sustainability

MDPI

Article

The Relationship between Human-Capital Variables and Innovative Performance: Evidence from Colombia

Orly Carvache-Franco [1], Mauricio Carvache-Franco [2], Wilmer Carvache-Franco [3,*] and Miguel A. Bustamante-Ubilla [4]

[1] Facultad de Especialidades Empresariales, Universidad Católica de Santiago de Guayaquil, Guayaquil 090615, Ecuador; a20147142@pucp.pe
[2] Facultad de Turismo y Hotelería, Universidad Espíritu Santo, Samborondón 092301, Ecuador; silcarfr@alumni.upv.es
[3] Facultad de Ciencias Sociales y Humanísticas, Escuela Superior Politécnica del Litoral (ESPOL), Guayaquil 09015863, Ecuador
[4] Facultad de Economía y Negocios, Universidad de Talca, Talca 3465548, Chile; mabu@utalca.cl
* Correspondence: wcarvach@espol.edu.ec; Tel.: +593-980-105-090

Abstract: The objective of the research is to analyze the variables of human capital and its relationship with innovation in manufacturing companies. The study is quantitative, nonexperimental, cross-sectional data obtained from Colombia, an emerging country, collected from a national survey of innovation activities. The regression used is bivariate probit. The findings show that the variable "R&D workers" is related to product and process innovation and the variable "workers with higher education" is related to product innovation. The theoretical implication is that the "R&D workers" variable is an important predictor for product and process innovation because it represents skills, abilities, and worker's experience, and enables finding new uses for knowledge or combining knowledge to achieve innovation. Furthermore, in these companies, the human capital acquired through education develops the skills and abilities that enable product innovation to be achieved, while low investment in training means that the skills achieved by this means are not significant for innovation. The study has practical implications for managers in emerging countries who want to increase the companies' innovative potential by increasing investment in education and training of its workers.

Keywords: innovation; human capital; innovative performance; training; R&D workers

Citation: Carvache-Franco, O.; Carvache-Franco, M.; Carvache-Franco, W.; Bustamante-Ubilla, M.A. The Relationship between Human-Capital Variables and Innovative Performance: Evidence from Colombia. *Sustainability* **2022**, *14*, 3294. https://doi.org/10.3390/su14063294

Academic Editors: Cristian Barra and Nazzareno Ruggiero

Received: 24 January 2022
Accepted: 8 March 2022
Published: 11 March 2022

1. Introduction

Human capital is a part of intellectual capital, known as the company's most relevant intangible asset [1]. Human capital has played a central role in theories of economic growth [2] such as the endogenous growth theory [3] and the evolutionary theory that considers the importance of innovation in the evolution of the economy [4]. Human capital of companies makes it possible to stablish innovative regions [5,6]. Through human capital, differences between regions can be explained in innovation and economic development [7], and even differences between countries [8].

In the theory of human capital [9–11], it is considered that investment in education can increase people's skills and abilities, and this increases job performance. Although the relationship between education and job performance has been proven [12,13], and although human capital can improve any productive activity including research and development (R&D) [14], it is still little known how these capabilities and skills provided by human capital affect the innovative performance of companies.

Innovation is the product of the use of new knowledge, and it is a systemic process [15]. The innovative potential of companies lies in the knowledge that the company has [16] and the human capital to carry out R&D [14]. This ability to transform innovation resources and

capabilities into products that have innovative success in the market is called innovative performance [17].

The evidence of the relationship between human capital and innovative performance indicates that it is more important for innovation in the context of high-tech industries that manage more complex knowledge [18], and in fast-growing economies [19], and the evidence of this relationship is concentrated in developed countries. Despite existing studies, it is still little-known how human capabilities affect the innovative performance of companies in other contexts with other types of industries and knowledge, so there is a gap in the literature on this relationship [20].

This research aims to examine the relationship between human capital and the innovative performance of the company, in Colombia, which is an emerging country, to contribute to the gap in the literature on how human capabilities affect innovative performance, since this is a country with companies that have a greater propensity to acquire technology than to develop it internally and have a shortage of qualified resources for innovation [21]. In addition, their companies are in sectors with lower levels of technology and complexity of knowledge than developed countries, and in 2018 it had investment in R&D of 0.23% of GDP [22], which is a low level compared to developed countries.

2. Literature Review

The endogenous growth theory maintains that the economic growth of a country is produced by endogenous factors such as human capital, innovation, and knowledge, without dependence on exogenous or external factors, so there is the endogenous capacity of countries to obtain economic growth by creating technology and knowledge [3].

In the human-capital theory [9–11], it is considered that human capital is formed by a set of productive capacities that are acquired by accumulation of knowledge in people, and as other forms of capital, produces a return in the economy, so investment in education to develop these skills and knowledge of people improves human capabilities, which increases productivity in human work and provides a positive rate of return.

According to the human-capital theory, in the economic perspective, investment in education increases human capital, which will improve the work performance of people [10,11]. In practice, there could be differences in the results in the qualities that investment develops due to the institutional and socio-cultural context in which investment in education is involved [23].

It has been proven that investing in people's education leads to an increase in the skills and abilities that make up people's human capital [12]. In this way, people's education is considered an important predictor of job performance [13]. Likewise, it has been proven that investment in training in specific qualities that are required in companies has a positive impact on people's job performance [24,25]. It has also been proven that staying for a long time in companies develops knowledge and skills in the staff that lead to experience and better job performance [26].

Human capital is considered the basis of the stock of knowledge necessary for innovation [27], and is an essential drive for innovation [28]. Therefore, human capital is a source of innovative action in companies [29,30]. Acquired human capital stimulates innovation because it is a source of new ideas and new ways of using knowledge in the company [31], it helps create organizational knowledge, and it can make knowledge available, tacitly and explicitly [32].

In the resource-based view of the firm, which explains innovation, companies are considered to be heterogeneous, that is, they have different resources and capabilities, which differentiate them from each other, and they obtain their competitive advantage and business results based on the resources and capabilities they use [33–35]. To achieve innovation, the knowledge resource is considered the most important in companies, since it is a resource that provides the company with dynamic capabilities [36,37].

In the open-innovation paradigm, companies seek to increase the flow of their knowledge to increase their innovative potential, and direct this search for knowledge externally

to other organizations and market players to find this knowledge they do not have internally and is complementary to the internal knowledge they have, to expand their innovative potential [38].

Innovation is achieved by the joint action of human capital and R&D [39]. Human capital and R&D explain long-term growth., R&D, through innovation, provides new products and services, while the increase in human capital improves the skills and abilities of staff to improve any productive activity including R&D. Thus, R&D is driven by growth in human capital [14].

Through R&D in the company, new knowledge is generated to lead to the innovation of new products [40], and this internal knowledge that the company possesses can be increased with the external knowledge that the company acquires through external sources of information to increase its innovative potential. However, this requires absorptive capacity in the company [41], which is the capacity to assimilate external knowledge that the company can acquire [42]. Therefore, to generate innovations, it is necessary to endogenize [43] the external knowledge for internal use in the company.

In the process of innovation, knowledge is made up of a separate set of bodies of knowledge obtained by the company internally in R&D and external knowledge acquired through external sources of information such as customers, competitors, suppliers, and others organizations, and that through absorptive capacity the company has assimilated and made available for innovation [41,44]. In the process of innovation, these bodies of knowledge can be combined or new uses can be found by existing knowledge to achieve innovation [45], using human capital, that is, the capabilities and skills of R&D personnel to generate new uses of knowledge or generate recombinations of existing knowledge to achieve innovation. [30]. R&D for innovation is driven by the human capital available to the company [14].

Several authors have identified appropriate measures for human capital in companies. Thus, Agostini et al. [46] considered that human capital could be measured by the total number of workers that represent the company's stock of knowledge. Mariz-Pérez et al. [47] emphasized that human capital represents skills, capacities, and practical knowledge that led to innovation, so human capital can be measured by the number of R&D workers. Another important variable that has been identified to measure human capital is the company's workers with higher education, because this increases the workers' level of specialization [48,49], and training that increases skills and knowledge for innovation [28].

Although it has been proven that the increase in human capital in skills and abilities improves staff qualification and this has improved staff performance at work, which has been achieved through investment in education [12], training [24,25], and long-term performance in companies [26], in relation to innovation activities in companies, the evidence on the relationship of human capital with the innovative performance of companies shows still ambiguous results. In most cases, the evidence shows that there is a positive relationship (e.g., Alshekaili et al. [50], Sanchez [27], McGuirk et al. [51], Van Uden et al. [52], Leiponen [53], and Vinding [54]), Aleknavičiūtė et al. [29], in several European countries, found that this relationship is positive in countries with high levels of innovation, but it is not significant in countries with low levels of innovation. However, the study by Koroglu and Eceral [55] found that there is no relationship between higher education and innovative performance. Other scholars have examined the relationship between staff skills and abilities with innovative performance and have found a positive relationship [56–60].

Other studies have examined the relationship between training and innovative performance and have found a positive relationship, and their results indicate that training provides specific skills used for innovation in companies [27,52,61,62]. However, in other studies it has been found that training is not related to innovative performance [55,63,64]. Schneider et al. [62] also found that training develops specific skills for jobs that have a greater impact than the skills achieved in formal education and required for innovation. Del Canto and Gonzalez [65] found that human capital measured by experience and qualification has a positive relationship with innovative performance.

Human capital is more important for the development of innovation in high-tech companies or companies that manage complex knowledge because they require a higher human capital or set of skills and abilities of staff to achieve innovation [18]. Human capital is also important in companies in the context of fast-growing economies due to the ability to increase productivity and innovation that companies require [19]. Furthermore, human capital, due to staff skills, helps mitigate the effects of restrictions on companies in acquiring resources necessary for innovation [66].

The empirical evidence in the literature on the relationship between human capital and innovative performance has generally been carried out in developed countries. From these studies, it is known that human capital is vital for innovation in high-tech industries that handle complex knowledge [18], or in companies with high levels of innovation [29], or in fast-growing economies [19]. Hence, experiences, skills, and knowledge are relevant factors in influencing innovation [46]. This confirms that the context in which the company operates influences the effect that these capabilities and skills of human capital have on innovation, so there is a gap in the literature in knowing how human capabilities affect the innovative performance of companies [20].

Innovative companies in emerging countries differ from companies in developed countries since they have a shortage of qualified human resources, different levels of technology and complexity of knowledge, and have little investment capital for innovation [21], so examining this relationship between human capital and innovative performance in an emerging country such as Colombia contributes to the gap in the literature of how human capacities influence innovation due to the fact that the evidence of this relationship is scarce in emerging countries.

3. Research Hypothesis

Considering that the relationship between human capital and innovative performance can be influenced by the type of innovation [20], this study examines the relationship between human capital and innovative performance for product innovation and for process innovation.

Other variables that need to be controlled in the relationship between human capital and innovative performance are: (1) the R&D intensity, measured as R&D/sales expenses, which is considered a one-dimensional measure of the absorption capacity of the company [41], which is an important capacity of the company to be able to assimilate and make available to innovation the external knowledge acquired by the company [42]; and (2) the size of the company, since larger companies have a greater variety of personnel who can accumulate knowledge and skills [67].

Based on the concepts analyzed, this work examines human-capital variables' relationship with companies' innovative performance by analyzing data from Colombia. Figure 1 describes the relationships of the variables.

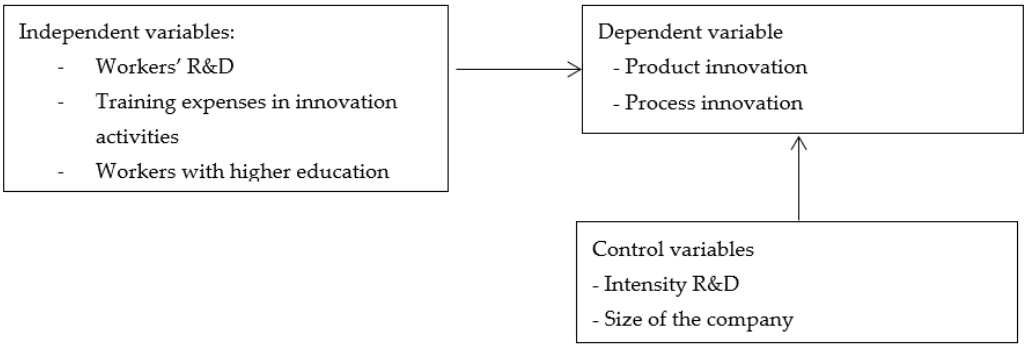

Figure 1. Relationships between the variables.

Innovation is achieved by the joint action of human capital and R&D [39]. R&D for innovation is driven by the human capital available to the company [14]. the skills, knowledge, and abilities of the R&D workers increase the absorptive capacity of the company to assimilate external knowledge [28,54]. R&D workers have technical skills and the

abilities to solve problems and contribute significantly to the production of inventions [68]. Using the skills of R&D workers, the company can find new uses for knowledge, combine existing knowledge, or develop new knowledge to achieve innovation [30]. R&D workers have knowledge, experience, and know-how or practical knowledge, and represent the company's R&D capabilities [69], as well as creativity, which represents an important component of human capital in companies for innovation [70]. Hence, it is essential to unveil if this knowledge and R&D worker capabilities are related to companies' innovative performance in Colombia. We argue the following hypothesis:

Hypothesis 1 (H1). *R&D workers are positively related to manufacturing companies' innovative performance in Colombia*.

Training improves performance at work [24,25], improves skills in staff that have been developed through formal education [62], and improves those specific skills that are required in the activities of innovation [27,52,61]. The training for innovation activities is obtained through training expenses in innovation activities of the company [28,71,72]. It is important to know if training expenses in innovation activities are related to companies' innovative performance in Colombia. We argue the following hypothesis.

Hypothesis 2 (H2). *Training expenses in innovation activities are positively related to manufacturing companies' innovative performance in Colombia*.

Investment in education improves the level of specialization of staff and performance at work [12]. Workers with higher education have knowledge and skills developed for work in the company [48,49], such as the ability to understand, create, and process information [73], and these skills developed in formal education are used in innovation activities [29,50,51,73–75]. Considering that workers' formal education provides knowledge and skills, this study explores if workers with higher education are related to innovative performance in companies in Colombia. We argue the following hypothesis:

Hypothesis 3 (H3). *Workers with higher education are positively related to manufacturing companies' innovative performance in Colombia*.

4. Methodology

The research uses a quantitative, nonexperimental, and cross-sectional design [76]. The population in Colombia was made up of all manufacturing companies with ten or more workers and a production value of more than COP 506 million. The survey data correspond to the Survey of Development and Technological Innovation(EDIT)—Industry from 2017–2018, collected by the National Statistics Office (DANE) of Colombia. The Colombian survey used follows the guidelines of the Oslo manual [15], which is currently used in many Latin American countries [77], countries of the Organization for Economic Cooperation and Development (OECD), and several African countries.

The sample was 7529 manufacturing companies. The data from the surveys for Colombia were in a currency different from USD. Hence, the authors used a COP conversion of 2951.32 COP/USD for 2017 and 2956.43 COP/USD for 2018.

4.1. Measurement of Variables

4.1.1. Dependent Variables

The Survey of Development and Technological Innovation-EDIT-Industry-2017–2018, from Colombia records the innovation of products and the innovation of processes with a binary variable, which takes the value of 1 if the company has innovated in the period 2017–2018 and the value of 0 otherwise.

Following the guidelines of the OECD (Oslo manual) [15], the measure of product innovation comes from a self-reported question in innovation surveys: has the company

introduced a new or significantly improved product or service in the period examined? The "product innovation" variable is binary and takes the value of 1 for companies that have innovated and takes the value of 0 for companies that have not innovated in the period examined [73].

4.1.2. Independent Variables

R&D workers.

The R&D workers variable was measured as R&D workers/total workers.

Ma and Yu [69] have used the measure of the number of R&D workers to represent the skills and abilities that people bring to the company's R&D as learning tasks and the role of performing R&D. Lin [78] used the number of R&D workers as a measure of human capital in R&D activities. R&D workers have also been used as a measure of R&D intensity, which is an indicator of the absorptive capacity of the company related to human abilities to assimilate external knowledge for innovation [79].

Training expenses.

The "training expenses in innovation activities" variable was measured as training expenses in innovation activities/total sales. Sung and Choi [71], Thornhill [72], and Sánchez Muñoz et al. [27] have used training expenditures in innovation activities as a measure of training which provides specific skills for the staff needed for innovation activities.

Workers with higher education.

The "workers with higher education" variable was measured as the total of workers with completed higher education/total workers. Van Uden et al. [73], Capozza and Divella [74], Caloghirou et al. [75], and Sánchez-Muñoz et al. [27] have used the measure of the number of workers with higher education that represents skills developed with formal education and that are usable in innovation activities. Na [80] similarly used a binary variable with the value of 1 for a firm with permanent full-time workers with a university degree $\geq$ 50%, and 0 otherwise.

4.1.3. Control Variables

The "R&D intensity" variable was measured as the ratio of R&D Expenses/Sales [41].

The size of the company was measured by the number of workers in the company [73].

For the econometric model, the existence of endogeneity, multicollinearity, and heteroscedasticity problems was analyzed. Multicollinearity was validated with the variance inflation factor (VIF). Robust standard errors were used in the model, in order not to have heteroscedasticity problems. The Hausman test was used to verify endogeneity problems.

4.2. Model

The model for the analyzed variables is presented in Formulas (1) and (2).

$$Y_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon_i \quad (1)$$

$$Y_2 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon_i \quad (2)$$

Dependent Variable:

Y_1 = Product innovation
Y_2 = Process innovation.

Independent Variables:

X_1 = R&D workers
X_2 = staff training expenses for innovation activities
X_3 = workers with completed higher education.

Control Variables:

X_4 = R&D Intensity (R&D expenses/sales)
X_5 = company size (number of workers in company).

The bivariate probit model was selected to process the data. The probit model is appropriate because the dependent variables are binary (1, 0). The use of ordinary least squares (OLS) estimators is not recommended when there is a binary dependent variable. The bivariate probit model is used because two dependent variables (product innovation and process innovation), which have the same group of independent variables in common and can be correlated, are processed simultaneously. There is evidence in the literature of bivariate probit model use to process the dependent variables of product innovation and process innovation [44,81,82].

5. Results

Table 1 shows the types of industries that are part of the survey sample in Colombia.

Table 1. Types of manufacturing in sample—Colombia.

International Standard Industrial Classification (CIIU)	Manufacture	Number of Companies	Percentage
C10	Food	1305	17.33
C11	Beverages	94	1.25
C12	Tobacco	2	0.03
C13	Textiles	266	3.53
C14	Wearing apparel	860	11.42
C15	Leather and related products	333	4.42
C16	Wood and products of wood and cork	151	2.01
C17	Paper	125	1.66
C18	Reproduction of recorded media	401	5.33
C19	Coke and refined petroleum products	52	0.69
C20	Chemicals	517	6.87
C21	Pharmaceuticals, medicinal, chemical, and botanical products	186	2.47
C22	Rubber and plastics products	646	8.58
C23	Other non-metallic mineral products	366	4.86
C24	Basic metals	142	1.89
C25	Fabricated metal products	591	7.85
C26	Computer, electronic, and optical products	24	0.32
C27	Electrical equipment	177	2.35
C28	Machinery and equipment NEC	420	5.58
C29	Motor vehicles, trailers, and semi-trailers	171	2.27
C30	Other transport equipment	33	0.44
C31	Furniture	382	5.07
C32	Other manufacturing	253	3.36
C33	Repair and installation of machinery and equipment	32	0.43
Total		7529	100

Table 2 shows the educational level of the staff during the years 2017 and 2018 that the survey was taken.

Table 2. Educational level of company staff.

Educational Level	2017	Percentage	2018	Percentage
Doctorate	284	0.03	297	0.04
Master's degree	5127	0.63	5550	0.69
Specialist	21,321	2.63	22,398	2.79
Higher education	106,133	13.07	107,501	13.39
Technologist/Technical	184,152	22.68	187,592	23.37
Bachelor	422,470	52.04	411,722	51.28
Basic education	65,075	8.02	60,905	7.59
None	7231	0.89	6902	0.86
Total	811,793	100	802,867	100

Table 3 shows descriptive results of the human-capital variables examined.

Table 3. Descriptive results.

Variables	Composition	Mean	Standard Deviation
R&D workers	R&D workers/Total workers	0.015	0.047
Training expenses	Training expenses for innovation/Sales	0.000058	0.00076
Workers with higher education	Workers with completed higher education/Total workers	0.313	0.221

Bivariate Probit Regression Results

The results of the probit bivariate regression as applied to the data from Colombia are detailed in Table 4.

Table 4. The bivariate probit regression results.

Variables	Product Innovation (Coefficient/Robust std. err.)	Process Innovation (Coefficient/Robust std. err.)
R&D workers	11.6314 *** (0.8898389)	9.864044 *** (0.8144703)
Training expenses	2.134569 (34.78712)	−136.607 (91.66845)
Workers with higher education	0.4835502 *** (0.1102509)	−0.017387 (0.1088288)
R&D Intensity	6.525368 *** (1.78864)	9.470023 *** (2.230346)
Company Size	1.151431 *** (0.0431154)	1.00789 *** (0.0378261)
Constant	−4.251775 *** (0.110464)	−3.579282 *** (0.0896716)
Observations	7529	
Wald chi2 (12)	1494.12	

Note: *** $p < 0.01$

The results admit that hypothesis H1, as the R&D workers variable is positively related to product and process innovation. Moreover, the hypothesis H2, of "training expenses in innovation activities", is rejected for product and process innovation. Regarding the hypothesis H3, of "workers with higher education", this is positively related to product innovation but rejected for process innovation.

Regarding the control variables, the R&D intensity variable (R&D expenses/sales) is significant in product and process innovation, and this means that R&D expenses could increase product and process innovation. The variable "company size" was statistically significant, and the outcome implies that larger companies have a greater advantage of having the human capital to achieve product and process innovation.

6. Discussion

The objective of the research was to examine the variables of human capital and their relationship with innovative performance in an emerging country such as Colombia to contribute to filling the gap in the literature on how the skills and abilities of personnel affect the innovative performance of companies.

The hypothesis H1 was accepted and holds that the variable R&D workers is positively related to product and process innovation. This result is in agreement with what was mentioned by Amara and Landry [40] and Ma and Yu [69] that, in R&D departments, the existing knowledge, with the skills and abilities of the staff, make it easier to achieve innovation. These results coincide with what was mentioned by Romer [39], who indicated that innovation is achieved by the joint action of human capital and (R&D), and the perspective of Blackburn et al. [14] that R&D is driven by the human capital available to the company. As mentioned by Zanello et al. [21], companies in emerging countries have a shortage of qualified human resources; therefore, for these companies it is key to carry out R&D activities, which allows them to increase human capital in knowledge, skills and abilities, and resources necessary to achieve innovation in companies [83].

Furthermore, the H2 hypothesis was rejected in Colombia for both product innovation and process innovation. Similarly, Koroglu and Eceral [55], Bapna et al. [63], and Lecuona and Reitzig [64] determined that training did not increase the innovative potential of companies. These results do not coincide with those obtained by Sánchez et al. [27], Van Uden et al. [52], Chatterjee [61], Schneider et al. [62], Sung and Choi [71], Thornhill [72], Van Uden et al. [73], Capozza and Divella [74], Caloghirou et al. [75], and Na [80] who have found that training is related to an increase in innovative potential. This result can be explained because innovation is achieved by the knowledge, skills, and abilities of the staff, and the objective of the training is precisely to complement higher education in the development of specific skills in the staff to develop innovation. Sometimes, this is not achieved in companies despite the existence of training to develop these specific skills, since the necessary level of skills and abilities of the personnel to achieve innovation is not reached.

Hypothesis H3 was accepted in product innovation. These results agree with those obtained by Alshekaili et al. [50], Sanchez [27], McGuirk et al. [51], Van Uden et al. [52], Leiponen [53], Vinding [54], Capozza and Divella [74], and Na [80], who found that there is a positive relationship between the skills of highly educated workers and product innovation. This result indicates that, through higher education, the necessary skills are developed in staff to manage the resources and knowledge to achieve innovation. These results do not coincide with those obtained by Koroglu and Eceral [55], Van Uden et al. [73], and Caloghirou et al. [75], who found that there is no relationship between higher education of staff and innovative performance in companies, and the results obtained by Aleknavičiūtė et al. [29], who in several European countries found ambiguous results, that is to say, that in some countries with a high level of innovation the relationship does exist but in other countries the relationship does not exist.

Results obtained from the higher-education relationship with product innovation and not with process innovation also indicate that the skills of the personnel obtained through higher education for product innovation are different from those required for process innovation. For product innovation, knowledge of a greater number of information sources is required [82], that is, it requires different capacities and skills to manage existing knowledge.

The contribution of this study is that it presents research in Colombia, an emerging country, in companies that present characteristics of a lower level of education and low level of investment in R&D, and the level of complexity of knowledge of their industries is

lower with respect to developed countries. Previous literature indicates that human capital is especially important for innovation in the context of high-tech companies or industries that handle higher levels of knowledge complexity, in fast-growing economies such as the context of developed countries, and contributes by finding that, in these companies, R&D workers and workers with higher education are related to innovative performance.

The research has theoretical implications since, in the companies examined with lower levels of investment in R&D and education, it is shown that human capital is important and is related to innovation. For the lower complexity of knowledge that industries have, the skills, abilities, and know-how which the R&D workers provide is enough to allow the company to achieve product and process innovation. In other words, the level of skills and abilities (human capital) required for R&D and achieving innovation is influenced by the level of complexity of the knowledge handled by the company for innovation. The level of skills and abilities provided by the educational level of staff in these companies allows companies to manage knowledge and find new uses of knowledge or the combination of knowledge that is required to achieve product innovation. Due to the low level of investment in training for developing specific skills in these companies, the training is not a significant factor to achieve innovation.

The study has practical implications for managers and administrators of companies in emerging countries who can increase human capital through investment in education and training and R&D activities, and increase the innovative potential of the companies.

7. Conclusions

The research concludes that the variable "R&D workers" that represents the human capital or capabilities, skills, and know-how, is positively related to the innovation of products and processes. This implies that human capital is important to achieving product and process innovation in these companies, while the variable "workers with higher education" that represents the human capital provided by education is related to product innovation. This implies that higher education provides skills and abilities which are used to develop product innovations in these companies. Likewise, it is verified that the low investment in training of these companies has not developed skills that affect innovation, and that human capital is related to the innovative potential in large companies and companies with greater intensity of R&D, being those that invest more in R&D.

The research has theoretical implications since, in the companies examined with lower levels of investment in R&D and education, it is shown that human capital is important and is related to innovation. For the lower complexity of knowledge that industries have, the skills, abilities and know-how provide the R&D workers provide is enough to allow the company to achieve product and process innovation. Therefore, the level of skills and abilities (human capital) required for R&D and achieving innovation is influenced by the level of complexity of the knowledge handled by the company for innovation. The level of skills and abilities provided by the educational level of staff in these companies allows companies to manage knowledge and find new uses of knowledge or the combination of knowledge that is required to achieve product innovation. Due to the low level of investment in training for developing specific skills in these companies, the training is not a significant factor to achieve innovation.

Furthermore, the study has practical implications for managers and administrators of companies in emerging countries who can increase human capital through investment in education and training and R&D activities, and increase the innovative potential of the companies. The study has limitations due to the temporality of the data corresponding to the period examined 2017–2018 and the country examined. For future research, it is suggested to examine the variables selected in other emerging countries, in order to confirm the results obtained.

Author Contributions: Conceptualization, O.C.-F.; Methodology, O.C.-F. and M.C.-F.; Software, O.C.-F.; Validation, O.C.-F.; Formal analysis, O.C.-F. and M.C.-F.; Investigation, O.C.-F. and M.C.-F.; Resources, O.C.-F., M.C.-F., W.C.-F. and M.A.B.-U. Data curation, O.C.-F. and M.C.-F.; Writing—original draft preparation, O.C.-F., M.C.-F., W.C.-F. and M.A.B.-U.; Writing—review and editing, O.C.-F., M.C.-F., W.C.-F. and M.A.B.-U.; Visualization, O.C.-F. and M.C.-F.; Supervision, O.C.-F.; Project administration, O.C.-F. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Allameh, S.M. Antecedents and consequences of intellectual capital: The Role of Social Capital, Knowledge Sharing and Innovation. *Intellect. Cap.* **2018**, *19*, 858–874. [CrossRef]
2. Storper, M.; Scott, A.J. Rethinking human capital, creativity and urban growth. *J. Econ. Geogr.* **2009**, *9*, 147–167. [CrossRef]
3. Romer, P.M. The Origins of Endogenous Growth. *J. Econ. Perspect.* **1994**, *8*, 3–22. [CrossRef]
4. Nelson, R.R.; Winter, S.G. *An Evolutionary Theory of Economic Change*; Harvard University Press: Cambridge, MA, USA, 1982.
5. Pedro, E.; Leitão, J.; Alves, H. Intellectual capital and performance: Taxonomy of Components and Multi-Dimensional Analysis Axes. *J. Intellect. Cap.* **2018**, *19*, 407–452. [CrossRef]
6. Suseno, Y.; Standing, C.; Kiani-Mavi, R.; Jackson, P. National innovation performance: The Role of Human Capital and Social Capital. *Innov. Eur. J. Soc. Sci. Res.* **2020**, *33*, 296–310. [CrossRef]
7. Diebolt, C.; Hippe, R. The long-run impact of human capital on innovation and economic development in the regions of Europe. *Appl. Econ.* **2019**, *51*, 542–563. [CrossRef]
8. Srholec, M. A multilevel analysis of innovation in developing countries. *Ind. Corp. Chang.* **2011**, *20*, 1539–1569. [CrossRef]
9. Becker, G. Investment in human capital: A Theoretical Analysis. *J. Polit Econ.* **1962**, *70*, 9–49. [CrossRef]
10. Schultz, T.W. Investment in human capital. *Am. Econ. Rev.* **1961**, *51*, 1–17.
11. Schultz, T.W. The economic importance of human capital in modernization. *Educ. Econ.* **1993**, *1*, 13–19. [CrossRef]
12. Mason, G.; Van Ark, B. Vocational training and productivity performance: An Anglo-Dutch Comparison. *Int. J. Manpow.* **1994**, *15*, 55–69. [CrossRef]
13. Ng, T.W.; Feldman, D.C. How broadly does education contribute to job performance? *Pers. Psychol.* **2009**, *62*, 89–134. [CrossRef]
14. Blackburn, K.; Hung, V.T.; Pozzolo, A.F. Research, development and human capital accumulation. *J. Macroecon.* **2000**, *22*, 189–206. [CrossRef]
15. OECD/Eurostat. *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation*, 4th ed.; The Measurement of Scientific, Technological and Innovation Activities; OECD Publishing: Paris, France; Eurostat: Luxembourg, 2018. [CrossRef]
16. Lin, B.W.; Chen, C.J. Fostering product innovation in industry networks: The Mediating Role of Knowledge Integration. *Int. J. Hum. Resour. Manag.* **2006**, *17*, 155–173. [CrossRef]
17. Abdulai, A.F. Social capital and innovation performance in firms. *Inn. Soc. Cap. Org. Ecosyst.* **2019**, 81–97. [CrossRef]
18. Buenechea-Elberdin, M. Structured literature review about intellectual capital and innovation. *J. Intellect. Cap.* **2017**, *18*, 262–285. [CrossRef]
19. Ma, L.; Zhai, X.; Zhong, W.; Zhang, Z.X. Deploying human capital for innovation: A Study of Multi-Country Manufacturing Firms. *Int. J. Prod. Econ.* **2019**, *208*, 241–253. [CrossRef]
20. Buenechea-Elberdin, M.; Sáenz, J.; Kianto, A. Exploring the role of human capital, renewal capital and entrepreneurial capital in innovation performance in high-tech and low-tech firms. *Knowl. Manag. Res. Pract.* **2017**, *15*, 369–379. [CrossRef]
21. Zanello, G.; Fu, X.; Mohnen, P.; Ventresca, M. The creation and diffusion of innovation in developing countries: A Systematic Literature Review. *J. Econ. Surv.* **2016**, *30*, 884–912. [CrossRef]
22. World Bank. Expenditure on Research and Development (% of GDP). 2019. Available online: https://datos.bancomundial.org/indicador/GB.XPD.RSDV.GD.ZS (accessed on 10 January 2022).
23. Peng, M.W. Institutional transitions and strategic choices. *Acad Manag. Rev.* **2003**, *28*, 275–296. [CrossRef]
24. Bartel, A.P. Productivity gains from the implementation of employee training programs. *Ind. Relat. J. Econ. Soc.* **1994**, *33*, 411–425. [CrossRef]
25. Hatch, N.W.; Dyer, J.H. Human capital and learning as a source of sustainable competitive advantage. *Strateg. Manag. J.* **2004**, *25*, 1155–1178. [CrossRef]
26. Sturman, M.C. Searching for the inverted U-shaped relationship between time and performance: Meta-analyses of the experience/performance, tenure/performance, and age/performance relationships. *J. Manag.* **2003**, *29*, 609–640. [CrossRef]

27. Sánchez Muñoz, P.; López López, A.; Salazar Elena, J.C. Gestión del Capital Intelectual y Desempeño Innovador. Resultados para España de PITEC. 2014. Available online: https://cpage.mpr.gob.es/producto/gestion-del-capital-intelectual-y-desempeno-innovador/ (accessed on 27 September 2019).
28. González, X.; Miles-Touya, D.; Pazó, C. R&D, worker training and innovation: Firm-Level Evidence. *Ind. Innov.* **2016**, *23*, 694–712. [CrossRef]
29. Aleknavičiūtė, R.; Skvarciany, V.; Survilaitė, S. The Role of Human Capital for National Innovation Capability in Eu Countries. *Econ. Cult.* **2016**, *13*, 114–125. [CrossRef]
30. Rupietta, C.; Backes-Gellner, U. Combining knowledge stock and knowledge flow to generate superior incremental innovation performance—Evidence from Swiss manufacturing. *J. Bus. Res.* **2019**, *94*, 209–222. [CrossRef]
31. Jones, B.; Grimshaw, D. The Effects of Policies for Training and Skills on Improving Innovation Capabilities in Firms. In *Compendium of Evidence on the Effectiveness of Innovation Policy Intervention*; NESTA. Manchester, Manchester Institute of Innovation Research, University of Manchester: Manchester, UK, 2012; pp. 1–38. Available online: https://www.researchgate.net/publication/337283250_The_effects_of_policies_for_training_and_skills_on_improving_innovation_capabilities_in_firms (accessed on 10 January 2022).
32. Nonaka, I.; Takeuchi, H. *The Knowledge-Creating Company*; Oxford University Press: Oxford, UK, 1995.
33. Barney, J. Firm resources and sustained competitive advantage. *J. Manag.* **1991**, *17*, 99–120. [CrossRef]
34. Penrose, E.T. *The Theory of the Growth of the Firm*; Sharpe: New York, NY, USA, 1959.
35. Wernerfelt, B. A resource-based view of the firm. *Strateg. Manag. J.* **1984**, *5*, 171–180. [CrossRef]
36. Farooq, R. Developing a conceptual framework of knowledge management. *Int. J. Innov. Sci.* **2018**, *11*, 139–160. [CrossRef]
37. Grant, R.M. Toward a knowledge-based theory of the firm. *Strateg. Manag. J.* **1996**, *17*, 109–122. [CrossRef]
38. Chesbrough, H.; Bogers, M. Explicating Open Innovatio.n: Clarifying an Emerging Paradigm for Understanding Innovation. In *New Frontiers in Open Innovation*; Chesbrough, H., Vanhaverbeke, W., West, J., Eds.; Oxford University Press: Oxford, UK, 2014; pp. 3–28.
39. Romer, P.M. Endogenous technological change. *J. Polit Econ.* **1990**, *98*, S71–S102. [CrossRef]
40. Amara, N.; Landry, R. Sources of information as determinants of novelty of innovation in manufacturing firms: Evidence from the 1999 Statistics Canada Innovation Survey. *Technovation* **2005**, *25*, 245–259. [CrossRef]
41. Laursen, K.; Salter, A. Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms. *Strateg. Manag. J.* **2006**, *27*, 131–150. [CrossRef]
42. Cohen, W.M.; Levinthal, D.A. Absorptive capacity: A new Perspective on Learning and Innovation. *Adm. Sci. Q.* **1990**, *35*, 128–152. [CrossRef]
43. Bustamante–Ubilla, M. d Libro: El hombre y su Medio Ambiente Social, Introducción, Concepto y Percepciones. In *Capítulo: "Entendiendo Las Organizaciones Desde Las Teorías De La Complejidad Y Ecología Social"*, 1st ed.; Universidad de Guanajuato y Órgano de Fiscalización Superior del Congreso del Estado de Guanajuato: México, 2015; ISBN 978-607-441-335-9. Available online: https://www.researchgate.net/publication/301867206_Capitulo_ENTENDIENDO_LAS_ORGANIZACIONES_DESDE_LAS_TEORIAS_DE_LA_COMPLEJIDAD_Y_ECOLOGIA_SOCIAL (accessed on 10 January 2022).
44. Criscuolo, P.; Laursen, K.; Reichstein, T.; Salter, A. Winning combinations: Search Strategies and Innovativeness in the UK. *Ind. Innov.* **2018**, *25*, 115–143. [CrossRef]
45. Appio, F.P.; Martini, A.; Messeni Petruzzelli, A.; Neirotti, P.; Van Looy, B. Search mechanisms and innovation: An Analysis Across Multiple Perspectives. *Technol. Forecast. Soc. Change.* **2017**, *120*, 103–116. [CrossRef]
46. Agostini, L.; Nosella, A.; Filippini, R. Does intellectual capital allow improving innovation performance? A quantitative analysis in the SME context. *J. Intellect. Cap.* **2017**, *18*, 400–418. [CrossRef]
47. Mariz-Pérez, R.M.; Teijeiro-Álvarez, M.M.; García-Álvarez, M.T. The relevance of human capital as a driver for innovation. *Econ. Noteb.* **2012**, *35*, 68–76. [CrossRef]
48. Carter, A.P. Knowhow trading as economic exchange. *Res. Policy* **1989**, *18*, 155–163. [CrossRef]
49. Hewitt, N. Resource and capability constraints to innovation in small and large plants. *Small Bus. Econ.* **2006**, *26*, 257–277. [CrossRef]
50. Alshekaili, S.A.R.; Boerhannoeddin, A. Human capital approach towards enhancing innovation performance in Omani industrial firms: The Role of Knowledge Management. *Prog. Bus. Innov. Technol. Manag.* **2011**, *1*, 23–33.
51. McGuirk, H.; Lenihan, H.; Hart, M. Measuring the impact of innovative human capital on small firms' propensity to innovate. *Res. Policy.* **2015**, *44*, 965–976. [CrossRef]
52. Van Uden, A.; Knoben, J.; Vermeulen, P. *Human Capital and Innovation in Developing Countries: A Firm Level Study*; Institute for Management Research, Nijmegen Institute for Management Research, Radboud University: Nijmegen, The Netherlands, 2014.
53. Leiponen, A. Skills and innovation. *Int. J. Ind. Organ.* **2005**, *23*, 303–323. [CrossRef]
54. Vinding, L.A. Absorptive capacity and innovative performance: A Human Capital Approach. *Econ. Innov. New Technol.* **2006**, *15*, 507–517. [CrossRef]
55. Koroglu, B.A.; Eceral, T.O. Human capital and innovation capacity of firms in defense and aviation industry in Ankara. *Procedia-Social. Behav. Sci.* **2015**, *195*, 1583–1592. [CrossRef]
56. Bakar, L.J.A.; Ahmad, H. Assessing the relationship between firm resources and product innovation performance: A Resource-Based View. *Bus. Process. Manag. J.* **2010**, *16*, 420–435. [CrossRef]

57. Cabello-Medina, C.; Carmona-Lavado, A.; Perez-Luntilde, A.; Cuevas-Rodriguez, G. Do best and worst innovation performance companies differ in terms of intellectual capital, knowledge and radicalness? *Afr. J. Bus. Manag.* **2011**, *5*, 11450–11466. [CrossRef]
58. Hsu, Y.-H.; Fang, W. Intellectual capital and new product development performance: The Mediating Role of Organizational Learning Capability. *Technol. Forecast. Soc. Change* **2009**, *76*, 664–677. [CrossRef]
59. Cabrilo, S.; Kianto, A.; Milic, B. The effect of IC components on innovation performance in Serbian companies. *VINE J. Inf. Knowl. Manag. Syst.* **2018**, *48*, 448–466. [CrossRef]
60. Subramaniam, M.; Youndt, M.A. The influence of intellectual capital on the types of innovative capabilities. *Acad Manage. J.* **2005**, *48*, 450–463. [CrossRef]
61. Chatterjee, J. Strategy, human capital investments, business-domain capabilities, and performance: A Study in the Global Software Services Industry. *Strat Manag. J.* **2017**, *38*, 588–608. [CrossRef]
62. Schneider, L.; Günther, J.; Brandenburg, B. Innovation and skills from a sectoral perspective: A Linked Employer–Employee Analysis. *Econ. Innov. New Technol.* **2010**, *19*, 185–202. [CrossRef]
63. Bapna, R.; Langer, N.; Mehra, A.; Gopal, R.; Gupta, A. Human capital investments and employee performance: An Analysis of IT Services Industry. *Manag. Sci.* **2013**, *59*, 641–658. [CrossRef]
64. Lecuona, J.R.; Reitzig, M. Knowledge worth having in "excess": The Value of Tacit and Firm-Specific Human Resource Slack. *Strateg Manag. J.* **2014**, *35*, 954–973. [CrossRef]
65. Del Canto, J.G.; Gonzalez, I.S. A resource based analysis of the factors determining a firm's R&D activities. *Res. Policy* **1999**, *28*, 891–905. [CrossRef]
66. Peng, H.; Tan, H.; Zhang, Y. Human capital, financial constraints, and innovation investment persistence. *Asian J. Technol. Innov.* **2020**, *28*, 453–475. [CrossRef]
67. Díaz-Díaz, N.L.; de Saá Pérez, P. The interaction between external and internal knowledge sources: An Open Innovation View. *J. Knowl. Manag.* **2014**, *18*, 430–446. [CrossRef]
68. Kaiser, U.; Kongsted, H.C.; Rønde, T. Does the mobility of R&D labor increase innovation? *J. Econ. Behav Organ.* **2015**, *110*, 91–105. [CrossRef]
69. Ma, B.; Yu, D. Research on the influence of R&D human resources on innovation capability—Empirical research on GEM-listed enterprises of China. *MDE Manag. Decis Econ.* **2021**, *42*, 751–761. [CrossRef]
70. Chen, M.H.; Kaufmann, G. Employee creativity and R&D: A Critical Review. *Creat. Innov. Manag.* **2008**, *17*, 71–76. [CrossRef]
71. Sung, S.Y.; Choi, J.N. Do organizations spend wisely on employees? Effects of training and development investments on learning and innovation in organizations. *J. Organ. Behav.* **2014**, *35*, 393–412. [CrossRef] [PubMed]
72. Thornhill, S. Knowledge, innovation and firm performance in high-and low-technology regimes. *J. Bus. Ventur.* **2006**, *21*, 687–703. [CrossRef]
73. Van Uden, A.; Knoben, J.; Vermeulen, P. Human capital and innovation in Sub-Saharan countries: A Firm-Level Study. *Innovation.* **2017**, *19*, 103–124. [CrossRef]
74. Capozza, C.; Divella, M. Human capital and firms' innovation: Evidence from Emerging Economies. *Econ. Innov. New Technol.* **2019**, *28*, 741–757. [CrossRef]
75. Caloghirou, Y.; Giotopoulos, I.; Korra, E.; Tsakanikas, A. How do employee training and knowledge stocks affect product innovation? *Econ. Innov. New Technol.* **2018**, *27*, 343–360. [CrossRef]
76. Neuman, W.L. *Social Research Methods: Qualitative and Quantitative Approaches*; Pearson Education: Edinburgh, UK, 2013.
77. Guillard, C.; Salazar, M. *The Experience in Innovation Surveys of Some Latin American Countries*; Banco Interamericano de Desarrollo (BID): Washington, DC, USA, 2017; Available online: https://publications.iadb.org/publications/english/document/The-Experience-in-Innovation-Surveys-of-Selected-Latin-American-Countries.pdf (accessed on 10 January 2022).
78. Lin, J.Y. Effects on diversity of R&D sources and human capital on industrial performance. *Technol. Forecast. Soc. Chang.* **2014**, *85*, 168–184. [CrossRef]
79. Fritsch, M.; Lukas, R. Who cooperates on R&D? *Res. Policy* **2001**, *30*, 297–312. [CrossRef]
80. Na, K. The effect of on-the-job training and education level of employees on innovation in emerging markets. *J. Open Innov. Technol. Market. Complex.* **2021**, *7*, 47. [CrossRef]
81. Gómez, J.; Salazar, I.; Vargas, P. Sources of Information as Determinants of Product and Process Innovation. *PLoS ONE* **2016**, *11*, e0152743. [CrossRef]
82. Ruiz-Pava, G.; Forero-Pineda, C. Internal and external search strategies of innovative firms: The Role of the Target Market. *J. Knowl. Manag.* **2018**, *24*, 495–518. [CrossRef]
83. Carlos, F.R.; Karina Edith, L.V.; Luz Melina, C.C. The theory of resources and capacities: A Bibliometric Analysis. *Nova Sci.* **2017**, *9*, 411–440. [CrossRef]