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System Of Indicators To Assess The Training And Development Of Teaching Experts And Researchers In Universities

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ABSTRACT

The objective of this study was to validate the modifications made to a system of indicators to assess the training and development of experts who work in teaching-research activity in universities. Based on the experience obtained in a research developed for the management of training and development of experts in a research center, modifications were made to the system obtained to adapt it to the activities carried out by teachers - researchers in higher education institutions. . The modified system was validated in the panel of experts with the use of the Delphi method and the application of the Likert scale, as well as with the statistical treatment of the participants' responses. Indicators of three variables of the "Expert qualification" dimension (professional career, leadership and national and international visibility) and of the "Teaching" variable of the "Expert management" dimension were modified. Cronbach's alpha coefficient (0.9274) demonstrated the internal consistency of the instrument used. The values of the medians and interquartile ranges reached allowed the consensus of the participants to be established in the validation of the indicator system. The modifications made to the original system allowed it to be adapted and applied for the assessment of teaching experts - researchers who work in the departments responsible for nuclear careers in the Faculty of Nuclear Sciences and Technologies of the Higher Institute of Technologies and Applied Sciences, attached to the University of Havana,

which showed average development both from the point of view of the qualification and management of its experts.

Keywords: Management indicators; knowledge management; Personal Development; teaching and research expert; university; Delphi method

INTRODUCTION

Since the end of the 20th century, knowledge has been recognized by many authors as a strategic resource for organizations. Knowledge has a cost that is transferred to the value and price of the product and is integrated into its quality. It is a decisive factor that can make the difference. This introduces the need for great dynamism, flexibility and elasticity in its management processes.

Knowledge management identifies and exploits, in daily work, the knowledge created in the organization and that acquired from outside; It generalizes best practices, promotes the increase of the organization's intellectual capital and its market value, while facilitating the generation of new knowledge and its materialization into products and services. [1] Its implementation and use requires information management, document management, the use of information technologies and efficient management of human resources. (1) For this, the organization must carry out actions, among which are: the identification of knowledge leaders, who can "support knowledge management by identifying experts and other sources of information"; (1) the multiplication of knowledge leaders through "the creation of knowledge teams, in which new knowledge is shared and generated and leadership qualities are cultivated." [1]

The quality of future professionals depends largely on the quality of the teaching staff that participates in their training. Therefore, the quality with which they carry out their work will depend on the training and development that teachers have and

will have a positive impact on the training of professionals who enroll in the different undergraduate and postgraduate activities. Likewise, the faculty will gain experience and its members will be able to serve as experts in different tasks, commissions and activities inside and outside the institution.

González and other authors stated that "organizations have to have all their human resources, particularly those with the highest qualifications and experience who constitute themselves as experts and contribute to the materialization of the strategic projections of the institutions." They emphasized the need for "organizations to have this professional figure and care about their training and development." [2] They designed, validated with the use of the Delphi method of consulting experts, and applied a system of indicators that allows assessing the development achieved by experts who work in a science, technology and innovation entity based on training actions and results obtained in a period of five years.

Based on the experience obtained by *Elías-Hardy* , *González-Olaguive* and *Martínez-Martínez* (2015), [2] modifications were made to the system of indicators proposed for the assessment of the training of experts in this type of institution to adapt it to the activities that teachers and researchers carry out in higher education entities when considering the similarities that exist in a set of functions that teachers and researchers perform. In this work, the modifications made are argued, the results of the validation of the system obtained with the use of the Delphi method of expert consultation are presented, as well as the application of the modified indicator system for the assessment of teaching and research experts at the Institute. Higher Degree in Technologies and Applied Sciences and the results achieved.

The objective of this study was to validate the modifications made to a system of indicators to assess the training and development of experts who work in teaching-research activity in universities.

System of indicators for teachers - researchers

The definition of whether a person is an expert or not in a topic or activity is carried out based on various criteria that depend on several factors such as, fundamentally, the type of activity, the years of work on the topic or activity, the results obtained. , among others. On the other hand, the objective for which the expert is being selected also affects the establishment of the criteria.

Elías-Hardy , González-Olaguive and *Martínez-Martínez* (2015) developed a working definition for the concept “expert” that the authors of this research assume for the development of the system of indicators for teachers - researchers: “high-level professional with recognized expertise in a certain area, possessor of a system of updated knowledge, skills, habits, values that allow him to solve problems, produce, conceive, judge and lead projects, strategies and technologies, participate in the training of other categories of personnel and "His results and contributions within and outside the limits of his organization give prestige and give visibility, projection and recognition to the very institution in which he works." [2]

The training of experts in a science, technology and innovation entity was assessed by *Elías-Hardy , González-Olaguive* and *Martínez-Martínez* (2015) through a system of indicators composed of two dimensions: qualification of the expert and management of the expert. with its variables and indicators. This system was developed to assess the individual behavior of experts over a period of five years of work. As several experts coexist in the same functional work unit (department), individual and collective measurement criteria (category and range) were

established for the designed indicators, variables and dimensions. Likewise, three generations of experts were considered taking into account different age periods: generation I (55 and over), II (45 to 54 years), III (35 to 44 years).

University professors and researchers developed similar activities in the areas of research and teaching. The time they dedicated to each activity was what established a difference between them. Professors dedicated more time to teaching activities, while researchers spent more of their time doing research. Hence, it was decided to adapt the system of indicators designed for the assessment of experts who worked in a science, technology and innovation entity and use it to assess the training and development of experts who worked in higher education centers.

Adequacy of the system of indicators for the assessment of the training and development of teaching and research experts

The functions of university professors are defined by the Regulations for the application of teaching categories in higher education. [3, 4] Among the general functions are: developing methodological and improvement activities, inherent to the undergraduate and postgraduate teaching process, [3] advice and methodological guidance in the preparation of subjects; [4] constantly raise their pedagogical, scientific-technical and cultural knowledge [3] and contribute to the improvement of the other members of the group; [4] direct [4] and carry out research, development work and technological innovation, as well as scientific, technical and application services; [3] guide the student during their journey through the degree, fulfilling the functions of tutoring course projects, diplomas and work practices; publish research results and participate in scientific events, as well as obtain scientific, technological, art and innovation results. [4] Other functions are also defined for each of the approved teaching categories, such as directing academic processes and/or

university organizational units; [3] direct and guide the student during their journey through the degree, fulfilling the functions of tutoring course projects, diplomas and work practices; [4] direct and participate in the scientific educational training of staff with lower teaching categories, [3] recent graduates and student assistants; [4] master's and doctoral thesis tutoring. [4]

Success in fulfilling the functions stated above is possible depending on the training and development achieved by the university professor. Among the problems that must be faced within the framework of the training of an expert university professor are those related to the expert's own qualification and his preparation to practice as such; In addition, they must contribute to the training of other professionals and socialize their knowledge, among other activities. It should be noted that as the teacher gains experience, the level of complexity of his tasks increases, which is reflected in his training and work plan. Therefore, a strategy for training expert teachers must include actions such as:

- Postgraduate education.
- Management of work groups, organizational units.
- Participation in projects occupying different roles.
- Management of personnel with lower teaching categories, recent graduates and student assistants.
- Participation in events, scientific societies, work commissions, courts.
- Publications and intellectual property registries.
- Tutoring for undergraduate thesis and postgraduate academic training (master's degrees, doctorates).

The main modifications were made in the indicators corresponding to the variables of the two dimensions:

1. Dimension "Qualification of the expert":
    a. Professional career of the expert.
        - The technological category is eliminated from the first indicator and remains with the name "Categorized with teaching and/or scientific category."
        - The name "Scientific degree due to academic training" is modified and the indicator "Experts with academic training" results.
    b. Leadership.
        - - The name is modified: "by expert leaders of groups of teachers and/or students", where the project leader becomes one of the possible responsibilities of the university professor and the head of the pedagogical group (subject, discipline, year, career) or holds a teaching position: department head, vice dean, dean, rector.
    c. National and international visibility and projection.
        - Participation in national and international events. The participation of separate works in national and international events is counted.
        - Publications and patents. The publications are classified into groups I - II and III - IV; books and other records of intellectual property including computer software packages are recognized.
        - Participation in national or international projects, groups of experts or others, adding employment contracts as a teacher, researcher or expert, work commissions, arbitration of

publications, evaluator, keynote speaker at events and meetings, awards received, decorations, among others.

2. Dimension "Expert management":
    a. Teaching:
        - The name of the indicator "Tutoring of undergraduate and postgraduate thesis" is modified to "Management of personnel in training".
        - The phrase "high academic level" is eliminated from the indicator "Productivity of the expert in the training of human resources".
        - The training of professionals (undergraduate level) is introduced in the three indicators (Teaching, Management of personnel in training and Productivity of the expert in the training of human resources); The postgraduate course is subdivided into postgraduate training (postgraduate courses, diploma courses) and academic training (master's degrees and doctorates). As a result of the modifications made, a system of indicators was obtained for the individual assessment (table 1) and another for the collective assessment (table 2).

Table 1 System of indicators for the individual assessment of expert teachers and researchers

Dimension	Variable	Indicator	Category and rank
Expert qualification	Professional career of the expert	Categorized with teaching and/or scientific category	Yes- Has any category No- Does not have any category

	Categorized with higher category	Yes- Holds any of the higher categories (Assistant, Head) No- Does not hold any of the higher categories
	Expert with scientific degree	With academic training - If you have a Doctor in specific sciences or higher, Master's degree or Postgraduate Specialist Without academic training - No
Expert competence	Expert competence coefficient (K)	High - $0.8 \leq K < 1.0$ Medium - $0.5 \leq K < 0.8$ Low - $K < 0.5$
Leadership	Expert heads of groups of teachers and/or students	Yes- Has been head of a group of professors or students (the type of group he has led is included: subject/discipline/career, main professor year, president or coordinator of diploma/master's/postgraduate specialty/doctorate, projects, laboratory/ department/vice dean/dean/science and technology unit/study center) No - Has not been group

		leader of teachers or students
National and international visibility and projection	Participation in national and international events	Yes - Participated in national and/or international events (the type of event is included; in national events, they are included according to the institutional, municipal, provincial, branch and national levels; in addition, participation role: organizing committee, scientific council, speaker, speaker) No- Did not participate in national and/or international events
	Publications (groups I and II, III and IV), patents and other intellectual property records	High intellectual production - 5 or more articles published in national and international journals and/or patents and other registries Medium intellectual production - 3 to 4 Low intellectual production - Less than 3 Observation: the type of group of publications 1 and 2 is collected, 3 and 4, others with ISBN or ISSN

		Participation in national and/or international projects, groups of experts or others (project, contract, work commissions, evaluator, keynote speaker, arbitration of published articles, societies and commissions, awards, decorations	Yes - Participated in any task of national and international projection No - Did not participate in any task of national or international projection Observation: The type of participation is recorded, whether it is national or international and the number of participations for each type.
Expert management	Organizational	Structuring the knowledge network	Yes - Expert associated with a group in which knowledge flow occurs (the role is listed, whether it is the head of the network or member; number of networks in which it participates). No- Expert not associated with any group
	Stages in the transit of knowledge	*Predominant modes of knowledge conversion (applying Nonaka* and *Takeuchi* 's SECI model of	Expert with actions predominantly in the socialization phase Expert with actions predominantly in the externalization phase

	knowledge creation [5])	Expert with actions predominantly in the combination phase Expert with actions predominantly in the internalization phase
Teaching	Teaching provision (in postgraduate studies it is classified into postgraduate improvement (courses, diploma) and academic training (master's and doctorate)	Yes - Has taught undergraduate and postgraduate teaching (the level is collected according to the classification: undergraduate, postgraduate course, diploma, training, master's degree, postgraduate specialty, doctorate) No - has not taught undergraduate or any form of Education Postgraduate
	Management of personnel in training	Yes - Has directed people who are in training: undergraduate (inserted students (work practice, project, research), student assistants, diploma work or thesis), postgraduate improvement (recent graduates, final diploma

	work), postgraduate academic figures (master's thesis, final postgraduate specialty thesis, doctoral thesis) No- Has not directed people who are in training
Productivity of the expert in the training of human resources (successful completion of the exercise of personnel in training)	High - Has trained more than 3 professionals with a bachelor's degree and scientific degree (doctor, master's and postgraduate specialist) Medium - Has trained between 3 and 2 professionals with a bachelor's degree and scientific degree (ibid.) Low - Has trained less 2 or has not trained professionals with a bachelor's degree and a scientific degree (ibid.)

Source: *Elías-Hardy* , *González-Olaguive* and *Martínez-Martínez.* [2]) Modified.

In the case of the variables “Expert competence” and “Stages in the transition of knowledge”, a survey consisting of three questions was applied to all identified experts, which included: [2]

- the degree of knowledge or information that the respondent considers to have about the area or topic in which he or she is considered an expert;
- the contribution of each of the sources of knowledge presented in the survey to the formation of your knowledge as an expert;
- the ways in which the knowledge transit processes occur in the work group in which the respondent is inserted (stages of socialization, externalization, combination and internalization of *Nonaka* and *Takeuchi* 's model of organizational knowledge creation) [5] based on the selection of a set of proposed actions.

On the other hand, taking as a source of information the results obtained individually by each expert, the behavior of the indicators for a group of teachers/researchers is assessed (for example: from a department, a faculty, etc.), taking into account the criteria that appear in table 2 . To facilitate a quick view of the status of each indicator, a map was created where the boxes are identified with colors that represent the rating obtained from the information collected and prepared (its application is shown in the case presented in the results).

Table 2 System of indicators for the collective assessment of expert teachers and researchers

Dimension	Variable	Variable description	Indicator	Category and Rank
Expert Qualification	Professional Career of the Expert	It is related to the fulfillment of requirements and acquisition of the planned categories	Categorized with teaching and/or scientific	High - More than 90% with some category. Medium - 80 -89% with some category. Low - Less

Dimension	Variable	Variable description	Indicator	Category and Rank
		that define their status within the organization. This includes teaching, scientific categories and scientific degrees (academic training).	category.	than 80% with any category.
			Categorized with higher teaching and/or scientific categories.	High - More than 90% with some higher category. Medium - 80 -89% with some higher category. Low - Less than 80% with some higher category.
			Experts with academic training.	High - More than 80% with a Dr.C., Master's or Postgraduate Specialist degree. Medium - 60 -79% with a Dr.C., Master's or Postgraduate Specialist degree. Low - Less than 60% with a

Dimension	Variable	Variable description	Indicator	Category and Rank
				Dr.C., Master's or Postgraduate Specialist degree.
	Expert Competence	It refers to the active and productive assimilation of the contents of your area of expertise. This process requires a close link between theory and practice and guarantees knowledge of the state of the art and the acquisition of practical experiences with all their experiential and relational load.	Expert Competence Coefficient (K).	High- More than 90% with a high coefficient. Medium - 80 - 89% with high coefficient. Low - Less than 80% with high coefficient.
	Leadership	Ability to lead groups of students,	Expert Heads of	High - More than 90% leader of

Dimension	Variable	Variable description	Indicator	Category and Rank
		teams and work groups, projects, commissions and have their competence recognized by colleagues and managers. It includes the possibility of planning, assigning and evaluating tasks, communicating, and promoting positive, ethical and cooperative work climates.	Groups of Teachers and/or Students.	groups of teachers and/or students. Medium - 80 -89% leader of groups of teachers and/or students. Low - Less than 80% leader of groups of teachers and/or students.
	Visibility and National and International Projection	It is given by the level of recognition that the expert achieves, mainly outside the	Participation in national and international events.	High - More than 90% participated in national and/or international events. Medium - 80

Dimension	Variable	Variable description	Indicator	Category and Rank
		organization (national and international) based on their results.		-89% participated in national and/or international events. Low - Less than 80% participated in national and/or international events.
	Publications, patents and other intellectual property records.	High - More than 80% with high intellectual production. Mediu m - 60 - 79% with high intellectual production. Low - Less than 60% with high intellectual production.		
	Participation in national and/or international projects,	High - More than 90% participated in some task of national or international		

Dimension	Variable	Variable description	Indicator	Category and Rank
	groups of experts or others.	projection. Medium - 80 -89% participated in some national or international outreach task. Low - Less than 80% participated in some national or international outreach task.		
Expert Management	Organizational	It is related to the organizational element that guarantees that the expert has work groups associated with him with different levels of training with which he interacts systematically and in which the flow of	Structuring of the Knowledge Network.	Good- More than 90% of experts have an associated knowledge transmission network. Regular - 80 -89% of experts have an associated knowledge transmission network. Bad - Less than 80% of experts

Dimension	Variable	Variable description	Indicator	Category and Rank
		knowledge transmission is structured.		have an associated knowledge transmission network.
	Stages in the Transit of Knowledge	It refers to the type of actions that predominate in your interrelation with the rest of the members of your team within the framework of the spiral of transformation of knowledge from tacit (T) to explicit (E) proposed by the Japanese Nonaka and Takeuchi [5]. Take into account the moments of socialization (TT),	Predominant mode of knowledge conversion.	Good - In more than 80% of the experts, actions that correspond to the externalization and combination stages predominate. Regular - Between 60-79% of experts, actions that correspond to the externalization and combination stages predominate. Bad - In less than 60% of the experts, actions that correspond to the externalization and combination

Dimension	Variable	Variable description	Indicator	Category and Rank
		externalization (TE), combination (EE) and internalization (ET).		stages predominate.
	Teaching	It refers to the participation of the expert in the different modes of higher education training: undergraduate, professional improvement and academic postgraduate and the results achieved.	Teaching delivery.	High - More than 90% have taught undergraduate and/or some form of Postgraduate Education. Medium - 80-89% have taught undergraduate and/or some form of Graduate Education. Low - Less than 80% have taught undergraduate and/or some form of Graduate Education.
			Management of personnel in	High - More than 90% have directed research and

Dimension	Variable	Variable description	Indicator	Category and Rank
			training.	practical activities of undergraduate and/or graduate students. Medium - 60 -79% have directed research and practical activities of undergraduate and/or graduate students. Low - Less than 60% have directed research and practical activities of undergraduate and/or graduate students.
			Productivity of the Expert in the training of human resources (successful completion	High - More than 80% with high productivity Medium - 60 - 79% with high productivity. Low - Less than 60% with high productivity.

Dimension	Variable	Variable description	Indicator	Category and Rank
			of the exercise of personnel in training).	

Source: *Elías-Hardy , González-Olaguive* and *Martínez-Martínez.* [2] Modified.

The modified indicator system maintained the number of dimensions, variables and indicators proposed by *Elías-Hardy , González-Olaguive* and *Martínez-Martínez ,* [2] so that the evaluation of the variables in the declared categories and ranges is maintained. As can be seen in Table 2, there are variables that are studied through a single indicator (Expert Competence, Leadership, Organizational and Stages of Knowledge Transit) and the results obtained in these indicators allow the variable to be directly evaluated in the declared categories and ranges. In the case of the variables that have three indicators (Professional Career of the Expert, National and International Visibility and Projection, and Teaching), their comprehensive assessment was proposed based on the considerations declared in Table 3 . The figure that appears in each column expresses the number of indicators valued with the corresponding category where it is located.

Table 3 Comprehensive assessment for the variables with three indicators

Indicador	Alto	Medio	Bajo	Valoración
	3	0	0	Alto
	2	1	0	Alto
	2	0	1	Medio
	1	2	0	Medio
	0	2	1	Medio
	1	1	1	Medio
	0	3	0	Medio
	1	0	2	Bajo
	0	1	2	Bajo
	0	0	3	Bajo

Source: *Elías-Hardy , González-Olaguive* and *Martínez-Martínez.* [2] Modified.

Application of the expert consultation method (Delphi) for the validation of the designed indicator system

The validation of the system of indicators for the evaluation of the training and development of expert teachers and researchers was carried out with the application of the Delphi method of consulting experts.

The panel of experts consulted was made up of 10 professionals with more than 25 years of teaching, scientific and management experience; 70% of them held the teaching category of full professor and all were doctors in specific sciences; They have held positions such as career department heads, teaching and research vice deans, postgraduate director, teaching vice chancellor, director of science and technology at the agency level; They have served as experts in teaching, scientific and management activities, as well as carrying out consulting and advisory activities at a national and international level. For each of the experts, their competence coefficient was determined, which was found to be in a range between

0.85 and 1.0 - considered high - so the opinions of all the experts consulted were included in the study.

A questionnaire was designed to collect the assessment of the panel of experts, taking into consideration whether the dimensions selected were appropriate; the correspondence of the variables to each dimension; the contribution of the indicator to the measurement of the variable; whether the designed criteria were adequate to recognize the expert status of a teacher and researcher who works in a university institution, as well as the table for the evaluation of the variables with three indicators. This questionnaire also included the proposal for the system of individual and collective indicators designed that should be assessed.

To collect the attitude of the experts in relation to the aspects that were consulted, the additive Likert scale was used, applied in a self-administered manner, where the expert selected the category that best described their response according to the scale provided (Very adequate, Fairly adequate, Adequate, Not Adequate and Not Adequate). The instrument provided that the consulted expert could express his ignorance of the topic (I don't know) and also issue opinions, suggestions and/or proposals. For the processing of the responses, values were assigned (Very suitable (6), Quite suitable (5), Suitable (4), Not very suitable (3), Not suitable (2), I don't know (1), No response (0)), determined the ranges for each category and the scores for each expert were obtained by adding the values written for the items evaluated.

The reliability analysis was carried out using Cronbach's alpha coefficient and a value of 0.9274 was obtained; This demonstrates the internal consistency of the instrument used, since the value is above 0.8 (the recommended value of this coefficient ranges between 0.7 and 0.9). [6]

For each question in the study, the median (m) was determined as a central measure of the response tendency of the group of experts. [2] The median remained in the range 6 (Very adequate) for the declared dimensions, as well as between 5 and 4 for the variables, indicators and criteria designed. The results obtained were satisfactory.

The interquartile range (k) was also calculated as the difference between the third and first quartile, in order to measure the dispersion of the sample. This was inversely proportional to the group consensus (the higher the rank, the lower the consensus). [2] In this context, unanimity was achieved when k = 0 and an acceptable degree of convergence (consensus) was estimated among the experts when $k \leq 1$. The participants in the expert panel had consensus on the dimensions and the table for the assessment of the variables with three indicators. There was also consensus regarding the correspondence of the variables to the defined dimension, except in the case of leadership (k= 3). The contribution of the indicators to the measurement of the variable with which it has been related did not reach consensus for "Categorized with teaching and/or scientific category" (k= 1.5), "National recognition" (k= 1.5) and "Predominant mode of knowledge conversion" (k= 3). The individual indicators with the least consensus were "Categorized with teaching and/or scientific category" (k= 2.5) and "Predominant mode of knowledge conversion" (k= 1.5), while the collective indicator with the least consensus was "Expert competence coefficient" (k = 3).

In the opinion of the panel of experts consulted, the proposed system of indicators is applicable to assess the training and development of expert teachers and researchers who work in higher education institutions.

The modified and validated indicator system for the individual and collective assessment of expert teachers and researchers was applied at the Faculty of Nuclear Sciences and Technologies (FCTN) of the Higher Institute of Technologies and Applied Sciences (InSTEC) attached to the University of Havana. , organizational unit where nuclear professionals are trained.

Application of the system of indicators for the assessment of the training and development of teachers - expert researchers in a university

In the case of nuclear activity, the accumulated scientific and technological experiences must be preserved taking into consideration the new applications of nuclear energy in different spheres of human activity in Cuba, fundamentally in medicine.

In recent years, the installation of nuclear medical equipment throughout the country has created a new need for pre- and postgraduate training of professionals for the assembly, operation and maintenance of said technology. This training is fundamentally developed at the Faculty of Nuclear Sciences and Technologies (FCTN) of the Higher Institute of Technologies and Applied Sciences (InSTEC) attached to the University of Havana. Three nuclear careers: engineering in nuclear and energy technologies, bachelor's degree in nuclear physics (accredited for excellence), and bachelor's degree in radiochemistry (certified) train nuclear professionals at the undergraduate level. Likewise, three accredited master's degrees of excellence: engineering in energy and nuclear facilities, nuclear physics and radiochemistry; and a master's degree (licensed) in medical physics are part of the postgraduate education options along with doctorates in nuclear technologies, core physics and radiochemistry.

The training of experts in nuclear sciences and technologies has its antecedents in the first group of teachers who integrated the departments of Nuclear Engineering and Nuclear Physics in the Faculty of Technology (currently the Technological University of Havana, CUJAE) and in the Faculty of Physics of the University of Havana. That first generation achieved a solid training and it is a strength of the institution to have part of these professionals, who have guaranteed the transition to new generations of experts. It is for these reasons that it was decided to apply the indicator system designed in this institution. To apply the system, the following premises were taken into account:

- The departments in the FCTN career were selected.
- Period covered by information collection: 2011 - 2015.
- Knowledge networks were established by discipline of each career that included recent graduates incorporated into the departments under study.
- The data were taken from the annual evaluations, life Abstracts filed in teaching category files, and Abstract information for the accreditation of careers and master's degrees.
- The faculty was considered to be made up of the department's professors and professors - collaborators from other areas of InSTEC who taught in that period. The personnel of the basic training department General Physics, Mathematics and Computing were not considered.
- The teacher must have worked for a minimum of four years in the period analyzed.
- Three generations of experts were considered as proposed for the original indicator system, considering age period: generation I (55 and older), II (45 to 54 years), III (35 to 44 years).

The results obtained at the faculty level are shown in the table , where it is observed that the experts have achieved an average development both from the point of view of their qualification and their management in the period 2011-2015. The results achieved at the level of each department and by generation are also presented.

The variables with high development in the faculty were the national and international visibility of the expert, organizational management with a good structuring of the knowledge network and a predominant mode of externalization and combination of the organizational knowledge creation cycle according to the Nonaka *model* and *Takeuchi*. [5] It is observed that leadership was the variable with the lowest development, since only 46.7% of the experts lead work groups. On the other hand, the indicators that have low development are experts with higher categories and productivity of the expert in the training of human resources, both undergraduate and postgraduate. The data presented allows us to establish in a comfortable visual form the degree of development of each indicator, variable and dimension, which facilitates the determination of indicators with a low degree of development. On the other hand, by showing the results achieved in each department and generation, the impact of each one on the overall result of the faculty can be established. For example, note that the low development in the faculty of the indicator “Experts with higher categories” responds to the low development in generations II and III of two departments, and the absence of a generation I teacher in one department. The low development of the “Leadership” variable is influenced by the low levels achieved in all generations of the three departments.

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Table Results of the application of the system of indicators that characterize the development of experts in the Faculty of Nuclear Sciences and Technologies (2011-2015)

-			Facultad				Departamento 1			Departamento 2			Departamento 3		
Dimensión	Variables	Indicadores	Generación de experto				Generación de experto			Generación de experto			Generación de experto		
			I (6)		II (6)	III (1)	I (5)	II (6)	III (1)	I (0)	II (8)	III (3)	I	II	III
Cualificación del experto Medio	Carrera profesional Medio	Expertos categorizados Alto (100 %)	Alto (100 %)		Alto (100 %)	Alto (100 %)	Alto (100 %)	Alto (100 %)	Alto (100 %)	-	Alto (100 %)	Alto (100 %)	Alto (100 %)	Alto (100 %)	Alto (100 %)
		Expertos con categorías superiores Bajo (70 %)	Medio (83,3 %)		Bajo (70,6 %)	Bajo (57,1 %)	Alto (100 %)	Bajo (66,7 %)	Bajo (0 %)	-	Alto (100 %)	Bajo (33,3 %)	Bajo (0 %)	Bajo (50 %)	Alto (100 %)
		Expertos con grado científico Alto (93,3 %)	Alto (100 %)		Alto (88,2 %)	Alto (100 %)	Alto (100 %)	Alto (83,3 %)	Alto (100 %)	-	Alto (100 %)	Alto (100 %)	Alto (100 %)	Alto (83,3 %)	Alto (100 %)
	Competencia del experto Medio	Coeficiente de competencia Medio (83,3 %)	Bajo (50 %)		Alto (94,1 %)	Medio (85,7 %)	Bajo (40 %)	Medio (83,3 %)	Alto (100 %)	-	Alto (100 %)	Bajo (66,7 %)	Alto (100 %)	Alto (100 %)	Alto (100 %)
	Liderazgo Bajo	Expertos jefes de proyectos Bajo (46,7 %)	Bajo (50 %)		Bajo (52,9 %)	Bajo (28,6 %)	Bajo (60 %)	Bajo (50 %)	Bajo (0 %)	-	Bajo (60 %)	Bajo (33,3 %)	Bajo (0 %)	Bajo (50 %)	Bajo (33,3 %)
	Visibilidad Alto	Participación en eventos Alto (100 %)	Alto (100 %)		Alto (100 %)	Alto (100 %)	Alto (100 %)	Alto (100 %)	Alto (100 %)	-	Alto (100 %)	Alto (100 %)	Alto (100 %)	Alto (100 %)	Alto (100 %)
		Publicaciones y patentes Medio (70 %)	Bajo (50 %)		Medio (70,6 %)	Alto (85,7 %)	Medio (60 %)	Bajo (50 %)	Bajo (0 %)	-	Alto (80 %)	Alto (100 %)	Bajo (0 %)	Alto (83,3 %)	Alto (100 %)
		Reconocimiento nacional e internacional Alto (90 %)	Medio (83,3 %)		Alto (94,1 %)	Medio (85,7 %)	Alto (100 %)	Medio (83,3 %)	Bajo (0 %)	-	Alto (100 %)	Alto (100%)	Bajo (0 %)	Alto (100 %)	Alto (100 %)
Gestión del Experto Medio	Organizacional Alto	Estructuración de la red de conocimientos Buena (100 %)	Buena (100 %)		Buena (100 %)	Buena (100 %)	Buena (100 %)	Buena (100 %)	Buena (100 %)	-	Buena (100 %)	Buena (100 %)	Buena (100 %)	Buena (100 %)	Buena (100 %)
	Etapas en el transito del conocimiento Alto	Modos de Conversión del Conocimiento Buena (93,3 %)	Buena (100 %)		Buena (88,2 %)	Buena (100 %)	Buena (100 %)	Buena (83,3 %)	Buena (100 %)	-	Buena (100 %)	Buena (100 %)	Buena (100 %)	Buena (83,3 %)	Buena (100 %)
	Docencia Medio	Impartición de docencia Medio	Pregrado Alto (96,7 %)	Alto (100 %)	Alto (100 %)	Medio (85,7 %)	Alto (100 %)	Alto (100 %)	Alto (100 %)	-	Alto (100 %)	Bajo (66,7 %)	Alto (100 %)	Alto (100 %)	Alto (100 %)
			Posgrado Bajo (60 %)	Bajo (50 %)	Bajo (70,6 %)	Bajo (42,8 %)	Bajo (60 %)	Medio (83,3 %)	Bajo (0 %)	-	Medio (80 %)	Bajo (66,7 %)	Bajo (0 %)	Bajo (50 %)	Bajo (33,3 %)
		Tutoria de Tesis Medio	Pregrado Medio (73,3 %)	Medio (66,7 %)	Medio (66,7 %)	Bajo (57,1 %)	Medio (80 %)	Medio (83,3 %)	Bajo (0 %)	-	Alto (100 %)	Medio (66,7 %)	Bajo (0 %)	Medio (66,7 %)	Medio (66,7 %)
			Posgrado Medio (60 %)	Medio (66,7 %)	Bajo (58,8 %)	Bajo (57,1 %)	Medio (80 %)	Medio (66,7 %)	Bajo (0 %)	-	Medio (80 %)	Medio (66,7 %)	Bajo (0 %)	Bajo (33,3 %)	Medio (66,7 %)
		Productividad del experto en la formación de recursos humanos Bajo	Nivel académico (graduado) Bajo (36,7 %)	Bajo (33,3 %)	Bajo (47,1 %)	Bajo (14,3 %)	Bajo (40 %)	Bajo (50 %)	Bajo (0 %)	-	Alto (80 %)	Bajo (33,3 %)	Bajo (0 %)	Bajo (16,7 %)	Bajo (0 %)
			Alto nivel académico de posgrado Bajo (20 %)	Bajo (33,3 %)	Bajo (17,6 %)	Bajo (14,3 %)	Bajo (40 %)	Bajo (33,3 %)	Bajo (0 %)	-	Bajo (20 %)	Bajo (0 %)	Bajo (0 %)	Bajo (0 %)	Bajo (33,3 %)

The dimensions “Qualification of the expert” and “Management of the expert” have been valued with an average rating, so it is necessary to review and propose the improvement of actions aimed fundamentally at increasing the number of teachers of the II and III generation with categories higher education, the leadership of teachers in all departments and generations, the participation of teachers in the delivery of postgraduate teaching and productivity in the training of human resources.

CONCLUSIONS

The modifications made to the system of indicators designed for the assessment of experts who work in a science, technology and innovation entity allow it to be adapted and applied for the assessment of teaching experts - researchers who work

in a university. Indicators of three variables of the "Expert Qualification" dimension (professional career, leadership and national and international visibility) and of the "Teaching" variable corresponding to the "Expert Management" dimension are modified.

Cronbach's alpha coefficient (0.9274) demonstrates the internal consistency of the instrument used. The values of the medians and the interquartile ranges achieved allow establishing the consensus of the participants in the validation of the indicator system.

As a result of the application of the Delphi method of consulting experts to validate the proposed system of indicators, it is obtained that the dimensions and the table for the assessment of the variables with three indicators reach consensus. All variables also reach consensus except "Leadership", as well as all indicators except "Categorized with teaching and/or scientific category", "National recognition" and "Predominant mode of knowledge conversion". The individual indicators with the least consensus are "Categorized with teaching and/or scientific category" and "Predominant mode of knowledge conversion", while the collective indicator with the least consensus is "Expert competence coefficient".

The experts of the faculty under study show an average development in the period analyzed, both from the point of view of their qualification and their management, where leadership is the variable with the lowest development, as do the indicators "Experts with higher categories" and "Expert productivity" in the training of human resources at both undergraduate and postgraduate levels.

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