Optimizing Knowledge Management With KMAT: Boosting Efficiency Through ICT And VLE

José Eduardo Padilla Beltrán[1], Elkin Leandro Velásquez Pesca[2], Luis Eduardo Pérez Peregrino[3], Pedro José Rivera Osorio[4]
[1]Universidad Militar Nueva Granada, Colombia, eduardo.padilla@unimilitar.edu.co; edopadilla@gmail.com
[2]Universidad Minuto de Dios, Colombia, elkinlvelasquez@gmail.com; evelasqu@uniminuto.edu.co
[3]Universidad Militar Nueva Granada, Colombia, lperez46@gmail.com; luis.perezp@unimilitar.edu.co
[4]Universidad Minuto de Dios, Colombia, invprivera@gmail.com; pedro.rivera-o@uniminuto.edu.co

Abstract.
The present study is framed within the utilization of Information and Communication Technologies (ICT) to design an implementation methodology for knowledge management based on the KMAT (Knowledge Management Assessment Tool) model, mediated by the Virtual Learning Environment (VLE) technology, with the purpose of enhancing students' academic performance. This project was developed following the evaluative research paradigm and is categorized as an implementation analysis since its primary objective is the creation of a knowledge management methodology to optimize the academic use of ICT in Higher Education Institutions, with the subsequent evaluation of its impact on the environment.

The proposal of this method for knowledge generation from virtual learning environments (VLE) involves an interesting interaction among the concepts involved in the learning process with ICT. However, the main challenge lies in ensuring that the involved stakeholders can interpret and effectively apply the theoretical model in practice, considering the variables that best fit the idiosyncrasy of each specific case. It is anticipated that the research results will reveal that higher education students are underutilizing the technological tools they use in their daily lives. As a practical outcome, it is intended that through the KMAT knowledge management model supported by ICT resources provided by the VLE, improved academic outcomes will be achieved.

Keywords: *Digital Knowledge Management, Learning in Virtual Environments, Technological Assessment of Knowledge Management, Technologies for Higher Education, Virtual Environments for Knowledge Management, Educational Technologies in Knowledge Management, ICT Tools for Knowledge Assessment, Digital Learning in Higher Education.*

1. INTRODUCTION.

In advanced countries in technological development, the concept of the "citizen of the future" is addressed, since training focuses on knowledge management and competence in the proper management of information; in this context and according to Fernández et al. (2022), the use of Information and Communication Technologies (ICT) becomes essential for citizens who seek to contribute to the socioeconomic development of their nation. According to Estrada (2019), in technological innovation processes, there is a participation of individuals, groups, and communities in local and virtual environments, these actors are acquiring a growing awareness of their ability to design and modify technologies, as well as to generate new uses and develop innovative applications.

In the search for an up-to-date and high-quality university model, the design of a knowledge management methodology to optimize the academic use of ICT is proposed. The objective is for university students in Colombia to acquire the essential skills in the use of Information Technologies, which will improve their academic performance and strengthen their capacities to effectively manage information, this will promote the training of students committed to the knowledge and information society, through the use of conceptual and technological tools (Zambrano et al., 2021).

2. Theoretical Foundations

2.1. Knowledge Society

Information and Communication Technologies (ICT) are now considered a relatively old term, since they have been present in various forms throughout the history of humanity, this is based on the premise that the concept of technology refers to the way in which activities are carried out with the aim of improving the quality of life. According to Hernández et al. (2023), the information society is a concept that refers to a phase of social and economic evolution in which information and knowledge play a central role in people's lives and in the development of economic activities. In this society, the generation, distribution and access to information are fundamental aspects and are closely linked to information and communication technology (ICT).

From this definition, the application of ICT in various sectors of society began to be recognized, but its greatest evolution has occurred in the field of information processing and transmission, that is, in the fields of computer science and telecommunications.

The influence of technological advances on the development of daily activities is undeniable, in this sense, the pace of growth of ICTs has been so fast and dynamic that today it is common to access information from anywhere in the world, make videoconferences, hold real-time conversations with people who are at great distances and carry out commercial transactions over the Internet.

The Japanese sociologist Yoneji Masuda is considered one of the precursors of the concept of the information society, in his most outstanding works, as reflected in the book "The Information Society as Postindustrial Society" (Masuda, 1984), he defines the information society as an environment that develops around information and that encourages an increase in human intellectual creativity rather than an increase in material consumption.

2.2 Application of ICT in Higher Education Institutions.

Information and Communication Technologies (ICTs) represent a tool that facilitates a wide range of activities in the educational community, as well as in other fields, including the development of materials that provide value-added features such as flexibility and mobility. According to Luz (2018), ICTs configure new environments and scenarios for training with notable characteristics; For example, they expand information opportunities and possibilities for guidance and tutoring, remove time and space constraints, encourage collaborative work and self-learning, and promote interactivity and flexibility in the learning process.

According to Ramírez (2021), in line with the policies established by entities such as UNESCO, which advocate for open educational resources through the commitment of governments, civil society, and productive sectors in the field of science, the essential need to improve teaching and support social programs of education in science and technology is recognized; This is based on the premise that science must be at the service of knowledge, and knowledge must be at the service of progress.

The computer revolution has driven the adaptation of educational activities to the contemporary demands of the environment, in this process, learning resources play an essential role, given that, currently, the creation and presentation of these resources must be aligned with the web, which has given rise to the term LCMS (Learning Content Management System) to describe this type of digital content (Bradley, 2021).

2.3. KMAT Model

The concept of Knowledge Management is based on the conversion of information into knowledge, this transformation can be understood as a process composed of various actions, which include the search, selection, organization, socialization and application of information by the individuals who are part of an institution. The main objective of this process is to obtain knowledge-related resources in order to share and use them effectively.

Although there are several models of Knowledge Management that are applied in various areas, they can be classified according to their objectives; First, there are models that focus on the storage, access, and transfer of knowledge, these models do not differentiate between information and knowledge, are independent of people, and use methods to store the organization's knowledge in order to facilitate its access and transfer among the members of the organization. According to Escorcia et al. (2020), Knowledge Management is considered one of the most important capabilities of the company and the fundamental basis for the development of other capabilities.

The second type of model is framed in the sociocultural field and promotes a change in people's attitudes to acquire knowledge and improve communication and cooperation between them. The third and last type of model is the technological one, where the use of computer systems and Information and Communication Technologies (ICT) for the acquisition of knowledge stands out.

According to Borrero et al. (2021), the KMAT model proposes four pillars that contribute to more effective knowledge management: culture, measurement, leadership, and technology; The leadership pillar refers to the strategies implemented by the company's management to define its activities and strengthen competencies through knowledge management; The culture pillar is considered a company policy aimed at promoting a change in people's behaviour towards the acquisition of new knowledge; The technology pillar describes how the company provides tools to its members to improve and streamline communication processes and establish interactions between them.

3. Implementation of the KMAT model: Proposal to create knowledge using VLE

The proposal of the method for the generation of knowledge from the Virtual Learning Environment (VLE) is based on the necessary integration between education and Information and Communication Technologies (ICT), this integration is approached from multiple dimensions that can be considered as interconnected subsystems, since their interaction is essential to achieve a common goal. therefore, the existence of one without the other is inconceivable in this context. The first dimension refers to the importance of having a solid theoretical foundation in any topic addressed in higher education subjects, this theoretical base not only allows defining and understanding the fundamental concepts, but also provides the necessary support to support them. The second dimension focuses on the inclusion of the pedagogical component, pedagogy, as described by Nóbile et al. (2021), encompasses a wide variety of interconnected knowledge, including socio-educational, psycho-affective, didactic, epistemological-pedagogical, educational administrative and curricular aspects, among others. The idea is to comprehensively address all the elements that influence the learning process. When an effective relationship is established between the first two dimensions, a new type of knowledge is generated that allows the development of learning resources enriched with the pedagogical component; Expertise in the subject is not enough to create high-quality educational resources in higher education. The third dimension highlights the importance of the productive use of technological resources, especially those commonly used in virtual learning environments (VLE). When these three dimensions, that is, the theoretical foundation, the pedagogical component and the use of technological resources interact as subsystems, a type of knowledge close to the concept of Learning and Knowledge Technologies (TAC) is achieved. According to Latorre et al. (2019), TACs go beyond the simple use of ICTs and explore the potential of these technological tools for learning and knowledge acquisition; These tools contribute to the student's academic performance by facilitating tasks related to their educational process.

Therefore, it is imperative that higher education institutions in Colombia integrate actions that respond to these needs into their training projects, this is crucial to guarantee the relevance of their programs not only in terms of quality and adaptation to the work, socioeconomic and environmental environment, but also to turn them into agents of development and productivity in academic communities. In this sense, Colombian universities must promote learning in the use of TAC, which will allow the social and productive development

of their students, during and after completing their education, forming critical and reflective individuals who understand their environment and can transform it through their knowledge and experience.

4. Structure of the Alternative Solution

The proposed alternative solution is based on a structure based on four key concepts: digital resources, information technologies, pedagogical component and knowledge management. The resources that best fit this alternative are considered to be Learning Content Management Systems (LCMS), due to their orientation towards working in web environments and their ability to comply with the essential characteristics of digital resources.

These systems offer flexibility and dynamism in the presentation of information, optimizing the search, filtering, and presentation processes in the educational environment (Cerna et al., 2020). Similarly, the association of LCMS resources plays a crucial role in the educational field by providing a clear, logical and coherent organization of information, this facilitates the navigation and appropriation of content, allowing to make the most of the benefits of Information and Communication Technologies (ICT).

An additional advantage of using content management systems for learning lies in the variety and type of resources they offer, which allows the resources to be adapted to the learning environment and include the use of text documents or the creation of virtual reality environments, characterized by involving all the user's senses. which makes them more immersive and realistic, this is partly due to the use of computers as virtual reality generators, which allows advanced communication between the machine and the user (Sousa et al., 2021).

Regardless of the teaching model, the fundamental thing is to arouse the student's interest, encourage their participation and interaction with the resources, which will contribute to the strengthening of their learning level and inclusion in Virtual Learning Environments (VLE), considered the most appropriate technological system to manage these resources, since it allows the integration of didactic content and Virtual Learning Objects (OVA). defined as pedagogical mediators designed for specific learning purposes; these objects must meet criteria such as timelessness, didactics, usability, interaction, and accessibility (Hernández-Suarez et al., 2020).

VLEs give students the ability to control their own pace of learning, which aligns with the constructivist approach; In this process, students take an active role in the individual and meaningful construction of their knowledge, which allows them to understand how much and what they have learned more effectively. According to Hinojosa et al. (2020), Jean Piaget's cognitive constructivism is based on learning that takes place in two moments: learning as an active process, where students assimilate information, and learning as a complete, authentic and real process, where they apply the knowledge acquired in real situations (Baque et al., 2021).

Active learning involves the first contact with information for its assimilation and subsequent application in real situations. Although mistakes can be made in this process, alternative solutions must be sought to improve and achieve the proposed objectives.

5. Analysis, Interpretation of the Data and Results Obtained

To collect information, the individual self-administered survey technique was implemented. The evaluation of this survey is carried out using the Likert Scale, which allows students to express their level of agreement or disagreement with respect to specific statements or approaches. The results obtained are presented below:

5.1. Shortcomings in the use of ICTs. "Do you consider that there are shortcomings in your academic training process related to the use and incorporation of ICTs?"
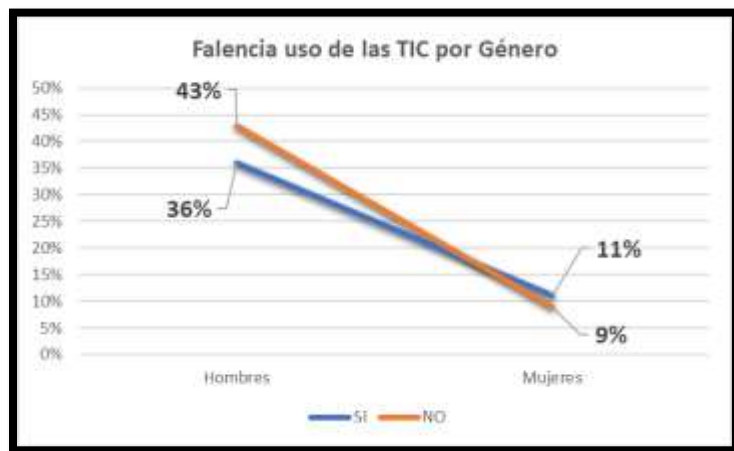

Figure 1. Lack of use of ICTs by gender. Source: authors' own elaboration. In original language Spanish
Of a total of 106 participants, 84 of them, representing 79%, point out the existence of deficiencies in the incorporation of Information and Communication Technologies (ICT) in their training process. Of this group, 38 are male and 46 female. On the other hand, the remaining 20%, made up of 12 male and 19 female participants, maintain that there are no deficiencies in this aspect. These results indicate that students recognize the need to implement a methodology that integrates ICT in the knowledge management process.

5.2. Level of incorporation of ICT in the University. "If you were to evaluate your institution in terms of ICT use, that level of technology would be:"

Figure 2. Incorporation of ICT in the University vs Influence on academic performance.
Source: authors' own elaboration. In original language Spanish
When students were asked to evaluate the level of implementation of Information and Communication Technologies (ICT) in their institution, the following results were obtained: 40 students (38%) considered that the University has a high level of ICT implementation, 62 students (58%) rated it as medium level, and 4 students (4%) classified it as low.

It is important to note that these results contrast with the perception previously mentioned in the previous question, where 79% of the students recognized the existence of deficiencies in the incorporation of ICT in their training process. Only one student, who believed that the level of ICT incorporation is low, stated that the use of ICT does not improve academic performance.

5.3. Frequency of use of VLE in academic work. How often are VLEs used to support teaching at your institution?
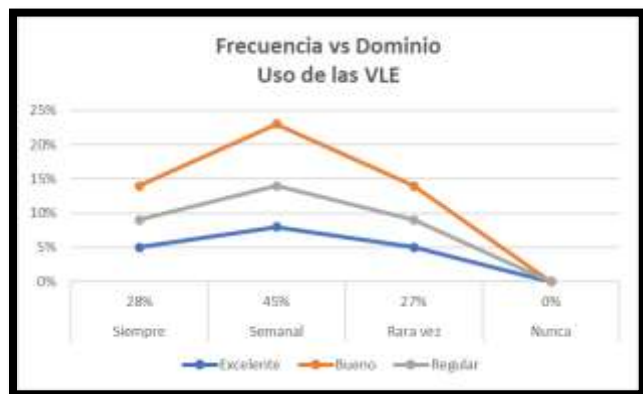

Figure 3. Frequency vs. dominance in the use of VLEs. Source: authors' own elaboration. In original language Spanish

When respondents were asked about the frequency with which they use Virtual Learning Environments (VLEs) as a support tool in their academic work, the following results were obtained: 30 respondents (28%) indicated that they always use them; 48 respondents stated that they use them at least once a week (45%); 28 respondents indicated that they rarely implement this type of tool (27%); None of the respondents said they have ever used them.

Regarding the mastery in the use of the VLEs, the respondents evaluated it as follows: 17% of the respondents considered that their mastery in the use of the VLEs is excellent; 51% of respondents said their domain is good; 32% of those surveyed classified it as regular; none of the respondents indicated that their use of Information and Communication Technologies (ICT) was null.

5.4. Factors of Advantages and Disadvantages of the use of ICT in the classroom. "From your point of view, what are the advantages and disadvantages of using ICT in the classroom?
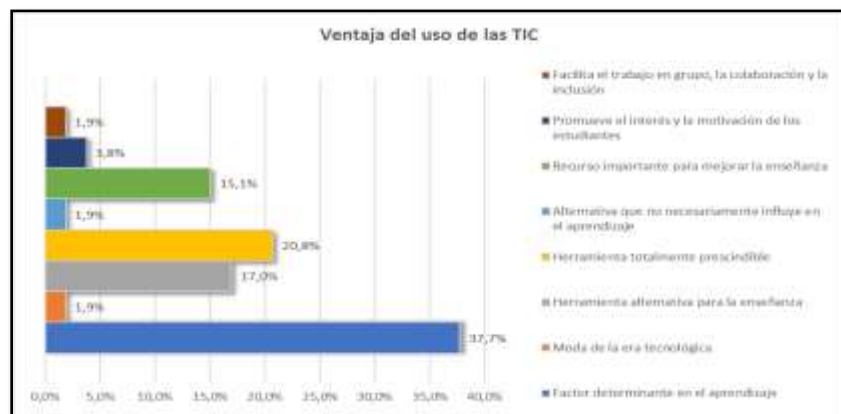

Figure 4. Advantage of the use of ICTs. Source: authors' own elaboration. In original language Spanish

When respondents were asked about the main advantages in the use of ICTs, 37.7% of them responded that it is a determining factor in learning; 20.8% indicate that it is a totally dispensable tool, 17% respond that it is an alternative tool for teaching; 15.1% mention that it is an important resource to improve teaching; 3.8% express that it promotes the interest and motivation of students; the remaining three questions regarding

whether it is considered a fad of the technological age; if it is an alternative that does not necessarily influence learning; if it facilitates group work, collaboration and inclusion, each one obtained 1.9% of the total.

6. Academic Performance Results

When evaluating the academic performance of students enrolled in programming subject II during the second academic semester of 2021, in a period in which the knowledge management methodology had not been implemented, suboptimal results were observed that reflected the difficulties associated with the learning process of this subject, which is mainly based on the use of the virtual classroom as the main resource.

Therefore, it is imperative that the University in Colombia reflect on the appropriate use of the resources available in the educational platform. This reflection must be closely linked to pedagogical aspects in order to improve the academic performance of their students.

6.1. Performance Result 1. When analyzing the academic performance results of Colombian university students enrolled in the second semester of 2021, particularly in the second semester, the following conclusions are reached:
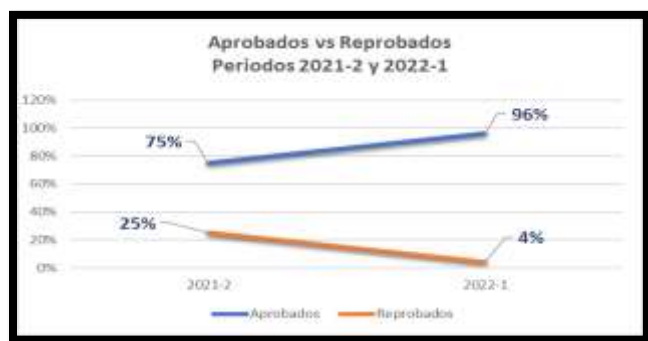

Figure 5. Approved vs failed periods 2021-2 and 2022-1. Source: authors' own elaboration. In original language Spanish

In the 2021-2 period, out of a total of 112 students who took the subject of Programming II, 84 students managed to pass it, which represents 75% of the population, while 28 students failed to pass it, equivalent to 25% of the population.

In the 2022-1 period, of the 112 students who took the Programming II subject, 108 students managed to pass it, which corresponds to 94% of the student population. On the other hand, only 4 students failed the subject, which represents 6% of the total population.

6.2. Performance result 2. In the 2021-2 period, of the 84 students who passed the subject, 40 obtained a grade between 3.0 and 3.5, which is considered an acceptable grade; and meanwhile, 44 of them achieved a grade between 3.6 and 5.0, which means a good or very good academic performance on the part of the student.
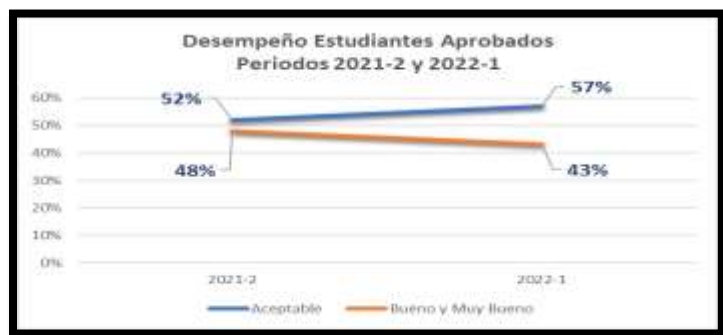
Figure 6. Approved performance for periods 2021-2 and 2022-1. Source: authors' own elaboration. In original language Spanish

In the 2022-1 academic period, of the 108 students who passed the course, 64 of them obtained a grade in the range of 3.0 to 3.5, which is considered an acceptable grade. On the other hand, 48 students achieved a grade in the range of 3.6 to 5.0, which indicates a good or very good academic performance by these students.

7. CONCLUSIONS

From the results obtained in the research, it can be concluded that the academic performance of the students of the programming II subject experienced significant improvements after the application of the prototype of the methodology for knowledge management.

First, the percentage of students who passed increased from 75% to 96%. In addition, the group's grade point average increased from 30% to 34%. Likewise, an improvement was observed in the proportion of students who obtained good and very good grades, going from 39% to 43%.

From a technological point of view, it is concluded that students underutilize the potential of Information and Communication Technologies (ICT), since they could use them more productively. In addition, it was identified that ICTs can become distractions during the learning process.

The implementation of the proposed system will only be possible if a solid educational platform is available, not only from a technological perspective, but also from a pedagogical and methodological perspective that facilitates knowledge management.

It is highlighted that students improve the development of their academic activities when they feel supported in this process. Significant changes were also observed in terms of the productive use of their technological devices, such as access to support material, the delivery of assignments, participation in communities and the exchange of academic information.

All this leads to an improvement in the cognitive and behavioral processes related to their professional training.

8. REFERENCES.

1. Baque-Reyes, G. R., & Portilla-Faican, G. I. (2021). Meaningful learning as a didactic strategy for teaching-learning.
2. Borrero-Puentes, N., & Alcalá-Zarate, A. Z. (2021). Virtual Team Management Model for Executing Collaborative Academic Projects. In Virtual Team Management Model for Executing Collaborative Academic Projects: Borrero-Puentes, Nicolás| uAlcalá-Zarate, Alcalá-Zarate. [Sl]: SSRN.
3. Bradley, V. M. (2021). Learning Management System (LMS) use with online instruction. International Journal of Technology in Education, 4(1), 68-92.
4. Cerna Loli, O. M. (2020). Analysis, Design and Implementation of a repository of learning objects with versionable content and integration with LMS platforms.
5. Escorcia Guzmán, J., & Barros Arrieta, D. (2020). Knowledge Management in Higher Education Institutions: Characterization from a Theoretical Reflection. Journal of Social Sciences.
6. Estrada, G. C. T., Montero, J. M. C., Hernandez, Y. C. U., & Herrera, J. J. R. (2019). Technological innovation: Theoretical reflections. Venezuelan Journal of Management, 24(85).
7. Fernández, A. M., Reyes, M. J., & López, M. I. V. (2022). Information and communication technologies (ICT) in training and teaching. CME-Continuing Medical Education in Primary Care, 29(3), 28-38.
8. Hernández, M. Á. V., & Salcedo, E. M. (2023). Education in the Information Society. Teaching.
9. Hernández-Suarez, C. A., Rojas Suárez, J. P., & Albarracín, C. Z. (2020). Virtual learning object to develop numerical skills: an experience with basic education students. Panorama, 14(26 (2020)), 111-133.
10. Hinojoza, H. M. C., & Regalado, C. D. B. (2020). The teaching-learning of law through an institutional virtual platform: Incipient findings of the constructivism of Piaget, Vygotsky and Ausubel according to the perceptions of the informants. Revista Pedagogía Universitaria y Didáctica del Derecho, 7(2), 143-166.
11. Latorre Iglesias, E. L., Castro Molina, K. P., & Potes Comas, I. D. (2019). ICTs, CTs and TEPs: educational innovation in the conceptual era. Sergio Arboleda University.
12. Luz, C. G. M. (2018). Education and technology: didactic strategies for the integration of ICTs. Editorial UNED.

13. Masuda, Y. (1984) The computerized society as a post-industrial society, Fundesco-Tecnos. Madrid.
14. Nóbile, C. I., Gauna Domínguez, C. D. V., Aude Berozonce, M. P., & Pérez, J. (2021). Active methodologies and knowledge management to promote creativity and innovation in the classroom. Innoeduca: international journal of technology and educational innovation.
15. Ramírez Montoya, M. S. (2021). New UNESCO Recommendations on Open Educational Resources: Visions for Open Science Horizon Architecture.
16. Sousa Ferreira, R., Campanari Xavier, R. A., & Rodrigues Ancioto, A. S. (2021). Virtual reality as a tool for basic and professional education. Revista Científica General José María Córdova, 19(33), 223-241.
17. Zambrano, Y. M. N., Laz, E. M. S. A., & Campuzano, M. F. P. (2021). Infopedagogy in the knowledge society. Mastery of the Sciences, 7(1), 11.