Design and Implementation of an Integrated Academic Management Model with LMS: A Peruvian Private University Study Case

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Abstract

This research aimed at designing and implementing a competency-based evaluation model, supported by the integration of academic management systems with Learning Management Systems (LMS) to verify the level of achievement of competencies of the graduate profile at the Universidad Católica Santo Toribio de Mogrovejo (USAT). The study corresponds to applied technological research since it designs and implements an integrated system for the improvement of the Teaching - Learning process, which is evidenced in the following results: (1) Integrated model achieved; (2) Total number of syllabi generated in the sub-process of design and update of the subjects; and (3) evidence of the achievement levels of the competencies of the graduate profile. It is concluded that implementing the integrated system made it possible to monitor and improve the achievement levels of the competencies of the students of all USAT's academic programs.

Keywords

Higher education, professional competencies, learning process, learning management systems.

1. Introduction

In 2007, the regulations of the National System of Evaluation, Accreditation and Certification of Quality (SINEACE, by its Spanish acronym) were made official in Peru. In 2016, this institution published its new "Accreditation Model for University Higher Education Study Programs" [1], including 34 quality standards, which generated in Peruvian universities the need to implement improvements in academic processes with the use of Information Technology (IT).

The Universidad Católica Santo Toribio de Mogrovejo (USAT) in its ongoing work to position itself as a pioneering institution in the use of technologies in its academic and administrative processes in the Lambayeque region, and responding to the standards of the SINEACE model (2016): (1) Articulated Purposes, (5) Relevance of the graduate profile, (6) Review of the graduate profile, (7) Quality Management System (QMS), (9) Curriculum and (33) Achievement of competencies, establishes the

need to review and propose a Teaching - Learning System that reflects the level of achievement of competencies of the graduate profile in all Academic Programs.

This proposal suggested the analysis on the Teaching - Learning process by competencies in USAT, where the following problems were evidenced:

- Lack of uniformity in the planning and execution in the subjects; encouraging that groups of the same subject and curriculum design, in practice, are managed with different contents, instruments and evaluation criteria, generating student discomfort.
- Poor control of the syllabus evaluation system by professors, leading to non-compliance in the number and type of evaluations applied, as well as in the timely delivery of grades to students in accordance with the regulations.
- The academic programs did not have systematized information on the level of achievement of competencies of the graduate profile, as well as the learning results of the subjects, which makes it difficult to make decisions to consolidate the student's formative process.
- The students did not know which performance indicators developed in the subject, were the most difficult for them and how to deal with them.
- The virtual platform of the professor and student (virtual campus) only had the registration and consultation of the final grades of the subject, and the virtual classroom (Moodle) with the registration and consultation of the partial grades, with different weightings to the evaluation system considered in the syllabus, these aspects, generated inconsistency in the information of both platforms and additional operational burden for professors as they had to keep an auxiliary record of the evaluations in Excel or in the evaluator of the virtual classroom, which exposed them to calculation errors causing complaints from students.

Therefore, the problem of USAT is not having a Teaching-Learning system that verifies to what extent the student has achieved the competencies foreseen in the graduate profile. This is evidenced by the lack of integration of the academic management systems with the Learning Management Systems (LMS) that should associate the evaluation by competencies, which starts from the planning of the subject, and requires readjusting all subsequent activities of the academic management system.

The question guiding the study was the following: **How does the integration of academic management systems with Learning Management Systems (LMS) propose an evaluation model that favors the level of achievement of competencies of the graduate profile at USAT?**

2. Theoretical Framework

Background

De Pro Chereguini [2] evaluates the competencies of Spanish universities, and they build a systematized model that allows a formative evaluation in the different subjects of the curricula in order to identify less developed aspects, allowing self-evaluation.

On the use of Learning Management Systems (LMS), Marks et al. (2016) [3] show that six U.S. universities use LMS capabilities to collect data, analyze and measure course and program metrics according to curricula, and evaluate student performance creating early warning and alert systems.

In the same vein, Juarez et al. [4] quantitatively determined the academic efficiency in the use of LMSs and indicated the benefit of implementing LMSs. Other scientific studies evidence a relationship between satisfaction and benefits in students when using LMS [5, 6, 7].

As for the Peruvian context, Barra et al. [8] emphasizes that in order to achieve graduate competencies, it is necessary to: adopt a self-assessment model that includes the criteria of the accrediting agency; link the graduate competencies to each subject; incorporate the design of rubrics into the measurement and evaluation process; and implement measurement tools to obtain results in an automated manner.

Universities have custom-developed academic systems that manage their academic planning, enrollment, grade records, up to the graduation of their students. Ayub, et al. [9] indicates that the portal should be designed in such a way that users do not have difficulties when using it.

Theoretical bases

"In the university, much is evaluated and little is changed...something is wrong, because evaluation should be an engine of transformation. It should lead to an understanding of the Teaching - Learning process and, based on this understanding, undertake pertinent improvement processes." [10].

It is necessary and important to find the relationship between the two processes: Teaching - Learning. Therefore, the teaching process is highlighted since it promotes exploration, construction and reflection on the theories of the learning process, as Monereo points out, they are two sides of the same coin [11]. Since the evaluation is one of the main components of a Teaching-Learning System, the proposal of Santos [10] is taken into account, who highlights as one of the essential components: "(…) To check whether the competencies that the students had to achieve, stated in the graduate profile, have actually been acquired, in the expected time and level, since these are always a more complex component than it seems to be; it is a rigorous verification, which is not reduced to intuitions, assumptions, being necessary to use methods and techniques."

In the university, the graduate profile considers all the competencies that will be acquired in the undergraduate or graduate program. For Zabalza (2003 p.5) [12] the definition of the profile is of great importance, since it will act as a point of reference and guide throughout the rest of the process, the contents to be selected, the practices to be incorporated, the sequence in which all this is integrated, will be conditioned by the professional profile, and evaluation is a component of great importance.

In the Teaching-Learning process, evaluation stands out as an essential part of all good teaching, since without the evaluative activity it would be difficult to ensure that any kind of learning occurs, as highlighted by Gregori [13]: "Different studies, of different nature and origin, point out the role of the evaluation of student learning as a central mechanism in the good progress of the teaching and learning processes (Black and William, 1998; Broadfoot, 1996; Gifford and O'Connor, 1992; Sadler, 1998)."

In USAT, the Teaching-Learning Process (TLP) involves first of all the design and update of the subject (Figure 1).
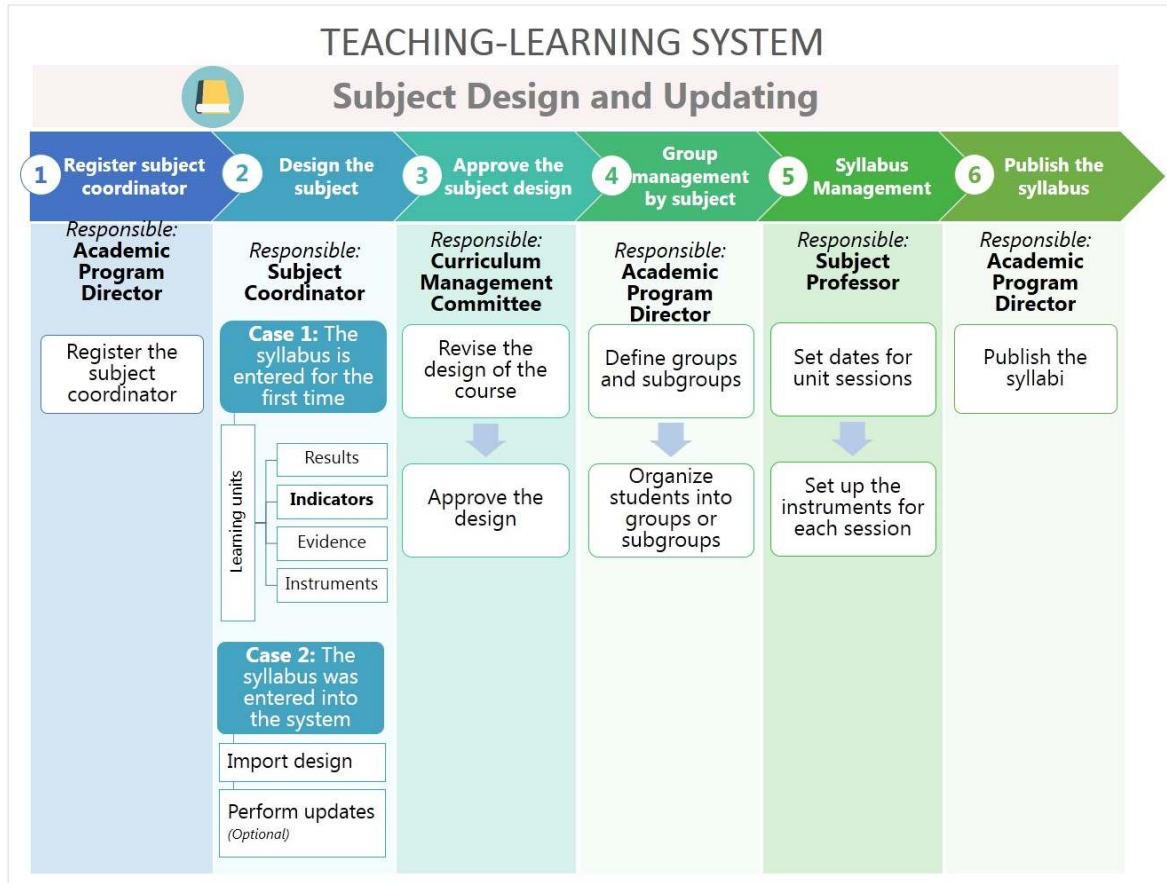
Figure 1: USAT Teaching-Learning System: Flow of the process of designing and updating the subject

Secondly, the TLP considers the learning development and evaluation, which involves the use of Learning Results Monitoring Matrices (LRMM).

Finally, the TLP finishes with a third stage called student follow-up, which guarantees in its proposal the personalized assistance and accompaniment of students, being one of the factors with the greatest impact on their learning outcomes, Adzharuddin and Ling [14]

Justification

Learning Management System (LMS) is a web application that connects professors and students, and allows sharing materials or activities in the classroom easily [14, 9. 15]. The goal of LMSs is to simulate learning environments with the use of IT [15]. In this context LMSs are generic and configurable platforms that can be used by any type of educational institution or companies that require a training support tool. LMSs help in the planning, implementation, distribution, management and evaluation of a specific learning process [9, 14, 16], processes that allow direct verification of the achievement of the graduate profile at the university.

Issakova et al. [17] in their study shows that the minimum level of preparation of graduates to work in the specialty suggests the effectiveness of professional competence training based on a systematic approach. For that purpose, it is necessary reforms in the education system with the aim of integrating scientific, educational and practical components, an aspect considered for the integration of those of academic management systems with Learning Management Systems (LMS).

In a university, the same subject can be taught by several professors in different time groups, and if it is desired to maintain a standard in student service, coordination and supervision efforts would be costly in terms of time and resources, since it implies having personnel dedicated to design, keep updated and report the progress of the execution of all virtual classrooms of common subjects. This

aspect was addressed in the proposal to integrate all the subjects of the various academic programs in USAT.

When universities want to adequately manage the curriculum under a model defined by achievement indicators, learning outcomes and competencies, they are limited by not having a tool that allows them to have the information integrated and available in a timely manner, so that they can take prompt action and not have to wait until the end of a semester to consolidate data and process results, an aspect achieved with the proposal of this research.

In practice, the more integrated the systems are, the greater the effectiveness of the organization (Moore and Kearsley, 2007) cited by De Oliveira, et al [15]. In the same vein, the research proposal was based on integrating the academic management system with the LMS to improve the teaching-learning process and the achievement of graduates' competencies.

3. Materials y methods

The present work is framed within **technological research**, it is aimed at creating new practical applications in the design and improvement of Cegarra [18] processes. Our study uses the level of **applied technological research**, which according to Espinoza [19], "designs technologies of immediate application for problem-solving, looking for efficiency and productivity" as well as the research design that develops the **design of applications or solutions**. In this context, the research follows the **systemic research method** which tackles the problem in all its complexity by relating all the parts and the resulting emergent properties [19].

The research considers as independent variables: Competency-based assessment and Integrated model of academic management systems with LMSs and the dependent variable: Level of achievement of the competencies of the graduate profile.

The study was developed between 2018 and 2020. In total, 26 meetings were developed to develop the different phases of the research: (1) Discovery, (2) Modeling, (3) Automation, (4) Execution, (5) Monitoring and (6) Optimization. This research develops the first four phases, which are detailed below:

First phase: **Discovery**, considered the collection and analysis of information through documentation review (normative framework) and focus group applied to authorities and professors, who have direct incidence in the development and application of the curricula of the different Academic Programs of USAT.

Second phase: **Modeling**, the flow of processes, reports and indicators to be evaluated was designed. This phase involved the areas of Quality, Academic Deputy Rector's Office (VRA), and Information Technology (IT). Bizagi modeling software was used in this phase.

Third phase: **Automation**, developed the analysis, implementation and integration of the information systems (IS), in the following activities:

- **Prepare the *backlog*** or system requirements, from the BPMN model of the workflow of the teaching-learning process, then, the alignment of the system proposal to the process is validated and the software components that would have to be built both for the support of the activities of the flow and for the interactions with the activities of external processes are identified.
- **Estimate the IT infrastructure resource capacity**; calculate the number of documents (files) that the system will have to generate and store, based on the academic programming estimate, to size the storage capacity to be allocated to the system. In addition, calculate the average file size to test response times.

- **Design the architecture**, data model and prototypes of the IS; (1) Architecture: it involved identifying the hardware and software components to be used and developed, analyzing the technical feasibility of the integration, the academic IS is implemented on a Microsoft platform (Windows Server, SQL Server, Internet Information Server, ASP. Net) and the LMS on a free platform (Ubuntu Server, MySQLServer, Apache, Php). (2) Data model: This involved analyzing the entities of the existing academic IS and identifying the new entities of the teaching-learning system, standardizing the entity-relationship model and creating a logical and physical model, then identifying the relationship of the entities of the academic platform's data model with the entities of the LMS platform's data model, ensuring the referential integrity of the data, traceability and query performance. (3) IS prototypes: The university has design patterns for the IS interfaces that allow for adequate usability, prototypes of forms, reports and indicators were developed and submitted for user validation.
- **Implement the technological platforms** within the Virtual Campus (Teaching-Learning System, Academic Management System and Curriculum Management System) and integrate them with the LMS, an aspect developed by the IT area using the SCRUM framework; two teams were established, one for the development of the teaching-learning system and its integration with the existing academic system and the other for the development of the LMS integration.

Fourth phase: **Performance**, developed in parallel, training and dissemination in the use of the IS to give way to the production and support stage. This phase was developed by the IT, Quality and VRA areas. Table 1 shows the training provided to professors and directors responsible for the evaluation and measurement of the level of achievement of competencies stated in the graduate profile.

Table 1
Training provided to professor and directors.

Date	Training Topic	# of Trained professors	Groups
Jan-Feb, 2019	Preparation of competency-based syllabi.	281	10 groups
Feb, Apr, Jul, 2019	Presentation of a worksheet to evaluate the syllabus. Learning Results Monitoring Matrices (LRMM). Use of the Teaching-Learning System.	223	6 groups
Nov, 2019	Management of indicators of the level of achievement of competencies stated in the graduate profile.	301	10 groups

4. Results

Result 1: The integration of the academic management system with the Enterprise Learning Management System (LMS) was achieved, which made it possible to verify the level of achievement of competencies of USAT graduates (See Figure 2).
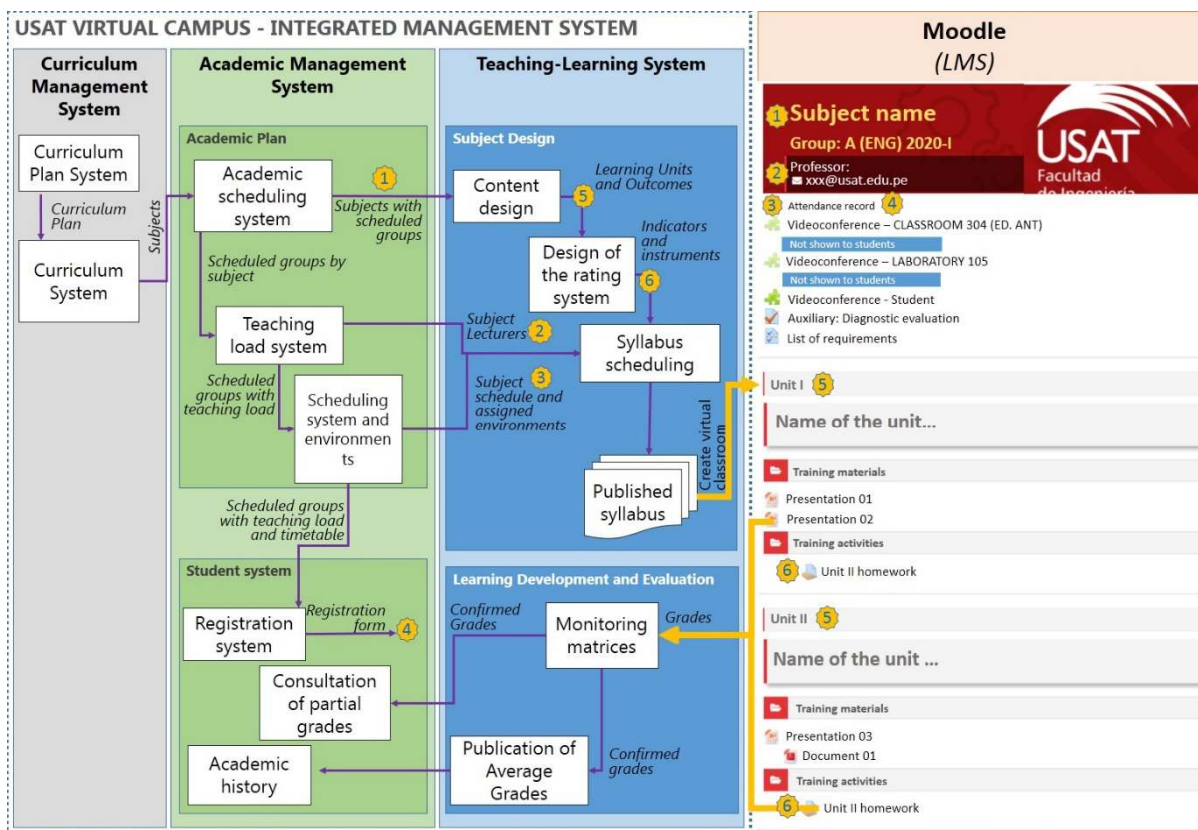
Figure 2: Integration of the academic management model with Learning Management Systems (LMS).

Result 2: Preparation of syllabi, focused on the development of competencies, according to the sub-process of design and update of the subject (See Figure 1) (See Table 2).

Table 2
Number of syllabi generated incorporating the subject design and update – compliance %, year 2020.

School	2020-II		
	Total # of Syllabi	# of Syllabi Published on Time	Compliance %
Business Sciences	336	333	99%
Law	164	160	98%
Humanities	162	161	99%
Engineering	476	473	99%
Medicine	180	140	78%
TOTAL	**1,318**	**1,267**	**96%**

Result 3: The integrated system made it possible to obtain semiannual results of the students' levels of achievement of competencies in their formative process, which favors monitoring and making decisions for improvement. (See Table 3).

Table 3
Percentage of the levels of achievement of competencies of students, according to the USAT Academic Program (Year 2020)

School	Academic Program	2020-I	2020-II
Business Sciences	Business Sciences	94.02%	89.28%
	Hotel and Tourism Services Administration	96.20%	97.50%
	Accounting	91.91%	92.48%
	Economy	94.29%	91.56%
Law	Law	94.80%	92.90%
Arts	Communication	94.36%	93.19%
	Early Childhood Education	96.75%	97.43%
	Primary Education	97.52%	100.00%
	Secondary Education: Philosophy and Theology	97.63%	94.72%
	Secondary Education: Language and Literature	92.57%	97.73%
Engineering	Architecture	86.24%	80.34%
	Civil Environmental Engineering	86.67%	79.86%
	Systems and Computer Engineering	80.95%	81.25%
	Industrial Engineering	88.96%	88.34%
	Mechanical and Electrical Engineering	94.10%	93.90%
Medicine	Nursing	96.75%	95.70%
	Human Medicine	96.47%	98.10%
	Dentistry	98.77%	98.26%
	Psychology	97.18%	92.24%

Discussion:

Results 1 and 3 of the research refer that the Integration of the academic management model with *Learning Management Systems* **(LMS)** was achieved, and favors verifying the level of achievement of competencies of USAT graduates, a finding that is related to the study by Marks et al. [3], which shows that six American universities use LMS to evaluate the performance of students by creating alert and early warning systems, aspects that coincide with the results of the present research, since in USAT, the level of achievement of the students' competencies is verified through progressive reports, reported in the edits made in the syllabi, during the semester development of the various subjects.

However, result 3 of the study indicates that the integrated system made it possible to obtain biannual results of the levels of achievement of the students' competencies in their formative process, which favors monitoring and making improvement decisions, a finding that is related to that supported by Ayub [9], Adzharuddin [14] and Almrashdeh [16], who state that LMSs help in the planning, implementation, distribution, management and evaluation of a specific learning process. Along the same lines of results, Juarez et al [4] quantitatively show the academic efficiency in the use of LMSs. Other studies propose strategies to help institutions to a more effective use of their LMS to achieve impact on Teaching - Learning [14, 20].

Momani [21] argues that choosing the most appropriate LMS that meets the needs and requirements of the professor and the learner is one of the most confusing and difficult decisions for any educational institution. However, in USAT's experience, the integration of the academic management model has been a proposal, which has provided the expected results, as shown in the research findings (Figure 2 and Table 2 and 3), this coincides with the findings of, De Oliveira [15] who indicates that the objective of LMS is to simulate learning environments with the use of IT, emphasizing that LMS are generic and configurable platforms that can be used by any type of educational institution that requires a training support tool, therefore the results in USAT could be taken as a precedent in similar studies in the future.

The second result achieves the standardization of the syllabi with an approach oriented to the development of competencies, and the sub-process of design and update of the subjects that is part of the TLP flow. The evaluation-grading systems in USAT incorporate uniform criteria such as: performance indicators coherent with the learning outcomes, collection of evidence, preparation of instruments related to the expected learning, a finding that is related to that proposed by Bezanilla and Arrans [22] who refer to "(…) A competency-based assessment model has to establish how these competencies are to be assessed, what techniques and activities are to be used, as well as determine the grading system, i.e., attribute to each competency and indicator a percentage or weight, according to their relative importance in the learning process of the subject."

5. Conclusions

The derivations of the study indicate that Learning Management Systems (LMS) can be integrated with academic management systems, which allowed for the optimization of the Teaching - Learning process and the evidence of the levels of achievement of the graduate profile acquired by the students.

The application of the integrated model of the Academic Management System (Teaching-Learning System, Academic Management System and Curriculum Management System) with the LMS improved the availability and reliability of information regarding the levels of achievement of the graduate profile.

This research demonstrates that the proposed model for incorporating technological innovation in university LMSs becomes a useful, necessary and adaptable component to the conditions of any higher education institution.

Finally, the research conducted contributed to the need to select the LMS platform to mediate academic management, which met the emerging needs.

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