

Measurement of the interdependence between Professors' Human Capitals and competitiveness in accredited universities in the Colombian Caribbean.

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Abstract: Universities require competent personnel for the jobs, innovation processes and to relate with their stakeholders to generate value, therefore the objective of the study is to measure the interdependence between the human capital of teachers and the competitiveness of accredited universities in the Colombian Caribbean, which allows providing a practical vision of how to identify, measure and manage it. The research is explanatory and sought to evaluate the effect that teachers have on the competitiveness of universities, using a mixed approach. The results expose the evidence of validity based on the internal structure collected from the Confirmatory Factor Analysis (CFA), shows the goodness-of-fit indices of the hierarchical model of human capital with a strong relationship (between .60 and .80) with capabilities (know-how) and a very strong relationship (greater than .80) with attitudes and skills (being) and knowledge (know-how). The relationship between human capital and competitiveness can be considered very strong (greater than .80). The AFC of the human capital scale presented an adequate fit, corroborating the hierarchical structure. Likewise, the AFC of the competitiveness scale indicated a good fit, corroborating the unidimensional structure. The theoretical contribution lies in developing a measurement scale based on two intellectual capital models: the Intellectus model and the Balanced Scorecard model, contributing with a human capital measurement tool focused on the characteristics of teachers for adequate management, improvement and decision making in universities.

Keywords: Human capital; Competitiveness, Project management, Measurement scale, Universities

Medición de la interdependencia entre el capital humano de los docentes y la competitividad en las universidades acreditadas en el Caribe colombiano

Resumen: Las universidades requieren de personal competente para los puestos de trabajo, procesos de innovación y relacionarse con sus grupos de interés para generar valor, por esto se propone el objetivo del estudio medir la interdependencia entre el capital humano de los docentes y la competitividad de universidades acreditadas del Caribe colombiano, que permita brindar una visión práctica de cómo identificarlo, medirlo y gestionarlo. La investigación es explicativa buscó evaluar el efecto que tienen los docentes, sobre la competitividad de las universidades, utilizando un enfoque mixto. Los resultados exponen la evidencia de validez basada en la estructura interna recolectada a partir del Análisis Factorial Confirmatorio (AFC), muestra los índices de bondad de ajuste del modelo jerárquico de capital humano con una fuerte relación (entre .60 y .80) con las capacidades (saber hacer) y una muy fuerte relación (mayor a .80) con las actitudes y habilidades (ser) y conocimientos (saber hacer). La relación entre el capital humano y la competitividad puede considerarse muy fuerte (mayor a .80). El AFC de la escala de capital humano presentó un adecuado ajuste, corroborando la

estructura jerárquica. Así mismo, el AFC de la escala de competitividad indicó un buen ajuste, corroborando la estructura unidimensional. La aportación teórica radica en desarrollar una escala de medición basada en dos modelos de capital intelectual: modelo *Intellectus* y el modelo *Balanced Scorecard*, contribuyendo con una herramienta de medición del capital humano centrada en las características de los docentes para una adecuada gestión, mejora y toma de decisiones en las universidades.

Palabras clave: Capital humano; Competitividad, Gestión de proyectos; Escala de medición; Universidades.

Introduction

Universities by nature are creators and transmitters of knowledge in all its dimensions, where every day they must be at the forefront of the demands of society and the business sector to train students who can perform effectively encouraging in them a culture of service, as well as the adoption of habits, vision, commitment and relevant knowledge [1]. For this reason, it can be said that human capital is the great intelligence of the members of the organization, represented in knowledge, skills and abilities of teachers, which when integrated with the resources found in the organization and the relationships they manage, generate an increase in the value of the university with its stakeholders [2] and ensure the achievement of goals with quality, welfare and capacity for projection into the future.

Although accredited universities have development plans for their teaching staff that allow them to ensure quality, academic strengthening, as well as the efficiency of internal processes to meet the needs of their stakeholders, sometimes there is a lack of encouragement for staff training, which is reflected in a high employee turnover, or low productivity, which affects the fulfillment of its mission.

Therefore, the objective of this study is to measure the interdependence between the human capital of teachers and the competitiveness of accredited universities in the Colombian Caribbean, in order to provide a practical vision of how to identify, measure and manage it.

The knowledge society is currently undergoing a series of transformations as a strategic resource, including socialization, externalization, internalization and combination that lead to the generation of new tacit and explicit knowledge [3, 4] and allow the creation of fundamental competencies that are the basis for competitive advantages to be sustainable over time [5].

One of the ways to manage knowledge is through intellectual capital, an approach that seeks to measure the value of knowledge of organizations in various areas: human capital and its intelligence, the organization, the know-how acquired by the company, patents, brands and market positioning (structural capital), reflected in the satisfaction of all stakeholders (relational capital) [6].

Intellectual capital has evolved from pioneering management and measurement models [7, 8], while advanced models have evolved as a dynamic system of knowledge-based intangible resources, including Balanced Score Card [9], Intellect Model [10], Meritum Project Measuring Intangibles to Understand and Improve Innovation Management, [11], Strategic Management Model by Competencies. [12] and Intellectus model [13].

Universities are currently undergoing significant changes primarily due to changes in their socioeconomic environment and, more recently, to the impact of Information and Communication Technologies (ICT), including artificial intelligence and globalization. These factors have generated the imperative need to adapt to the new emerging scenarios. In this context, research acquires a crucial importance by demonstrating that human capital constitutes a fundamental element for accredited universities, being a generating source of new knowledge and the development of competencies that add value to these institutions. This perspective underscores the urgency of exploring new strategies for action, control and management that will make it possible to effectively face the competitive challenges of the present.

The most important capital within an institution is its professors, researchers and students, as well as the interactions and organizational practices they establish, which is why the most significant resulting product is the knowledge that materializes in new research discoveries, publications and the training of students, demonstrating an interest in measuring human capital as a factor that contributes to educational quality [14, 15], however, so far no specific measurement model has been created for accredited universities that is statistically validated, This model would give them the ability to increase the value offered to its various stakeholders and be more competitive.

From a theoretical perspective, the research facilitates an exhaustive review of the available literature, finding that a fundamental characteristic of institutions is their commitment to the generation of knowledge to apply it in the resolution of challenges and opportunities faced by society [16].

In organizations and universities, the transfer of knowledge among their collaborators maximizes their cognitive abilities, directly influencing their productivity and effective performance; on the other hand, the loss of human capital decreases the intellectual capital of an institution; therefore, it is important that people are motivated, qualified, trained, well remunerated and that they can develop professionally to maintain and strengthen universities in terms of organizational management, in addition to their relationship [17, 18, 19, 20].

In this sense, it can be mentioned that human capital is mainly represented by the intelligence of the people who make up the organization. It reflects the combination of knowledge, skills, abilities and competencies of employees; it encompasses the set of tacit and explicit knowledge possessed by individuals and teams that is beneficial to organizations either explicitly or implicitly used according to existing agreements [21, 22].

Human capital is a key strategic element to generate a sustainable competitive advantage. Empirical evidence reflects that human capital is a determinant actor in the growth of an organization and can determine productivity among different countries [23, 24, 25].

In universities, human capital is reflected in the competencies of being (attitudes and values), knowing (knowledge and capabilities) and doing (skills and experiences) of each of its members [14].

Human capital must manage all the resources that an organization has, from the university principles, strategic direction, research and education processes, procedures included in the systems, databases, research infrastructure, publications, intellectual property, among other organizational and technological aspects of a university, associated with all the valuable relationships it has with its stakeholders.

On the other hand, competitiveness should not only be considered from an economic perspective, but should also be seen from the skills that a person has to perform his or her work with quality [26, 27].

The empirical contributions of several authors were also reviewed, finding research such as: the study on knowledge management and intellectual capital studying sociodemographic variables in university professors where they sought to establish the differences in knowledge management and intellectual capital according to age, sex and seniority in teachers of the Universidad Peruana Unión 2022. The results show that there are no significant differences that imply a change in knowledge management and intellectual capital in relation to sociodemographic data and that significant differences are found with respect to the sociodemographic factor years in the institution [28].

On the other hand, the study on how to create innovation based on human capital and transformational leadership work behavior in higher education [29], which aims to examine the role of transformational management to increase the impact of human capital on innovation work behavior for academics in personal universities in Surabaya, evidencing that human capital and transformational leadership impact on innovation work behavior for private tertiary education teachers in institutions in Surabaya.

And the research the role and evolution of knowledge network-based intellectual capital in corporate university that aimed to explore the knowledge network-based intellectual capital of corporate universities and its co-evolution process with knowledge management activities, the significant contribution of this article lies in operationalizing the concept of intellectual capital within the ecosystem of the fourth stage to a wider range of knowledge networks. In exploring the dynamics and network of intellectual capital in corporate universities [30].

These researches have points of agreement that knowledge is essential for human capital in universities, seeking to add value and be competitive. Therefore, the research hypothesis is posed: Hi. There is a significant relationship between the human capital of teachers (Attitudes - skills, knowledge and abilities) and the level of competitiveness of accredited universities in the Colombian Caribbean.

Methodology

The study is of an explanatory type, because it sought to explain the effect of the teachers considered as an independent variable, on competitiveness (made up of structural capital and relational capital) as a dependent variable of the accredited universities of the Colombian Caribbean Coast, and also sought to evaluate the degree of relationship between human capital and competitiveness. The importance of this research lies in knowing how a variable behaves when knowing the functioning of another or other variables with which it is related [31].

A mixed approach was used through a sequential exploratory design (DEXPLOS); integrating qualitative and quantitative information, obtained empirically, to address the research problem.

The population consisted of teachers from six accredited universities in the Colombian Caribbean coast, in each modality of teaching contract, part-time and full-time, for a total of 5,365 according to information from SNIES, 2021.

The sampling was probabilistic of stratified type, applying the statistical formula that takes into consideration a conservative approach of $p = 50\%$ and $q = 50\%$, which guarantees the largest sample size, keeping the other values of the formula constant. Likewise, we sought to maintain homogeneity of characteristics among the accredited universities, obtaining a sample of 359 teachers.

Table 1. Stratified sample by university

Name of University	Professor
University of the North	95
Simón Bolívar University	72
University of Cartagena	80
Almirante Padilla Naval Cadet School	10
Technological University of Bolívar	28
University of Magdalena	74
Total	359

Source: Authors, (2021).

To obtain the primary information, we proceeded with the construction and application of the measurement instrument based on the literature review of the intellectus and Balanced Scorecard model and according to the characteristics of the accredited universities, following a systematic sequence through the techniques with a group of experts, pilot study and statistically validated, with Likert-type questions of five positions, the questionnaire consisted of 64 questions divided into three parts, The first part inquires about the sociodemographic characteristics of the teachers that served to describe the sample of accredited universities; the second contains the human capital variables made up of attitudes and skills (being), knowledge (knowing) and abilities (knowing how to do) that allow, with their competencies, the achievement of the universities' mission objectives with the collaboration of the teachers, [32] and the third part corresponds to the

competitiveness supported by the execution of work in the company and the relationship that the accredited universities have with the outside, that is, with their stakeholders [33]. It should be noted that the questionnaire is based on the author [34].

Secondary sources were obtained by searching for articles published in indexed journals, international conferences, empirical works and university management reports. For the processing and analysis of the data, the following stages were developed: 1, descriptive analysis of the items (descriptive statistics to summarize the sociodemographic characteristics and their percentages), 2 exploratory factor analysis (defining groups of variables-factors), 3, confirmatory factor analysis (contrasting the model); (4) reliability analysis (reliability of internal consistency of the model).

Results

The sociodemographic characteristics of the sample of teachers indicate that the majority were male (54.839%), with a predominance of master's degrees (54.839%). Regarding university affiliation, the majority belonged to the Universidad del Norte (27.859%), with a permanent contract (60.411%), 54.545% are full-time teachers and had 6 to 10 years of teaching experience (38.123%). On the other hand, 69.501% indicated having received some type of award, distinction or recognition and 51.613% indicated that they speak English. Regarding the questions related to the field of research, most of the teachers are categorized as associate researchers in Colciencias (47.507%), belonging to a research group (92.375%), with experience between 6 and 10 years in the line of research (41.935%), with a predominance of category A of the research group to which they belong (35.191%), are linked to a research network or association (84.457%) and have published in indexed journals (50.733%).

The descriptive and discrimination analysis of the items in the group of teachers. Regarding the central tendency of the items, all are between 4 and 5, indicating a tendency to choose the highest response options by the sample, where item p85 showed the highest average ($M = 4.663$). Regarding the degree of dispersion of the indicators, item p56 had the highest variability ($SD = 0.955$). In relation to the shape measures of the items, the values of skewness and kurtosis were below 2 and 7 in absolute value, respectively, with the exception of item p85, which presented an excess of kurtosis (8.509).

The distribution of the scores in most of the items followed a normal distribution, except for item p85 (it showed the highest mean ($M = 4.663$)). With respect to item discrimination, all the indicators presented a polyserial item-rest correlation higher than .30, indicating a good discriminative capacity of the items, both in the human capital scale and in the competitiveness scale. The item-rest polyserial correlations were between .474 (item p31) and .760 (item p53).

Regarding the Confirmatory Factor Analysis (CFA), validity evidence based on internal structure was collected from the CFA. It shows the goodness-of-fit indices of the hierarchical model of human capital (one general factor and three specific factors: attitudes and skills, knowledge and abilities) and of the unidimensional model of competitiveness in the sample of teachers. The CFA of the human capital scale presented an adequate fit, corroborating the hierarchical structure. On the other hand, the AFC of the competitiveness scale also indicated a good fit, with the exception of the SRMR which showed a value slightly higher than .08, thus corroborating the unidimensional structure.

Table 2. Goodness-of-fit indices of the confirmatory factor analysis in the group of professor.

Model	χ^2	gl	χ^2/gl	RMSEA [IC 90%]	CFI	TLI	SRMR
Human capital	270.250	149	1.814	.046 [.037, .054]	.983	.981	.067
Competitiveness	1464.833	779	1.880	.057 [.052, .061]	.974	.973	.088

Source: Authors, (2024).

The reliability analysis by internal consistency of the human capital and competitiveness scales in the sample of teachers. The results indicate that the three dimensions of human capital present an adequate reliability ($\omega > .70$), being also good the reliability in the general factor of human capital ($\omega > .70$). A good level of reliability was also found in the competitiveness scale, with the omega coefficient being greater than .70, but less than .95, which implies that the internal consistency was not so high that it could generate suspicions of redundancy in the items.

Regarding the evidence of convergent validity evaluated through the AVE (Table 3), an acceptable level is observed for the dimensions, attitudes and skills (being) and knowledge (knowing) according to their reliability values ($\omega > .70$) and magnitudes of the factor loadings of their items greater than .50. Likewise, the AVE was also acceptable for the dimension, capabilities (know-how) according to its reliability value ($\omega > .75$) and magnitudes of the factor loadings of its items greater than .50. Finally, the competitiveness variable showed an acceptable AVE according to its reliability value ($\omega > .80$) and magnitudes of the factor loadings of its items greater than .50. In all cases, the AVE was greater than the AVEcriterion. Thus, it can be concluded that the human capital and competitiveness scales in the sample of teachers have evidence of reliability and convergent validity.

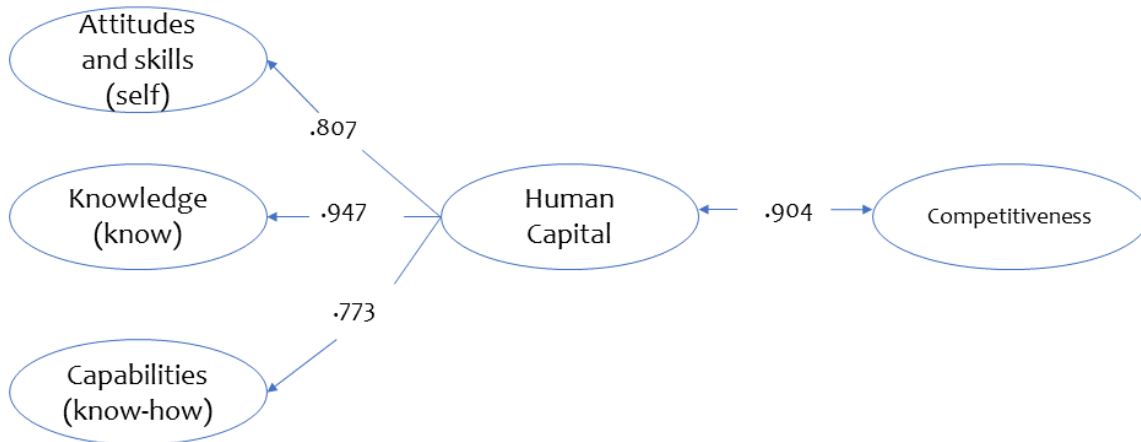
Table 3. Reliability and convergent validity analysis in the group of professors.

Variable	n	ω	AVE	AVEcriterion
Human capital	19	.782	—	—
Attitudes and skills (self)	5	.792	.467	.320
Knowledge (know)	6	.843	.535	.280
Capabilities (know-how)	8	.799	.406	.250
Competitividad	41	.941	.448	.250

Fuente: Los autores, (2024).

The Structural Equations Model (SEM) for teachers indicated a good model fit ($\chi^2 = 7018.480$, $gl = 1770$, $\chi^2/gl = 3.965$, $RMSEA [90\% CI] = .044 [.040, .049]$, $CFI = .982$, $TLI = .981$, $SRMR = .073$) proving the interdependence between human capital and competitiveness. Figure 1 shows the results of the model, where human capital has a strong relationship (between .70 and .80) with capabilities (know-how) and a very strong relationship (greater than .80) with attitudes and skills (being) and knowledge (know-how). Finally, the relationship between human capital and competitiveness can be considered very strong (greater than .80).

Figure 1. Interdependence between human capital and competitiveness in the group of teachers.



Source: Authors, (2024).

Conclusions

Knowledge management enhances the competitiveness of a company, this includes both productive and competitive elements, integrated in the intellectual capital and that in the research we identify it from the point of view of human capital and competitiveness.

The human capital of university professors is crucial to empower universities, through knowledge, skills and attitudes that when combined effectively with the management of institutions and their relationships allow them to be competitive.

Universities must assume the responsibility of leading knowledge management and producing solutions to the various problems faced by society at all levels: personal, professional, commercial and business.

The factor loadings presented in the hierarchical model of human capital (a general factor and three specific factors: attitudes and skills, knowledge and abilities) and of the unidimensional model of competitiveness in the sample of teachers were high and statistically significant, which leads to the conclusion that the model fits adequately.

The structural equation model confirms the interdependence of human capital and competitiveness, with this it can be inferred that the human capital factors of the accredited universities lead to a better performance of the group of teachers, creating value in them, showing how relevant human capital is for the achievement of the mission objectives.

The investment in human capital becomes a strategic factor to achieve high quality accreditation and competitiveness of the universities.

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Appendix

Table 4. Intellectual capital measurement scale

Part I. Demographic Identification Data	
Part II. Human Capital	
<i>Attitudes and skills (self)</i>	
P20	The university fosters an adequate work environment that allows for the motivation of the personnel involved.
P21	You feel satisfied with the activities you perform versus your contribution.
P22	You feel satisfied with the activities you perform versus your compensation.
P23	Their contribution to the achievement of organizational objectives allows them to fulfill their professional expectations.
P24	In the university there is empathy in the working relationship of its professors.
Knowledge (know)	
P25	The university indicates the functions to be performed during the academic period.
P26	The university follows up on academic planning.
P27	The university evaluates academic planning.
P28	The university provides professional training to teachers for further qualification.
P29	The university provides professional training for teachers to contextualize in the classroom.
P30	The university supports the professional training of teachers for further qualification.
Capabilities (know-how)	
P31	In her academic activities she uses information and communication technologies as a pedagogical tool to develop her classes.
P32	In his teaching practice he applies different didactic strategies.
P33	He uses the results of his research in the development of his classes to generate new knowledge.
P37	As part of his research work, he works interdisciplinary with other researchers at the university.
P38	As part of his research work, he works interdisciplinary with other researchers from other universities.
P39	Receives incentives for publications of research results.
P40	The university remunerates its professors in accordance with its bylaws (teaching scale).
P41	The university supports the academic mobility of its faculty.
Part III. Competitiveness	
P42	Knows the mission, vision and university principles that guide the life of the university.
P43	Shares the university's mission, vision and principles that guide the life of the university.
P44	Physical resources are available for the development of its teaching activities.
P45	For the development of its teaching practice, it has the technological resources.
P46	For the development of its teaching activities, it has the financial resources.
P47	In their teaching practice there is a psychosocial work environment for effective performance.
P48	Knows the organizational structure of the university.
P49	Knows the procedures to work together with other internal and external areas.
P50	Within their pedagogical practices, they believe that the university provides them with spaces to stimulate creative and innovative ideas.
P51	The university has a process for administering and managing documentation that facilitates its teaching work.

P52	The university invests in the acquisition of technology to develop teaching activities.
P53	The university has digital resources for the development of professors and research activities.
P54	The university has an intellectual property policy to protect the development of professors and research activities.
P55	The university has a policy that allows faculty to develop prototypes.
P56	The university has a policy that allows teachers to design trademarks.
P57	The university has a policy that allows teachers to develop trademarks.
P58	The university has a policy that allows faculty members to obtain a trademark registration.
P59	The university has a collaborative research policy.
P60	The university has a selective process to gather internal and external information for decision making.
P61	The university has databases to quickly select the data you need.
P62	The university has links with researchers to increase knowledge.
P63	The university has links with external research groups that allow it to increase its knowledge.
P64	The university has links with external research centers that allow it to increase its knowledge.
P65	The university has links with technological development centers that allow it to increase knowledge.
P66	In faculty-university relations, the sense of belonging is strengthened.
P67	The university attracts teachers who are distinguished by their performance.
P68	The university retains teachers who distinguish themselves by their performance.
P69	The university develops policies that favor internal communication with its faculty.
P70	The university supports him to interact with national research networks.
P71	The university supports him to interact with international research networks.
P72	The university supports him to interact with national academic networks.
P73	The university supports him to interact with international academic networks.
P74	The university promotes the services that institutional welfare offers to teachers.
P75	The university keeps track of the annual rate of faculty complaints.
P76	The university keeps track of the annual rate of faculty grievances.
P77	The university has relations with public institutions.
P78	The university has relationships with unions and private institutions.
P79	The university promulgates and carries out social responsibility actions.
P80	The university's alliances with other universities are solid.
P81	The university's alliances with the external sector are solid.
P82	The professional quality of professors is recognized in the environment in which they work.
P83	The university has a reputation for its research products (projects, articles, books and technical reports, prototypes, etc.).
P84	The university has a reputation for its innovative products.
P85	The university has a reputation for its professors

Source: Atencio, Y. V. (2020).