposed that Perez et al. consider that they “will serve as variables which will allow in a fair and objective manner to assign a numerical value or a letter as the case may be.” [7, p. 62]. For all of the above, the following evaluation format is proposed, which is organized as follows:

- Criterion: Summarizes concretely the competence to be developed, the criteria should be organized considering whether the competence is thematic, axiological or basic.
- Obtained level of assessment which is classified as:
 - Deficient: In the proposal has an assignment of zero (0) points.
 - Insufficient: In the proposal it has an assignment of one (1) point.
 - Acceptable: The proposal has an assignment of two (2) points.
 - Good or Excellent: The proposal has an allocation of three (3) points.
- Points obtained: is the allocation of points, considering the evaluation scale (0 or 1 or 2 or 3 points).
- Total points obtained: Sum of all the points assigned to each criterion.
- Numerical score between 0.0 and 5.0: As mentioned above the Institution has a score from 0 to 5. In this proposal it is obtained according to the formula described below.
- Observations: Space to make suggestions for improvement or something to be considered by the team or the student.

III. METHODOLOGY

Each teacher will have a format and according to his/her module can place the criteria he/she considers necessary to validate the competencies in a student or in a work team. Such as the example presented below:

Table 1: Evaluation Format

CRITERION	LEVEL OBTAINED IN THE VALUATION				
	DEFICIENT (0 PONTOS)	INSUFFICIENT (1 PONTOS)	ACCEPTABLE (2 PONTOS)	GOOD – EXCELLENT (3 PONTOS)	POINTS OBTAINED
THEMATIC CRITERIA					
1. Project interpretation	Does not demonstrate preparation or does not	Demonstrates little mastery and interpretation is not adequate.	Demonstrates a fair amount of preparation but requires	Demonstrates mastery and interprets the project	

	adequately interpret the project.		improvement in interpretation.	correctly	
2.					
AXIOLOGICAL CRITERIA					
3. Ortography	Has many errors that distract the reader considerably or completely	It has spelling errors in accentuation or verb conjugation. The voice is not active and is inappropriate for the topic and audience. Errors distract the reader.	Few spelling errors in accentuation or verb conjugation. Active voice and appropriate for the topic and audience.	No spelling errors in accentuation or verb conjugation. Active voice and appropriate for the topic and audience.	
4.					
n.					
Total points obtained					
Numerical score between 0.0 and 5.0.					
REMARKS:					

The grading scale depends on the number of evaluation criteria stipulated. It will be calculated by applying the following formulas:

C = Criteria

N = Numerical grade

P = Sum of Points (Total points obtained)

$X = C \times 3$

$Y = C \times 2$

If $P < (C \times 1) N = 0.0$

If $P > (C \times 1) N = 3.0 + ((P - Y) * 2) / (X - Y)$

For example:

C = 6

N = ?

P = Sum of Points (Total points obtained)

$X = 6 \times 3 = 18$

$Y = 6 \times 2 = 12$

For $P > (6 \times 1)$: $N = 3.0 + ((P - 12) * 2) / (18 - 12)$

The conversion scale for the example would be expressed as in the following table.

Table 2. Conversion scale from points to numerical score

		Rating scale												
Points	0 a 5	6	7	8	9	10	11	12	13	14	15	16	17	18
Num. grade	0,0	1,0	1,3	1,7	2,0	2,3	2,7	3,0	3,3	3,7	4,0	4,3	4,7	5,0

2. Performance criteria to validate the level of competence achieved in the IPP

The performance criteria are proposed based on the competencies to be developed by the modules and these are assessed through four (4) rubrics described as:

- Deficient with zero (0) Points.
- Insufficient with one (1) point.
- Acceptable with two (2) points.
- Good or Excellent with three (3) points.

The level of achievement of the competency reached by the student will be calculated in the same way as the PPI is evaluated with the point conversion scale. This process will be done automatically by the information system.

In this proposal, not only an evaluation format is proposed, but also the development of a software that allows obtaining the systematization of the grades in real time. The way in which the software was developed will be described later. An example of performance criteria is shown in table 3 below.

Table 3. Performance criteria

Performance criteria to validate the level of proficiency achieved						
Element of Competence	Modules	Performance Criteria	Rubrics for assessment			
			Deficient	Insufficient	Acceptable	Good
Construct the manuals for the information system in accordance with the established standards	- Construction of reports using office automation tools. - Development of communication and negotiation skills	Build Reports	Does not comply with the minimum guidelines required in a report or does not submit a report at all	Complies with some guidelines but they are insufficient	Complies with the guidelines, but needs to supplement or improve them	Meets guidelines excellently
		Use standards to develop manuals	Does not use established standards for manuals	Uses some standards but they are insufficient	Uses standards to prepare manuals in an acceptable manner	Excellent use of standards to prepare manuals
		Apply ICONTEC – APA - IEEE standards	Does not apply the Icontec or APA or IEEE standards in any written document.	Insufficient application of the Icontec or APA or IEEE standards.	Applies some items of the Icontec or APA or IEEE standards in your documents.	Properly applies the Icontec or APA or IEEE standards in its documents.

3. Implement an information system to formalize the competency monitoring process.

Based on the information collected, the proposed design to comprehensively evaluate the students proposes the development of a software that contains the evaluation system to demonstrate the competencies in software development. This information system will make it easier for teachers and students to know and identify the level of achievement of the competency in real time. Additionally, at an institutional level, it formalizes the process of monitoring the competencies of the students of the Institutions of Higher Education. Consequently, “Software requirements are born out of a need for an automation, in most cases a functional rule is described at a high level and an idea is described in a global way.” [8] So potential users were identified, and the concepts of Requirements Engineering

were considered which “serves as a solid foundation in the software development process.” [9]. Potential users or stakeholders were identified and the following user, functional and non-functional requirements were raised.

Description of Actors or users

Potential stakeholders or users

The users identified for the proposed information system are the following with their respective descriptions, as shown in the table below.

Table 4: User requirements.

stakeholders or users	Description
Administrator	It is the one who creates the access accounts to the system, assigns permissions to each user depending on the role to be developed and changes the password.
Teachers	This is the person who evaluates, based on the rubrics, the achievement of the competencies of an EMI Student.
PPI Coordinator	It is the person interested in knowing the level of achievement of the competence of an EMI Student.
Students	This is the person interested in knowing the level of achievement of his or her competencies.
Mentors or employers	It is the person interested in knowing the level of achievement of the competencies of an EMI Student.

User requirements

The user requirements arise from the needs raised by different stakeholders, in this case teachers, program coordinators, PPI coordinators and students, since a tool is needed to validate the level of achievement of the competencies and to produce the respective reports.

Table 5: User requirements.

ID. Requirement	Requirement Name	Requirement Description
RU-01	User administration	The system must allow the creation, consultation, modification and disabling of application users. Allowing the assignment of profiles to them. Users: Administrator, Teachers, PPI Coordinator, Students, Mentors.
RU-02	Student Administration	The system must allow the registration, consultation, modification and disabling of the Students of the IEM. Each student must be associated to a study plan and will allow the administration of the student's resume.
RU-03	Administration of teachers	The system must allow the creation, consultation, modification and disabling of the Teachers that teach modules in the IEMs and each teacher must have the Module he/she teaches associated to him/her.
RU-04	Business Administration (Mentors)	The system shall allow the creation, consultation, modification and disqualification of the companies that are part of the Business Mentor program, they will be able to consult the level of achievement of competencies in the students.
RU-05	Study Plans Administration	The system must allow the creation, consultation, modification and disabling of the program's Study Plans with their respective Modules, credits of each one of the modules, pre-requisites and co-requirements, hourly intensity and thus be able to generate the curricular mesh governed by the study plan. For this case of the Politécnico Colombiano Jaime Isaza Cadavid
RU-06	Competency Management	The system must allow the creation, consultation, modification and disabling of all information related to competencies, criteria and rubrics. Calculating the level of achievement of the competencies per student.
RU-07	Report Management	The system must allow the generation of reports such as: - Reports of students and associated modules. - competencies (standard and competency elements) - Report of competencies, criteria and rubrics per module. - Competency achievement level per student. - Generate Enrolled Students Report

Functional Requirements

Based on the user requirements, the needs previously stated are detailed to provide a solution to the problems presented.

Table 6: Functional Requirements

ID. Requirement	Requirement Name	Requirement Description	User	Id User requirement
RF-01	Department Management	The application shall allow entering, modifying, consulting or deleting department information. It shall have the following fields: ID, Name of the department	Administrator	RU-02
RF-02	Manage Municipality	The application shall allow entering, modifying, consulting or deleting information of the municipalities. It shall have the following fields: ID, Department name, Municipality name.	Administrator	RU-02
RF-03	Access to the system	The application shall allow the control of access to the application by valid users through a username and password	Admin, Student, Teacher, PPI Coordinator and Mentor.	RU-01
RF-04	Change Password	The system must allow the change of the password to the user who is in the system and who has logged in to the application.	Admin, Student, Teacher, PPI Coordinator and Mentor.	RU-01
RF-05	Manage Profile	Allows you to enter, modify, consult or disable a profile that will be assigned to a user with their respective permissions for access to the different functionalities. With the following fields: Code (It is generated by the application), Profile Name, Status (Enabled / Disabled) and select the permissions for this profile.	Administrator	RU-01
RF-06	User Management	Allows to enter, modify, consult or disable a user and its respective assignment of a profile for the navigation in the system through the different functionalities. With the following fields: - User, - Password, - Full names - Assign Profile (Drop-down list with previously created profiles).	Administrator	RU-02
RF-07	Manage Module (Subject)	Allows to enter, modify, consult or disable the Modules (Subjects) that a student sees during the whole course of his Technical High School cycle. With the following fields: Code, Module Name, Prerequisites, Co-requisites, Number of Credits, Semester, Hourly Intensity, Propaedeutic (Yes/No), Status.	Administrator	RU-02 RU-03
RF-08	Manage Student	Allows you to enter, modify, consult or disable a student's information. It will have the following fields: Type of Identification (Citizenship Card, Identity Card, Civil Registration, Alien Registration Card, Passport), Identification Document number, Full Names, Full Surnames, Photo, Gender, Date of Birth, Address, Telephone, Cellular, Email, Alternate Email, Articulated Student (yes or no. If articulated activate the following information: Educational Institution where you study or studied, Year of graduation, State.	Administrator	RU-02
RF-09	Manage Teachers	Allows you to enter, modify, consult or disable the information of a teacher who teaches one or more modules. With the following fields: Type of Identification (C.C., Alien ID, Passport), Identification Document Full name(s), Full surname(s), Profession, Address, E-mail, Telephone, Cellular, Date of Birth, Type of Teacher (Chair - Permanent - Occasional), Module, Status.	Administrator	RU-03
RF-010	Manage Competency Standard	Allows you to enter, modify, consult or disable a competency standard. It has the following fields: standard ID, standard name, description.	Administrator	RU-06
RF-011	Manage Competition Item	Allows to enter, modify, consult or disable a competency element. It has the following fields: rule Id, element Id, name, description.	Administrator	RU-06
RF-012	Manage Evaluation Criteria and Rubrics	The system allows you to create, modify, consult or disable an evaluation criterion, taking into account the following fields: criterion ID, description, rubrics (4), rubric value, associated to a competency.	Administrator	RU-06
RF-013	Assigning scores	The system allows you to assign scores according to a scale determined by the criteria and rubrics.	Administrator	RU-06
RF-014	Calculate the level of achievement	The system must perform the calculation of points to determine the result of the level of achievement of a competency, depending on the criteria and rubrics selected by	Administrator	RU-06

	of the competency	the teacher in his evaluation.		
RF-015	Generate reports	Allows the generation of reports such as: Reports of students and associated modules. competencies (standard and competency elements) Report of competencies, criteria and rubrics per module. Competency achievement level per student. Generate report of Curriculum with its Modules.	Administrator	RU-07

Non-Functional Requirements

Considering the needs evidenced and taking into account the end user, the following non-functional requirements were obtained.

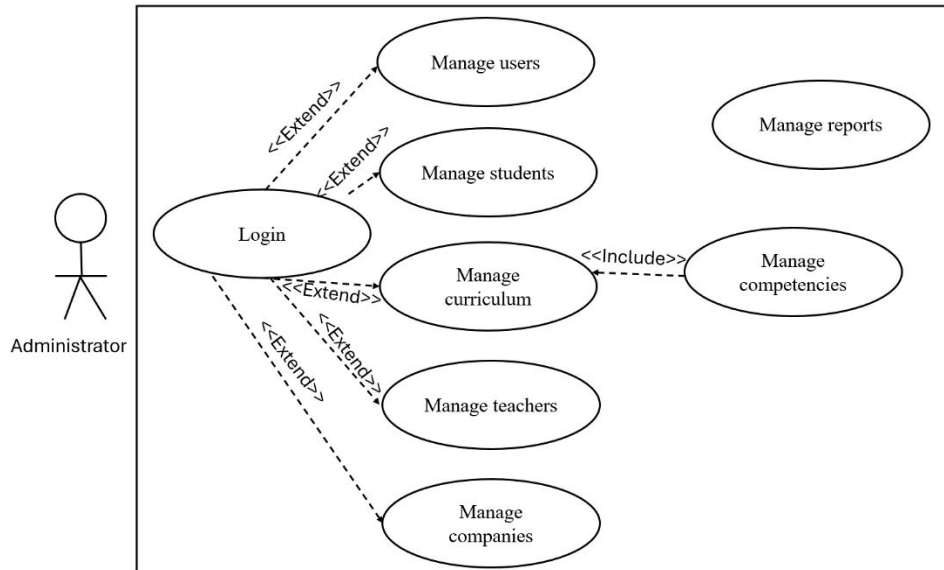
Table 7: Non-Functional Requirements

ID. Requirement	Requirement Name	Requirement Description
RNF-01	Standard Design	Appropriate design with the standard colors of the Politécnico Colombiano Jaime Isaza Cadavid (white, green, yellow).
RNF-02	Availability	The system must be available to use the systematized information at any time of the day, either by students for information or by the persons in charge in the middle of the institution's office hours.
RNF-03	Updating	The system must ensure the permanent updating of the database, when the system's managers register the information provided.
RNF-04	Keys	Key encryption.
RNF-05	Backups	Perform a backup of the database on disk with sufficient capacity and by dates to have an additional level of protection of the information.
RNF-06	User Manual	A user's manual will be presented with the specifications for the use of each Master and component of the system.
RNF-07	Help	The system will contain a help tab with basic system information.
RNF-08	Ram and Hard Disk Capacity	A minimum Ram of 1GB is required for a good processing of the data and a Hard Disk of 320 to 500 GB per issue for the support of the database.
RNF-09	Language and Database Engine	The application will be developed in Java and the database in MySQL.

IV. EXPERIMENTAL RESULTS

For this research, the Unified Modeling Language (UML) was used, which "is a graphical, semi-formal language that has been accepted as a standard for describing object-oriented software systems. UML defines several types of diagrams that are used to describe different aspects or views of a system" [10]. In this case a general use case diagram was performed.

Use cases are important "in software application development to capture functional requirements and to handle the complexity of robust systems." [11] that captures a global idea of what is intended to be developed. Based on the above "The main input for the development of the use case diagram is the functional requirements, so the first task is to identify the requirements" [12]. This process was previously carried out and is described in detail in Tables 5, 6. Figure 1 represents the UML diagram - general use case of the system.



V. CONCLUSION

Competency-based assessment requires a more holistic and formative approach than the traditional numerical grading system. Therefore, the proposed evaluation format, together with the software developed, offers a comprehensive solution for the monitoring and validation of competencies within the framework of the Integrating Pedagogical Project.

This proposal facilitates the teaching work and provides more accurate information on the achievement of competencies, optimizing resources and time. Additionally, it allows monitoring progress in real time, formalizing the process of monitoring competencies at the institutional level.

The implementation of this evaluation approach has the potential to generate a significant impact on educational quality, benefiting both teachers and students in their academic and professional development. Therefore, this evaluation model is aligned with current trends in higher education and responds to the demands of a more comprehensive and competency-oriented training.

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