Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 198 (2022) 644–649

Procedia Computer Science

www.elsevier.com/locate/procedia

The 2nd International Workshop of Innovation and Technologies (IWIT 2021)
November 1-4, 2021, Leuven, Belgium

# Information and Communication Technologies (ICT) in the processes of distribution and use of knowledge in Higher Education Institutions (HEIs)

Jey Howard Escorcia Guzman[a]*, Rohemi Alfredo Zuluaga-Ortiz[b], David Andres Barrios-Miranda[a], Enrique José Delahoz-Dominguez[c]

[a]*Universidad de la Costa CUC, Facultad de Ciencias Empresariales, Barranquilla, 08003, Colombia.*
[b]*Universidad del Sinú, Facultad de Ingeniería, Cartagena, 13001, Colombia.*
[c]*Universidad Tecnológica de Bolívar, Facultad de Ingeniería, Cartagena, 13001, Colombia.*

**Abstract**

This research aims to relate Information and Communication Technologies (ICT) in the processes of distribution and use of knowledge in Higher Education Institutions (HEI). The methodology used was based on the quantitative approach, descriptive scope, and non-experimental cross-sectional design, the sample was non-probabilistic, convenience sampling. We used the survey as a technique for data collection, through a questionnaire with Likert and ordinal scales applied to the directors and vice-rectors of research in the research departments. The methodology developed allowed us to show that the profiles of the universities to carry out knowledge management focus on two components: distribution and use of knowledge.



*Keywords:* Knowledge Distribution; Higher Education Institution; Knowledge Management; Knowledge Use; TIC.

* Corresponding author. Tel.: +57 302 4083182.
*E-mail address:* jescorci8@cuc.edu.co


10.1016/j.procs.2021.12.300

## 1. Introduction

Knowledge has become the most valuable resource for all organizations in the twenty-first century; as a result, Higher Education Institutions must manage it properly to generate long-term competitive advantages. As a result, the linking of ICT facilitates knowledge management processes of distribution and use; as a result, research departments must stimulate and train researchers [1, 2, 3, 4].

Artificial intelligence (AI) is a science that tries to get a profound understanding of human behavior. When we talk about ICT, we are also talking about AI [5]. Knowledge representation and reasoning, automated learning, natural language processing, computer vision, robotics, and automatic speech recognition are all areas where artificial intelligence can help [6]. As a result, this type of knowledge management technology enables the development of software architectures that enable the creation of learning environments in research departments of Higher Education Institutions, allowing experts to access tacit and explicit knowledge that improves individual learning. Furthermore, these technologies are linked to the processes of knowledge identification, generation, diffusion, use, and measurement [7, 8, 9, 10].

There is an unlimited number of technological instruments that have been mentioned by many academics as acts to assist and promote knowledge, but they are excluded from the vision of knowledge management since they generate errors, based on their conceptualization and functionality. As a result, the ICT tools used by research departments in HEIs must be completely integrated into each activity for the vision of what this collection of tools represents to be understood [11, 12, 13].

ICT applications are the first of the famous tools for knowledge management, therefore, this research seeks to answer the following question: How do Information and Communication Technologies (ICT) relate to the processes of distribution and use of knowledge in Higher Education Institutions (HEIs)?

## 2. Framework

Information and communication technologies (ICTs) are the tools that allow knowledge to be distributed and used [14]. As a result, they are internally compatible with research departments and must respond to stated demands, because it would be nonsensical for a department with only two research groups and four researchers to incur an unnecessary investment [8].

The distribution of knowledge is the process by which organizations extend the flows of knowledge generated in stages of creation and transformation of information into knowledge, which allows researchers, teachers, and administrators to access new knowledge for decision making, it is highlighted that knowledge through ICT is stored in the different repositories of Higher Education Institutions [8, 15, 16].

The process of use allows HEIs to generate value on knowledge because when knowledge is not used it is losing value until it reaches a level of obsolescence, and also indicates that the organization is not learning, whereas when researchers use knowledge, it ensures competitive advantages, generates innovation and organizations are at the forefront of the latest trends [8, 16].

On the other hand, the ICTs that are related to the processes of distribution and use of knowledge in Higher Education Institutions are the intranet, repositories (virtual libraries), learning management tools such as Moodle, scientific databases such as Scopus, Web of Science, and IEEE, Framework (SharePoint and Microsoft Teams), digital narratives and e-learning [16, 17, 18].

## 3. Methods

The proposed research methodology consists of two stages (see Fig. 1): Principal Component Analysis (PCA) and cluster analysis. The first stage aims to investigate the relationships between variables and the information they provide to the phenomenon through dimensionality reduction. In the second stage, the aim is to analyze the profiles or groups found in the observed data set.

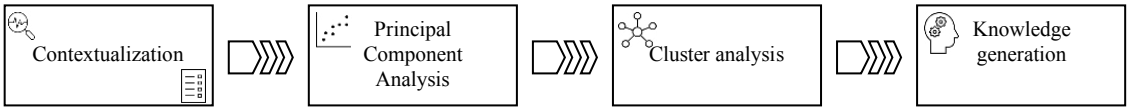


Fig. 1. Methodology.

However, this study adheres to the quantitative paradigm and is descriptive, with a descriptive transversal non-experimental design that includes activities suggested by [19, 20, 21, 22, 23]. To achieve the stated objective, the survey technique was used, using a Likert-type questionnaire structured by eleven (11) items, with an ordinal scale of five (5) alternative answers (5 Strongly Agree, 4 Agree, 3 Neither Agree, Neither Disagree, 2 Disagree and 1 Strongly Disagree), which were evaluated considering the degree of conformity of the items with the reality of the Higher Education Institutions. The questionnaire was subjected to the scrutiny of three (3) experts, who systematically examined the content and structure of the instrument, conducting a pilot test on 10% of the studied sample of 11 items, and calculating the Cronbach's alpha coefficient, which resulted in a level of reliability of 0.838 out of 11 items; this situation indicates that the instrument is reliable. It should be highlighted that the dimension related to the use of ICT tools was used in the formulation of this research (see Table 1).

Table 1: Variables of the study

| Dimensions | Indicators | Item | Statements |
|---|---|---|---|
| Distribution | ICT tools | 24 | Information and Communication Technologies (ICT) are efficient for the distribution of knowledge. |
| | | 25 | The internet is a tool that helps to make research results visible. |
| | | 26 | The research department has intranet tools for research processes. |
| | | 27 | Research results are published in Scopus databases. |
| | | 28 | Research results are published in a web of science databases. |
| | | 29 | The results found in the repositories are reflected in the theoretical construction of the research. |
| | | 30 | Technological tools are managed for the use of all research groups. |
| Use | ICT | 31 | Researchers are trained to use ICT information and communication systems. |
| | | 32 | ICTs stimulate interaction between research groups. |
| | | 33 | Research projects reference the results found in the repositories. |
| | | 34 | ICT tools are used to publish the information they need to communicate to the rest of the group. |

In order to execute the measures of central tendency, the weighted scale to be used in this research for the different categories will be based on the studies carried out by [24], where they estimated the intervals according to the formula: IB = (V-v)/N° Cat. Where the highest result was 1 and the lowest was 5, resulting in 0.8. Therefore, the following table shows the categories that will be used to carry out the convenient analysis of the data from the descriptive statistics.

Table 2: Weighted scale for the categorization of results

| Category | Range |
|---|---|
| Strongly agree | $1{,}00 \leq x < 1{,}80$ |
| Agree | $1{,}80 \leq x < 2{,}60$ |
| Neither agree nor disagree | $2{,}60 \leq x < 3{,}40$ |
| Disagree | $3{,}40 \leq x < 4{,}20$ |
| Strongly Disagree | $4{,}20 \leq x \leq 5{,}00$ |

Finally, the research population is presented in Table 3, with 7 universities in the city of Barranquilla in Colombia.

Table 3: Study population

| University | Variable |
|---|---|
| Universidad Simón Bolivar | USB |
| Universidad Atlántico | UA |
| Universidad de la Costa CUC | CUC |
| Universidad Metropolitana | UM |
| Corporación Universitaria Rafael Nuñez | CURN |
| Corporación Universitaria Latinoamericana | CUL |
| Universidad del Norte | UN |

## 4. Results

### *4.1. Principal Component Analysis*

Now, concerning the contribution of the variables on the dimensions of the PCA, it is observed that in the first dimension the variables that make the greatest contribution are related to the items related to research, therefore, we will call this dimension, which absorbs 37.7% of the variability of the data, Research findings. On the other hand, the variables that have the greatest contribution in the second dimension are related to ICT, therefore, the second dimension, which absorbs approximately 37% of the variability of the data, is called Use of ICT.

Fig. 2 shows the graphical representation of the PCA. It should be noted that the direction of the variable indicates its growth, i.e. if an observation is located in the same direction as the variable, then this observation has a higher level for this variable; otherwise, if an observation is located in the opposite direction to a variable, then it will have a lower level for the variable. Considering the research methodology, the results of the Principal Component Analysis (PCA) stage are presented first. Also, Fig. 2 shows the correlation of the variables in the observed data set, this figure indicates that if two variables point in the same direction it means that they are correlated; two variables that form an angle of 90 degrees do not correlate and, finally, two variables that point in opposite directions represent a negative correlation. For example, it is observed that items 24, 28, and 27 have the same direction and are therefore correlated, while items 26 and 29 have opposite directions and are therefore negatively correlated, and finally, items 34 and 29 form a 90-degree angle and are therefore uncorrelated.

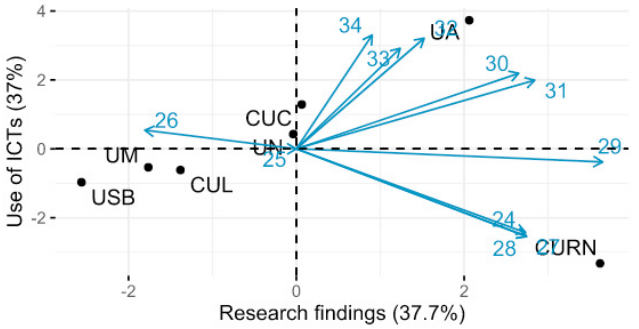


Fig. 2: Graphic representation of the PCA

For example, considering Fig. 2, the Universidad del Atlántico (UN) has a higher score in variables 30, 31, 32, 33 and 34 than the other universities, however, the Universidad del Atlántico (UN) has a lower score in variable 26 than the universities Universidad Simón Bolívar (USB), Universidad Metropolitana (UM) and Corporación Universitaria Latinoamericana (CUL).

### *4.1. Cluster analysis*

The k-means algorithm is used to determine the number of clusters, with the number of centroids ranging from two to six. As a result, the greatest Silhouette value is around 0.3, indicating that two clusters are the best quantity. The average of the elements is used to characterize the profiles of each group in Fig. 3.

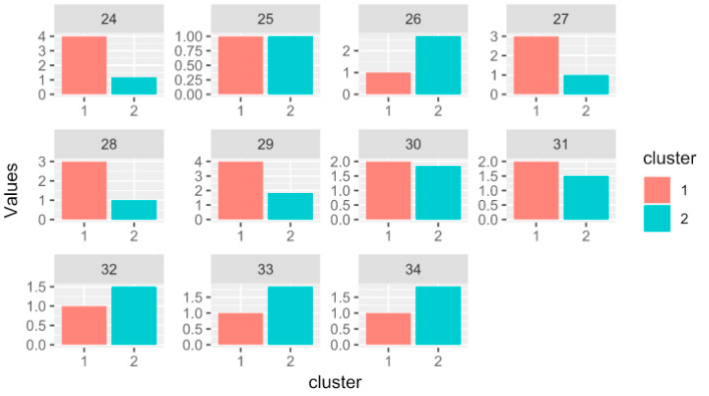


Fig. 3: Characterization of the groups

Finally, to give a better interpretation of the created profiles, the k-means algorithm has been developed to make the two-dimensional representation (see Fig. 4). It can be seen that the first group and the second group are separated, indicating distinguishable characteristics between the two and that the first group has fewer observations than the second group, which may be a limitation for the analysis that should be complemented.

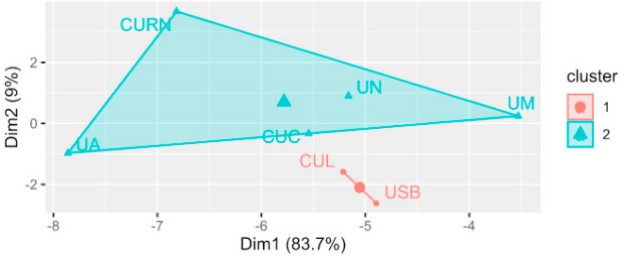


Fig. 4: Graphic representation of the k-means cluster

## 5. Discussion

The literature points out that Higher Education Institutions as organizations that create knowledge through research departments generate high knowledge flows, the results show that Information and Communication Technologies (ICT) are efficient for the distribution of knowledge flows, therefore, the ICT used for this activity is the Scopus and Web of Science databases which is following the theoretical constructs [16, 17, 18].

On the other hand, the research findings revealed that research results stored in university repositories cannot be distributed to all stakeholders in the organization; as a result, the theoretical postulates of [16, 17, 18] are incorrect; as a result, when knowledge is not used, Higher Education Institutions lose value, as revealed by [8, 16].

## 6. Conclusion

This research presented a methodology composed of two tools: Principal Component Analysis and cluster analysis. Among the most relevant results, it can be highlighted that two main profiles were found that characterize

the process of knowledge management using ICT. However, the first group has a higher level than the second group in items 24, 27, 28, 29, 30, and 31; in contrast, the second group has a higher level than the second group in items 26, 32, 33, and 34. This indicates that the universities in the first group have greater strength in the research component, which means that they manage the promotion and dissemination of research in academic spaces. On the other hand, the second group has greater strength in the ICT component for the use of knowledge, which indicates that the universities in the second group focus their efforts on ICT management as a means of knowledge management.

## References


[1] Garzón, Manuel. (2005) "Niveles del aprendizaje organizacional", Bogotá: Universidad del Rosario.

[2] Poveda Derley and Cinfuentes Jose (2020). Incorporación de las tecnologías de información y comunicación (TIC) durante el proceso de aprendizaje en la educación superior. Formación universitaria, **13**(6): 95-104. doi: 10.4067/S0718-50062020000600095.

[3] Valarmathi and Vasanth, Kumar (2020). Factors affecting Knowledge management process in higher educational institution. **7**: 997-1007. doi: 10.31838/jcr.07.15.139.

[4] Megnounif, Abdellatif, and Asma Kherbouche (2020) Knowledge Management Promising Contribution to University Performance: Empirical Study Based on Teachers' Opinions. Journal of Information & Knowledge Management, 1**9**(03): doi: 10.1142/S0219649220500227.

[5] Herrera Leandro and Muñoz Diego (2017). Inteligencia artificial y lenguaje natural. Lenguas Modernas, (19): 157-165. Consultado de https://revistas.uchile.cl/index.php/LM/article/view/45790/47818.

[6] Wollowski, Michael, et al. (2016). A survey of current practice and teaching of AI. In Proceedings of the AAAI Conference on Artificial Intelligence, **30**(1), Consultado de: https://ojs.aaai.org/index.php/AAAI/article/view/9857.

[7] Ramjeawon, Poonam Veer, and Jennifer Rowley (2017). Knowledge management in higher education institutions: Enablers and barriers in Mauritius. The Learning Organization, **24**(5): 366-377. doi: 10.1108/TLO-03-2017-0030.

[8] Probst, Gilbert, et al. (2001) "Administre el conocimiento", México: Prentice Hall.

[9] Nica, Elvira (2017), Techno-pedagogy knowledge in Smart learning environments. Economics, Management, and Financial Markets, **12**(1): 75-81. doi: 10.22381/EMFM12120175.

[10] Chergui Meriyem, Aziza Chakir, and Hajar Mansouri (2020). Smart Pedagogical Knowledge Management System. Universal Journal of Educational Research, **8**(12): 6585-6597. doi: 10.13189/ujer.2020.081223.

[11] Miquel José et al. (2004). Las herramientas de gestión del conocimiento. Una visión integrada. VIII Congreso de Ingeniería de Organización, 725 - 734.

[12] Barreto, Carmen and Fernando Iriarte (2017). Las Tic en educación superior: Experiencias de innovación. Barranquilla: Universidad del Norte.

[13] Kalyanaraman et al. (2018). An Investigation on ELearning Tools and Techniques Towards Effective Knowledge Management. Knowledge Computing and its Applications, 335 - 346.

[14] Ruggles Rudy (1997). Tools for knowledge management: An introduction Knowledge management tools. 1–8. doi: 10.1016/B978-0-7506-9849-8.50003-4.

[15] Linder Alexander, et al. (2016). Technical Complaint Feedback to Ramp-Up. 3rd International Conference on Ramp-up Management (ICRM), 99-104.

[16] Escorcia Jey and Barros David (2020). Gestión del conocimiento en Instituciones de Educación Superior: Caracterización desde una reflexión teórica. Revista de Ciencias Sociales (Ve), XXVI **(3),** 83-97. DOI: http://dx.doi.org/10.31876/rcs.v26i3.33235.

[17] Semertzaki, E. (2011). Components of a knowledge management system at a special library. Chandos Information Professional Series, 121-186. doi: 10.1016/B978-1-84334-613-5.50003-0.

[18] Hakiman Hakiman, et al. (2019). Design of knowledge management implementation in Islamic universities. Humanities & Social Sciences Reviews, **7**(1): 266-277. doi: 10.18510/hssr.2019.7131

[19] Bernal Cesar. (2010) "Metodología de la investigación administración, economía, humanidades y ciencias sociales", México: Pearson.

[20] Méndez Carlos. (2011) "Diseño y desarrollo del proceso de investigación con énfasis en ciencias empresariales", México: Limusa.

[21] Arias, Fidias (2012) "El proyecto de investigación introducción a la metodología científica", Caracas: Editorial Episteme C.A.

[22] Hernández et al. (2014) "Metodología de la investigación", México: Mc Graw Hill.

[23] Hernández Roberto and Mendoza Christian (2018) "Metodología de la investigación las rutas cuantitativa, cualitativa y mixta", México: Mc Graw Hill Education.

[24] Sukier, Harold et al. (2017) Dirección estratégica en las empresas familiars. Espacios, vol. 38, 23.