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INTEGRATED MANAGEMENT MODEL FOR MULTIMEDIA EDUCATIONAL APPLICATIONS

Edwin Mauricio Sequeda Arenas[1], Jose del Carmen Santiago Guevara[2]

Albert Miyer Suarez Castrillon[3], Sir-Alexci Suarez Castrillon[4]

[1, 2] Master's Degree in IT Project Management. University of Pamplona, Pamplona, Colombia.

[3] Faculty of Engineering and Architecture. University of Pamplona, Pamplona, Colombia.

[4] Faculty of Engineering. Francisco de Paula Santander University, Ocaña, Colombia.

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ABSTRACT

This research arose from the need to define a management model that allows the integration of digital educational resources to support university teaching. This model is based on the good practices of project management of the PMBOK (Knowledge Area: Project Integration Management), based on the strategies and guidelines of the Ministry of National Education for the professional development of teachers; as a contribution to knowledge, composed of six components: Strategic, Organizational, Development, Integration, Evaluation, and Management.

INTRODUCTION

This research article is the product of several research experiences carried out jointly with professors and students of the Faculty of Engineering and Architecture and the Faculty of Agricultural Sciences. During the production and development of Educational Multimedia Applications in Veterinary Medicine and Animal Husbandry, it was observed that there was no management model to monitor and control the correct integration of the products in the educational environment. The synergy of IT Project Management knowledge and the object of research allowed for the structuring of the present model.

Currently, there are many methods in educational software development that allow getting educational applications for distance learning, and virtual courses, among others. Implementing Multimedia Web Applications in university teaching, as part of the work developed at the undergraduate level, led to a thorough analysis of the background in Educational Software Development. The preliminary results of the analysis showed that several authors established development models or methodologies because of their research experiences. However, it was not observed a procedure that allows executing, monitoring, and controlling of the final product from the point of view of the good practices of Project Management, specifically from the Project Integration Management. The Colombian Ministry of National Education, through the document "ICT Competencies for the Professional Development of Teachers", establishes guidelines on the use of ICTs to strengthen quality education. (MEN, 2013) establishes guidelines on the use of ICTs to strengthen quality education. According to the guidelines and observing the high number of dropouts in some undergraduate programs of the Faculty of Agricultural Sciences of the University of Pamplona (e.g. Veterinary Medicine, dropout rate higher than 13% and Zootechnics higher than 17%, besides a high rate of repetition (understood as a repetition of subjects) in the areas of specialization, the development of an integrated management model was proposed to promote the successful inclusion of ICT tools to address this problem, seeking to improve the teaching-learning processes.

The work on multimedia applications for the development of educational software facilitates a pedagogic environment through elements and activities (García Sánchez et al., 2016) applied to medicine and pediatrics, facilitating the literature on this subject increasing the quality of teaching (Robaina-Castillo et al., 2020). The applications have a direct benefit in distance education, where students must work mostly independently, and need support material, facilitating their learning (Navarro et al., 2019). New learning technologies such as Facebook (Parada et al., 2017) tools for inclusive education during the Covid-19 pandemic or using flipped classrooms (Suarez, 2020) or using flipped classrooms (Suarez et al., 2021) can be incorporated through models with educational applications, which can complement all teaching strategies.

To define the model of integrated management of digital educational resources that included the instructional (pedagogical) process, the good practices of the PMBOK in Project Integration Management were applied and validated by experts at the end of the research. This model was given the name I-3MEA Management Model. The motivation to implement the model arises from monitoring and controlling the correct integration of products in the educational environment.

METHODOLOGY

The research took the development of four multimedia educational applications in Veterinary Medicine and Animal Husbandry as input. The applications developed were aimed at supporting the teaching-learning processes in university teaching. The results of the applied research experiences are listed based on the following experiences (Angulo, 2017; Gonzalez, 2014; Solano, 2015; Villareal, 2016).

Based on previous experiences, information gathering instruments were used and applied to teachers of the Veterinary Medicine and Animal Husbandry programs of the Faculty of Agricultural Sciences of the University of Pamplona. A survey was applied to know the comprehensiveness and management of digital educational resources and to determine the level of ICT competencies of teachers. Similarly, an unstructured interview was applied through informal technical consultations with professionals from the UETIC Unit, CIADTI, and research groups, among others, to identify the characteristics of the current management of digital educational resources at the institutional level.

RESULTS

Structure of the I-3MEA Management Model.

Once research activities proposed in the method have been carried out, the management model is defined, the structure of which is shown in figure 1:

- Strategic Component.
- Organizational Component.
- Development Component.
- Integration Component.
- Evaluation Component.
- Management Component.

Subsequently, the requirements for the development of applications are made, selecting the development method for elaborating the artifacts. From there, we continue using the developed application, generating indicators that allow measuring the appropriation and improvement in the teaching-learning performance. Throughout the cycle, tools and techniques recommended by the good practices of the Project Management Fundamentals Guide are used in the integral management knowledge area, as detailed below.

Strategic Component

The main aim of the strategic component within the model comprised analyzing whether the institution (University of Pamplona) advocates for incorporating the strategies proposed by the ICT Integration Policies in Educational Systems from the Office of Educational Innovation with the Use of New Technologies. (MEN, 2018) which are mentioned below:

- Teacher Professional Development.
- Content Management.
- Virtual Education.
- Promotion of Research (ICT and Education).
- Access to Technology.

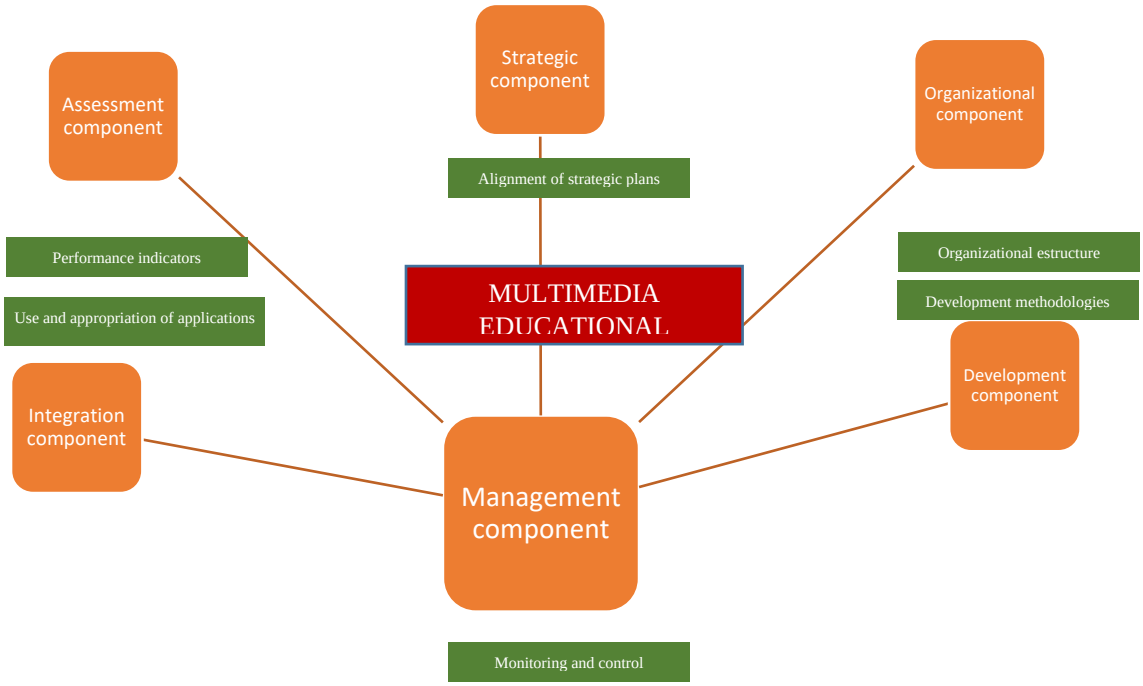

Figure 1. Basic Structure of the I-3MEA Management Model.

In the institutional context, there is Planestic Unipamplona, the strategic plan for incorporating ICT at the University of Pamplona, which contemplates three macro strategies (Planestic, 2018) and the respective Action Plan that includes budget and funding sources.

Macro Strategy 1: Formulation of an institutional policy that promotes the culture of use and appropriation of ICTs.

Macro Strategy 2: Manage and merge resources for implementing the ICT use model for educational processes based on the mission processes of teaching, research, and social interaction.

Macro Strategy 3: Adaptation of Pedagogical Models for the use of ICT in educational processes. Figure 2 summarizes the process of the Strategic Component of the-3MEA Management Model.

Figure 2. Strategic Component Processes

Organizational Component

The organizational component aims to identify and represent the organizational elements and responsibilities within the project orderly. It is composed of 4 processes:

- Analysis of the organizational structure.
- Identification of hierarchical levels.
- Identification of stakeholders.
- Assignment of roles.
- Preparation of the project's Articles of Incorporation.

Figure 3 shows the organizational structure from this component within the institution to develop the experiences of the Veterinary Medicine and Animal Husbandry program. Note the hierarchical levels within the structure: Vice-Rectory-UETIC Unit-Faculties-Research Groups-Seeders and their responsibilities: Sponsor-Supervisor-Developer.

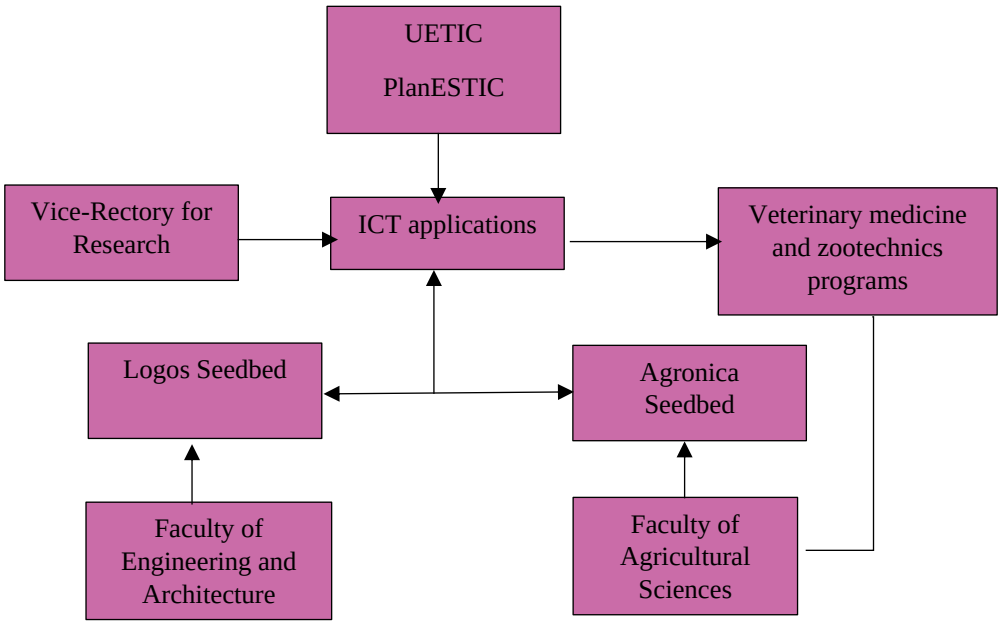

Figure 3. Organizational Component for Application Development.

It is essential to mention that, in higher education institutions, it is widespread to formalize the project constitution act in undergraduate formats (Preliminary Project) or research project formats.

The different identification matrices available in good project management practices (Influence-Power, Interests-Power, Influence-Impact) and the identification and classification of stakeholders can identify stakeholders.

Figure 4 summarizes the processes of the organizational component of the-3MEA Management Model.

Figure 4. Process of the Organizational Component

Development Component

The purpose of the development component is to construct Digital Educational Resources of the Educational and Multimedia Applications type. The experiences in the development of applications for the Faculty of Agricultural Sciences programs with the mentioned characteristics allowed the selection of a development method based on the software life cycle model with evolutionary prototyping, applying successive refinements. The advantage of evolutionary prototyping lies in maximizing the understanding of the requirements from the user's and client's perspectives to the development team by refining the product. Figure 5 summarizes the processes of the development component.

Figure 5. Development Component Processes.

Integration Component

The integration component is oriented toward identifying the competencies to be promoted and gained by teachers who will incorporate multimedia educational applications into the subjects and their curricula. For this purpose, see Figure 6, known as the Pentagon of ICT Competencies defined by the Ministry of National Education, which contains five competencies and 3 of them, as well as a list of the competencies to be gained by the teachers who will incorporate multimedia educational applications in their curricula. (MEN, 2013) which contains five competencies and three moments:

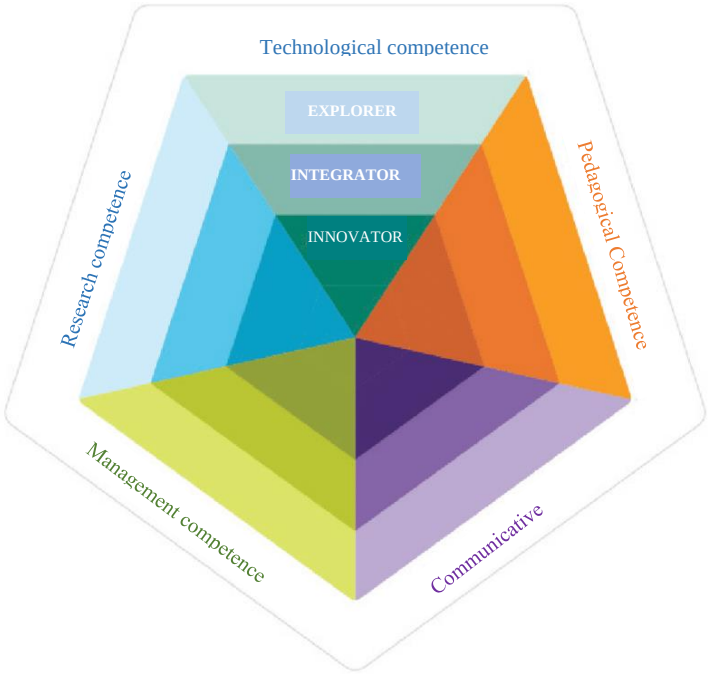

Figure 6. Pentagon of ICT competencies. Source: (MEN, 2013).

Competencies:

- Technological (Selection and use of technological tools).
- Pedagogical (Use of ICT in teaching-learning processes).
- Communicative (Ability to express oneself in virtual and audiovisual environments).
- Management (Use of ICT in planning, organization, administration, and evaluation of educational processes).
- Research (Use of ICT for transformation and generation of new knowledge).

Moments:

- Exploration (First approach to opportunities using ICT).
- Integration (Ability to use ICT autonomously in educational processes).
- Innovation (Use of ICT to create and build novel strategies in educational practice).

The management model designed changes and adapts the ICT Competencies Pentagon to give rise to the Integrating Triangle I-3MEA, prioritizing the following competencies: Technological, Pedagogical, and research, as shown in Figure 7.

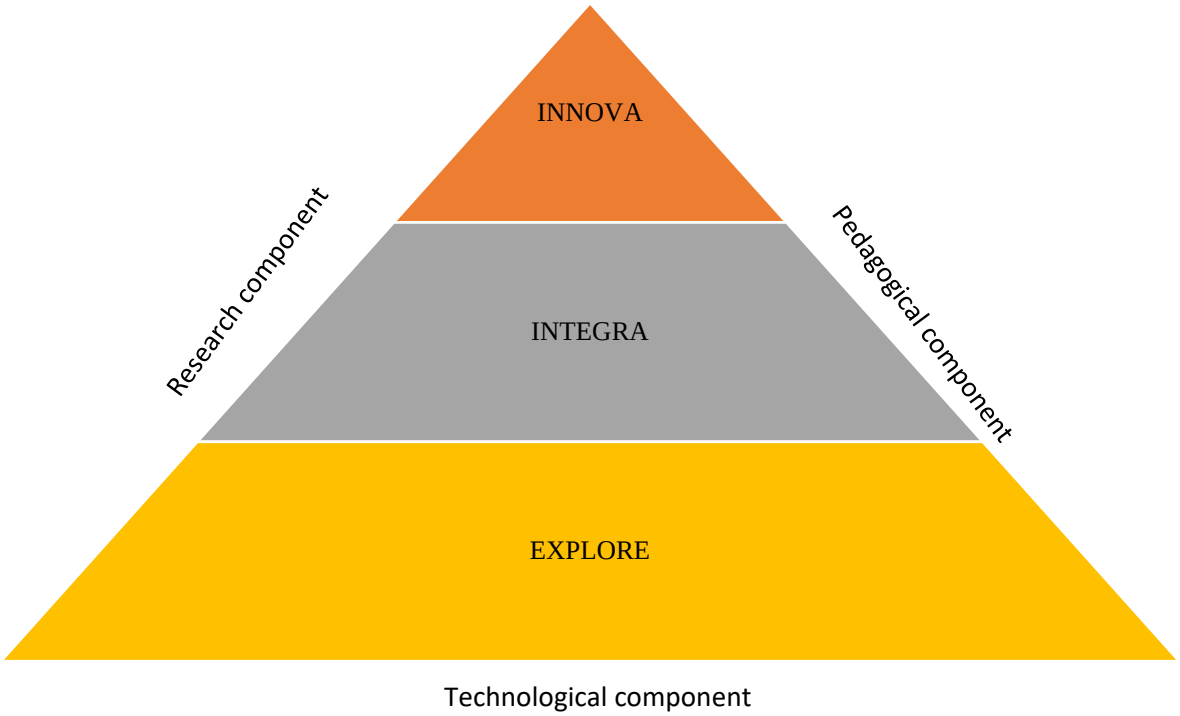

Figure 7. Integrating Triangle, I-3MEA.

Based on the document "ICT Competencies for teacher professional development," we use guidelines for placing the levels. Figure 8 describes the descriptor process for placing levels for the Technological Competence:

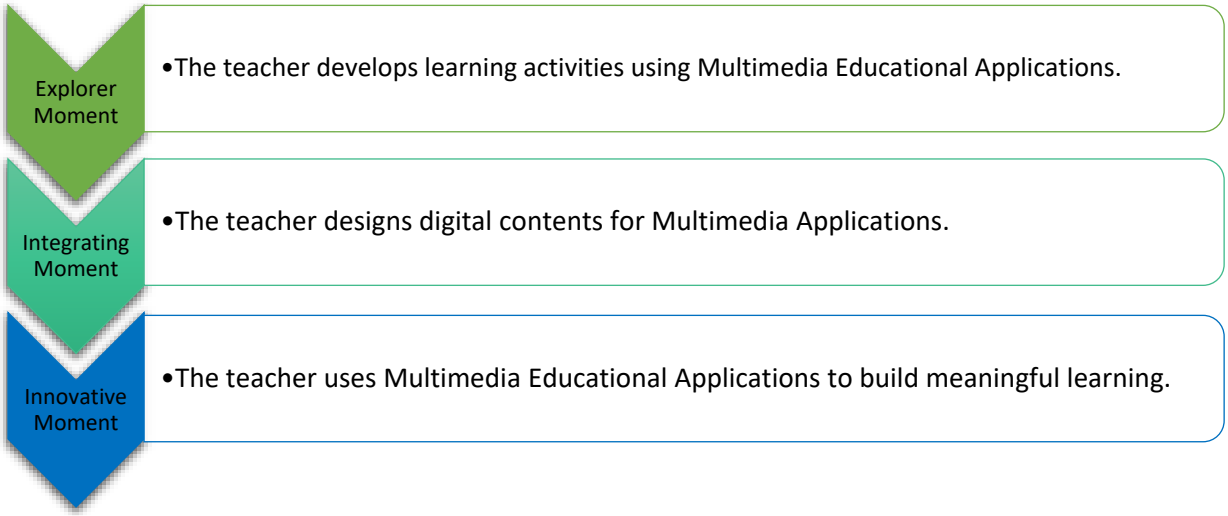

Figure 8. Technological Component Descriptor Guide

Figure 9 describes the descriptor process of level placement for Pedagogical Competence:

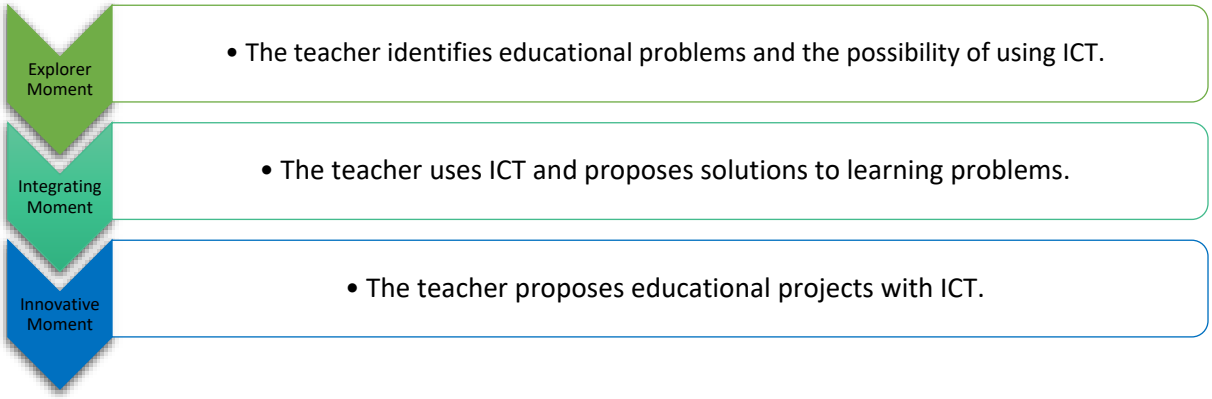

Figure 9. Descriptor guide Pedagogical Competence.

Figure 10 describes the descriptor process for the placement of levels for the Investigative Competence:

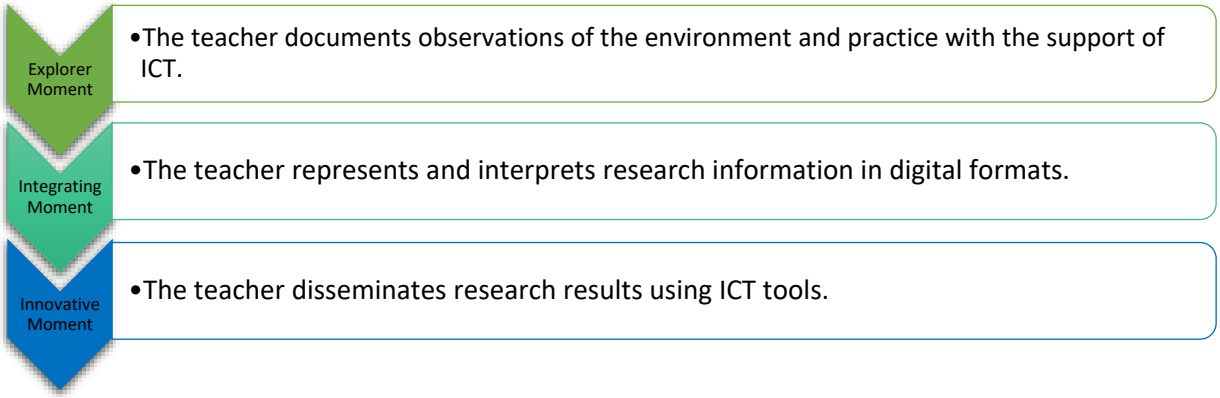

Figure 10. Descriptor Guide Research Competence.

Figure 11 summarizes the process of the integration component:

Figure 11. Integration Component Processes.

Evaluation Component

The evaluation component identifies strategies that are part of the Action Plans, establishes indicators to measure the integration of the Educational Multimedia Applications, and evaluates the strategies to redefine them if necessary. The indicators are defined according to the competencies mentioned in the Integrating Triangle (Technological-Pedagogical-Research).

The method used in the "Design of an instrument to assess the level of use and appropriation of ICT in a higher education institution" is recommended (Taquez et al., 2017).

The institutional analysis of the Action Plan prepared by Planestic (2016) allowed the identification of the following indicators in the area:

• Number of teachers using ICT in educational processes / total number of teachers.
• Number of students using ICT in educational processes / total number of students.
• Number of teachers with sensitization process / total number of teachers.
• Number of research projects on the model's design for the use of ICT in educational processes / Total number of research projects.
• Number of research projects on systems for monitoring ICT use in educational processes / Total number of research projects.
• Resources available/total resources required for ICT use and appropriation policies.
• Number of institutional policies implemented / institutional policies defined.
• Number of teachers with sensitization process / total number of teachers.
• Number of training events developed/Total events programmed.
• Number of teachers trained/total number of teachers.
• Number of students trained/total students.
• Number of courses developed through the use of ICT/Total number of courses.
• Number of programs developed through ICT/Total programs.
• Number of teachers trained in using ICT in educational processes/Total number of teachers.
• Number of curricula applying pedagogical models that incorporate the cross-cutting use of ICTs/ Total Curricula.
• Number of ICT tools used in educational processes / Total number of tools available in the institution.
• Number of curricula applying pedagogical models that incorporate the cross-cutting use of ICTs/ Total Curricula.
• Number of ICT tools used in educational processes / Total number of tools available in the institution.
• Resources available/total resources required for infrastructure and technology.
• Number of computers for teaching / total number of computers.
• Number of servers dedicated to ICT incorporation in teaching / total number of servers.
• Internet Channel Bandwidth for ICT incorporation / Total Institutional Internet Bandwidth.
• Number of network nodes for incorporation of ICTs / Total Institutional Nodes
• Number of tools gained / Total ICT tools defined.
• Number of cooperation agreements with entities and institutions of higher education for the use of ICT in education / Total number of academic institutional agreements.

Figure 12 summarizes the processes of the Evaluation component.

Figure 12. Processes of the Evaluation Component.

Management Component

The Management component is the central axis of the I-3MEA model. It is in charge of the processes for monitoring and control during the life cycle. It seeks to ensure the correct integration of the developed multimedia educational applications. Under the PMI project management perspective, integrating knowledge area includes the processes and activities of project management in a controlled manner. As a result, the model proposes the following processes:

-Plan for the management of multimedia educational applications integration.
-Lead and manage the integration of applications.
-Monitor, control and supervise.

Lead and Manage the Work.

During the process of successive refinements of the evolutionary prototyping, the incidence of changes in the application under development is expected; therefore, it is convenient to perform change management.

Monitor and Control the Project.

The scheduling of Coordination Meetings is proposed to track and report the progress of the integration of the developed applications. It is recommended to fill out the Meeting Minutes.

Figure 13 summarizes the processes of the Management component.

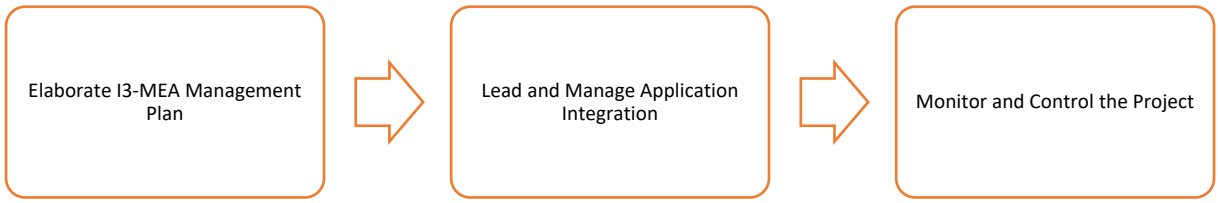

Figure 13. Management Component Processes.

CONCLUSIONS

The I-3MEA model has a life cycle with the main axis, the Management Component, accompanied by 5 complementary components (Strategic-Organizational-Development-Development-Integration-Evaluation).

Each component is accompanied by a series of internal processes and their respective tools and techniques to generate a product or deliverable, as suggested by the PMBOK Project Management best practices.

The main engine of the model is based on the monitoring and control to apply to each component, identifying strategic plans, project stakeholders, and the software development method, integrating the developed product, and fulfilling goals and indicators. The above is evidenced in the project's elaboration's constitution act, the identification of stakeholders (matrices), the descriptive guides of competence levels (technological, pedagogical, and investigative) and moments (Exploration, Integration, Innovation), the formats for management plans and secondary plans, as well as the format for change management and meeting minutes.

In the validation and survey process, as a sample of the applicability of the Integration Component of the I-3MEA model, a survey was carried out based on the determination of the ICT moments (Exploration, Integration, or Innovation) of the teachers of the Faculty of Agricultural Sciences, using the descriptor guide extracted from the document provided by the Ministry of National Education. Three items were added to the descriptor guide to identify the ICT tools preferred in the faculty, the predominant type of teaching contract, and the program to which they are attached. From the data collection analysis, it can be concluded that most of the teachers surveyed belong to the Veterinary Medicine program (58%), with a predominance of Occasional Full-Time contracts (79%) and a majority preference for using Virtual Simulators as a support for teaching. Another visualized result comprises the information of the ICT Moment of the Faculty teachers as Integrators (53%), only 16% were classified as innovators. From the instrument applied, it is concluded that higher education institutions require the existence and continuous execution of training courses in the Use, Appropriation, and Integration of ICT in the pedagogical task, which could be part of the Faculty Development Plans.

Through the judgment of a couple of experts in Information Systems and Project Management, the informal preliminary validation procedure provided relevant information in the evaluation matrix. There are 11 indicators with high compliance and two indicators with medium compliance. The indicators with medium compliance belong to Factor 1: Strategy and Factor 3: Development. Following the review and analysis of the criteria expressed by the pair of experts, Factor 1: Strategy presents an opportunity for improvement that can be remedied, showing the procedure for identifying specific institutional programs and items of Information Technologies for teaching. As for Factor 3: Development, there is an opportunity for improvement that can be solved, including a wide range of methodologies related to educational software development.

The preliminary validation determined high compliance in the indicators and factors. The consistency in the ratings assigned by the experts shows the model is viable and could have a wide acceptance and applicability in Higher Education Institutions of the national order and other disciplines of university education.

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