

Investing in Intellectual Capital and Achieving Research Excellence in Algerian Higher Education Institutions : A Field Study at Ferhat Abbas University Setif 1

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1. Abstract

Higher education has witnessed profound transformations in recent decades, compelling universities to strive to improve their academic standing and enhance their capacity to produce knowledge in an increasingly competitive international environment, fraught with pressures related to rankings and academic legitimacy. In this context, intellectual capital has emerged as a suitable analytical framework for interpreting the sources of institutional and research excellence, as it combines human, intellectual, organizational, and relational resources capable of creating sustainable scientific value.

This study aimed to analyze the impact of investment in intellectual capital, with its human, structural, and relational dimensions, on achieving research excellence at Ferhat Abbas University Setif 1. The study employed a descriptive-analytical approach, relying on a questionnaire administered to a stratified random sample of 307 professors from a study population of 1,527. Spearman's rank correlation coefficient and simple and multiple regression models were used to analyze the relationships and effects among the study variables. Reliability and validity tests demonstrated acceptable to good levels, supporting the suitability of the measurement instrument.

The results demonstrated positive and statistically significant relationships between investment in intellectual capital and the dimensions of research excellence. Relational capital emerged as the most influential dimension in organizing and developing scientific research, fostering scientific relationships and partnerships, and valuing scientific research, in addition to its strong correlation with research excellence. Furthermore, the multiple regression model showed that the dimensions of intellectual capital collectively explain a high percentage of the variance in research excellence, thus reinforcing the explanatory value of this approach within the context of Algerian universities.

Keywords: Intellectual capital, human capital, structural capital, relational capital, research excellence, Ferhat Abbas University Setif 1.

2. Introduction

The global higher education sector has undergone structural transformations over the past three decades, driven by intensifying international competition and the increasing centrality of research leadership and internationalization in academic discourse and university

policies. This has prompted universities and regulatory bodies to adopt strategic measures to enhance their global standing and improve their innovative capabilities according to increasingly rigorous international standards (Geuna & Martin, 2003; Leitner et al., 2014; Secundo et al., 2018).

Furthermore, the growing emphasis on the quality of research output has placed increasing pressure on universities to establish transparency and knowledge excellence in order to maintain their academic legitimacy and presence in global rankings (Geuna & Martin, 2003; Cañibano & Sánchez, 2008; Ramírez et al., 2007). From this perspective, developing research excellence is no longer merely an institutional choice, but has become an integral part of the mechanisms for survival and competitiveness in an open knowledge environment that demands the continuous ability to attract and effectively utilize talent and resources (Leitner et al., 2014; Secundo et al., 2018; Cricelli et al., 2018; Bontis, 1999; Edvinsson, 2002).

In this context, the importance of intellectual capital emerges as a strategic resource that explains the ability of a higher education institution to transform its intangible resources into measurable research value (Bontis, 1999; Chen et al., 2004; Cañibano & Sánchez, 2008; Ramírez et al., 2007). The literature on knowledge management and intangible assets has confirmed that universities capable of leveraging their human, structural, and relational capital are better prepared to face the transformations of the research environment and achieve sustainable competitive advantages (Roos et al., 2005; Leitner et al., 2014; Chahal & Bakshi, 2014; Secundo et al., 2018; Cricelli et al., 2018).

The problem addressed in this study stems from the contradiction between the abundance of knowledge assets within higher education institutions and the continued failure to achieve sustainable research excellence. The question is no longer simply the existence of these assets, but rather the university's ability to value, invest in, and transform them from latent resources into research outputs with scientific, organizational, and societal impact. Furthermore, a significant portion of the literature has focused on measuring intellectual capital as a static entity, while the mechanisms for investing in it as a means to achieve research excellence have received less attention, particularly in the Algerian context.

Based on this, this study seeks to examine the nature of the relationship between investment in the dimensions of intellectual capital, represented by human, structural and relational, and research excellence at Ferhat Abbas University Setif 1. It also aims to test the relative explanatory power of each of these dimensions in improving research excellence, based on indicators of organizing and developing scientific research, scientific relationships and partnerships, and the valorization of scientific research.

3. Theoretical Framework and Hypothesis Development

In modern management literature, intellectual capital is viewed as an intangible strategic asset comprising knowledge, information, experience, and capabilities that are employed to create value and achieve outstanding performance (Stewart, 1997; Roos et al., 2005; Al-Ali, 2003).

Within the context of higher education institutions, this concept takes on a broader dimension, encompassing applied knowledge, organizational structures, and collaborative networks that provide the university with a sustainable competitive advantage (Leitner et al., 2014; Secundo et al., 2018; Ramirez et al., 2014).

This perspective implies that research excellence stems not only from the availability of material resources, but also from the effective management and investment of knowledge assets in supporting the quality of scientific output, increasing research openness, and enhancing the transformation of results into academic and societal value (Leitner et al., 2014; Secundo et al., 2018; Cricelli et al., 2018). Therefore, intellectual capital becomes a suitable analytical framework for explaining differences in research excellence between universities or within a single university (Ramirez et al., 2014; Bueno et al., 2002; Secundo et al., 2018).

3.1. Human Capital:

Human capital represents the cornerstone of all academic activity, as it encompasses professors, researchers, administrators, and students who create and develop knowledge within the institution (Sultanova et al., 2018; Ramirez et al., 2014). Its value lies in its combination of explicit and tacit knowledge, and its connection to creativity, research quality, and participation in scientific projects, making it a key source of institutional competitive advantage (Sultanova et al., 2018; Leitner et al., 2014; Cricelli et al., 2018).

Human capital also gains importance from being the actual foundation of productivity and strategic renewal, as investment in skills, experience, training, and scientific motivation directly impacts performance quality and the capacity for innovation (Elnaga & Imran, 2013; Sultana et al., 2012; Kelly, 2004). Numerous studies have supported this view, highlighting that human capital development is linked to increased productivity and enhanced organizational effectiveness, and that it represents the driving force behind the other components of intellectual capital (Youndt et al., 2004; Kamarul Zaman & Abu Bakar, 2003).

From this perspective, investment in human capital is expected to contribute to raising the level of research excellence within the university, whether through improving the organization of scientific research, expanding partnerships, or supporting the valorization of its results. Therefore, **the hypothesis related to this dimension was formulated based on the existence of a statistically significant positive effect of human capital on research excellence.**

3.2. Structural Capital:

Structural capital refers to the knowledge that an institution retains within its systems, procedures, structures, databases, and organizational culture, even after individuals leave (Al-Ali, 2003; Meyer et al., 2014; Sharabati & Nour, 2013). In this sense, it represents the remaining knowledge and organizational assets within higher education institutions that can be continuously accessed and utilized to support academic and research work (Meyer et al., 2014; Chen, 2004).

The importance of this dimension lies in its role as the incubator for human capital, transforming tacit knowledge into procedures, systems, and operating rules that allow for improved operational efficiency, information flow, and organizational learning (Chen, 2004; Meyer et al., 2014; Sharabati & Nour, 2013). The literature has also shown that investment in organizational systems, infrastructure, and information technology enhances an institution's public image and is strongly correlated with performance indicators in various organizations (Youndt et al., 2004; Al-Kaabi, 2020).

Therefore, a university with flexible organizational structures, well-equipped laboratories, effective information systems, and accurate databases is better able to organize its research activities and improve its outputs. **From this perspective, it was hypothesized that structural capital has a statistically significant positive effect on enhancing research excellence.**

3.3. Relational Capital:

Relational capital is a fundamental component of intellectual capital, as it reflects the flow of knowledge between an institution and its external environment through relationships with stakeholders and academic, economic, and social partners (Ramírez et al., 2007; Leitner et al., 2014). This dimension is not limited to formal communication but also includes the ability to build stable, trust-based relationships and develop collaborative networks that provide access to information, opportunities, and resources not available through traditional channels (Ramírez et al., 2007).

In the university context, the value of this dimension lies in its contribution to increased scientific productivity, enhanced engagement in national and international collaboration, and the university's connection to its societal and economic functions (Aldieri et al., 2020; Secundo et al., 2018).

In light of this, **investment in relational capital is expected to be the most effective dimension for explaining research excellence**, as partnerships, agreements, and interaction with the scientific and economic environment provide practical channels for disseminating, valuing, and maximizing the impact of knowledge. Therefore, an empirical analysis was conducted to test the strength of this impact compared to the human and structural capital dimensions.

4. Methodology

The study adopted the descriptive-analytical approach as the most suitable for examining the relationships between the study variables and analyzing the impact of intellectual capital dimensions on research excellence. This methodological choice is based on collecting field data from the study population, then using appropriate statistical tools to describe patterns and test hypotheses related to correlation and influence.

The study population consisted of professors at **Ferhat Abbas University Setif1**, across various disciplines and ranks, totaling 1,527 professors. The population was limited to this category due to the relevance of the study topic to the nature of the academic and research tasks undertaken by professors, thus allowing for more accurate and relevant data.

To calculate the sample size, a suitable statistical equation was used for a limited population, assuming a 50% availability rate, a 95% confidence level, and a 5% margin of error. The application resulted in a minimum sample size of 306.94, which was rounded to 307, the size actually used in the study. Stratified random sampling was employed, dividing the target population into seven strata based on the number of colleges, and then drawing a simple random sample from each stratum according to proportional distribution. This procedure enhances the representation of different groups within the population and reduces the potential for bias in sample selection.

The study instrument consisted of a questionnaire designed to measure the dimensions of investment in intellectual capital and the dimensions of research excellence. The dimensions of intellectual capital included investment in human capital, investment in structural capital, and investment in relational capital. The dimensions of research excellence included the organization and development of scientific research, scientific relationships and partnerships, and the valorization of scientific research.

The instrument underwent validity and reliability tests using correlation coefficients, Cronbach's alpha coefficient, and Guttman split-seconds. The tables for each dimension showed that the reliability coefficients were at acceptable to high levels. Cronbach's alpha coefficient was 0.840 for the human capital investment dimension, 0.855 for the structural capital investment dimension, and 0.841 for the relational capital investment dimension. Some research excellence dimensions also achieved good values, such as 0.821 for the research valuation dimension, which supports the instrument's internal consistency and its suitability for field application.

Regarding the analytical methods, Spearman's rank correlation coefficient was used to test the relationships between variables, a choice consistent with the nature of the data and the analytical approach of the study. Simple regression was used to test the individual effect of each intellectual capital dimension on the research excellence dimensions, while multiple regression was used to test the combined effect of the three dimensions on research excellence.

5. Results

5.1. Human Capital and Research Excellence

Spearman's correlation matrix revealed statistically significant positive correlations between investment in human capital and the three dimensions of research excellence. The correlation coefficient was 0.459 with the organization and development of scientific research, 0.538 with scientific relationships and partnerships, and 0.431 with the valuation of scientific research. All three correlations were significant at the 0.000 level, confirming that investment in competencies, expertise, and cognitive abilities is associated with a clear improvement in research excellence indicators.

Simple regression analysis also demonstrated that investment in human capital has a significant positive impact on the organization and development of scientific research. The correlation coefficient was 0.460, the coefficient of determination was 0.211, and Fisher's p-value was 82.805 at the 0.000 level. The regression coefficient was 0.453, and the t-value was

9.100. These indicators suggest that human capital makes a significant explanatory contribution to improving the organization and development of scientific research.

Regarding scientific relationships and partnerships, the model showed that investment in human capital has a significant effect, with a correlation coefficient of 0.547, a coefficient of determination of 0.300, a Fisher's value of 132.154, a regression coefficient of 0.509, and a t-value of 11.496. These results indicate that improving human capital directly impacts the university's ability to build more effective scientific relationships and partnerships.

As for the valorization of scientific research, the results confirmed a statistically significant positive effect, with a correlation coefficient of 0.421, a coefficient of determination of 0.177, a Fisher's value of 66.635, a regression coefficient of 0.410, and a t-value of 8.163. This means that developing human capital not only contributes to knowledge production but also to supporting its investment and valorization within the university.

5.2. Structural Capital and Research Excellence

The correlation results showed that investment in structural capital is also positively and significantly correlated with the dimensions of research excellence. Correlation coefficients reached 0.494 with the organization and development of scientific research, 0.562 with scientific relationships and partnerships, and 0.481 with the valorization of scientific research, all at a significance level of 0.000. This reflects the positive role of organizational and procedural structure in supporting research work.

The simple regression results also showed that structural capital has a positive and significant effect on the organization and development of scientific research, with a correlation coefficient of 0.509, a coefficient of determination of 0.259, a Fisher's value of 108.078, a regression coefficient of 0.502, and a t-value of 10.396. These results confirm that systems, procedures, and knowledge infrastructure are key drivers for improving the organization of research activity.

In the scientific relationships and partnerships model, the correlation coefficient was 0.595, the coefficient of determination was 0.354, the Fisher's value was 169.033, the regression coefficient was 0.554, and the t-value was 13.001. These values indicate that a suitable organizational and informational structure supports research openness and enhances the university's ability to build effective scientific collaboration.

Regarding the valorization of scientific research, the results also showed a significant positive effect, with a correlation coefficient of 0.492, the coefficient of determination of 0.242, the Fisher's value of 98.741, the regression coefficient of 0.480, and the t-value of 9.937. This demonstrates that structural capital contributes to creating a suitable institutional environment for transforming produced knowledge into added value.

5.3. Relational Capital and Research Excellence

The results revealed that relational capital is the dimension most strongly associated with research excellence compared to the other dimensions. Correlation coefficients were 0.895 with the organization and development of scientific research, 0.704 with scientific relationships and partnerships, and 0.919 with the valuation of scientific research—all

positive and significant at the 0.000 level. This indicates a strong relationship between relational networks and improved research excellence.

In the regression model for the organization and development of scientific research, the correlation coefficient was 0.898, the coefficient of determination was 0.806, and the Fisher coefficient was 1283.266. The regression coefficient was 0.886, and the t-value was 35.823. These results strongly suggest that investment in scientific and institutional relationships explains a significant portion of the variance in this dimension of research excellence.

Regarding scientific relationships and partnerships, the correlation coefficient was 0.719, the coefficient of determination was 0.517, and the Fisher's value was 330.971, while the regression coefficient was 0.670 and the t-value was 18.193. This confirms that relational capital is not only theoretically linked to partnerships but also appears as a real explanatory factor in their formation and development.

With respect to the valorization of scientific research, the results showed the highest levels of impact, with a correlation coefficient of 0.931, a coefficient of determination of 0.867, and a Fisher's value of 2016.682, while the regression coefficient was 0.909 and the t-value was 44.907. This result highlights the importance of external relationships and networks in enhancing the ability to translate scientific research findings into broader institutional, societal, and scientific value.

5.4. Intellectual Capital and Research Excellence

The correlation matrix for research excellence showed that all dimensions of intellectual capital are positively and statistically significantly correlated with it. The correlation coefficient between research excellence and investment in human capital was 0.504, with investment in structural capital 0.541, and with investment in relational capital 0.903, all of which were significant at the 0.000 level. These results reveal that research excellence is influenced by the integration of the three dimensions, with relational capital showing a clear advantage.

At the multiple regression level, the results showed that the dimensions of intellectual capital collectively explain a high proportion of the variance in research excellence. The multiple correlation coefficient was 0.927, the coefficient of determination was 0.859, the adjusted coefficient of determination was 0.857, and the Fisher's p-value was 622.648 at a significance level of 0.000, confirming the overall significance of the model.

The standardized tests also indicated that relational capital was the most influential variable in the multiple model, with a regression coefficient of 0.740 and a t-value of 32.538, followed by human capital with a coefficient of 0.131 and a t-value of 5.507, and then structural capital with a coefficient of 0.056 and a t-value of 2.191. These results support the conclusion that scientific and institutional relationships constitute the most prominent source for enhancing research excellence at the university under study.

6. Discussion

The results reveal that investment in intellectual capital provides a strong explanatory framework for understanding disparities in research excellence within higher education

institutions. This conclusion aligns with the literature that views intellectual capital as a strategic resource enabling the transformation of knowledge, skills, and experience into competitively valuable outputs, particularly in knowledge-based organizational environments (Stewart, 1997; Al-Ali, 2003; Leitner et al., 2014; Secundo et al., 2018).

The findings related to human capital indicate that developing research competencies, scientific expertise, and academic motivation directly impacts the organization of scientific research, the building of partnerships, and the valorization of results. This reinforces the argument that human capital is the primary source of renewal and innovation within an organization, and that investment in individuals' knowledge and capabilities forms the basis of organizational competitive advantage (Schultz, 1961; Manuti & de Palma, 2016; Youndt et al., 2004; Elnaga & Imran, 2013).

Furthermore, the findings regarding structural capital highlight that the effectiveness of organizational structure is no less important than the effectiveness of human resources, because systems, procedures, databases, and infrastructure provide the necessary institutional conditions for transforming individual effort into organized and sustainable research performance (Amiri et al., 2010; Leitner et al., 2014). This interpretation aligns with the literature confirming that institutionalized knowledge within an organization, when supported by flexible structures and effective information systems, significantly enhances performance and innovation (Amiri et al., 2010; Leitner et al., 2014; Chen et al., 2004).

However, the most significant finding of the current study is the clear superiority of relational capital, both in terms of correlation strength and explanatory power in the regression models. This can be explained by the fact that universities that build strong relationships with their academic, economic, and social partners gain greater access to resources, opportunities, and knowledge networks (Cricelli et al., 2018), which is reflected in the quality, value, and impact of scientific research. This aligns with studies that have highlighted the importance of scientific collaboration, engagement in the university's third mission, and expanding partnerships as key drivers of scientific productivity and institutional excellence (Aldieri et al., 2020; Secundo et al., 2018).

The results also allow us to understand research excellence as a complex outcome not determined by a single dimension, but rather by the integration of the three dimensions of intellectual capital, with relational capital playing a prominent role. This means that a university, even if it has good human resources and a suitable organizational structure, may not reach a high level of research excellence unless it succeeds in activating its cooperative links and opening up to its scientific, social and economic environment.

7. Applied Implications

This study offers several applied implications relevant to decision-makers at Algerian universities. First, fostering research excellence requires continuous investment in attracting talent, providing research training, offering incentives, and enhancing the scientific and methodological skills of professors and researchers, recognizing human capital as the foundation for building research excellence.

Second, developing structural capital should be an integral part of university governance, achieved through improving organizational structures, modernizing information systems, developing laboratories, expanding databases, and streamlining administrative procedures related to research activity. The more efficient and flexible the institutional structure, the greater the university's capacity to translate knowledge into organized and sustainable performance.

Third, and most important in light of the findings, is the necessity of prioritizing the strategic development of relational capital. This involves expanding partnerships with national and international universities, activating cooperation agreements, connecting the university with its economic and social environment, and developing mechanisms for transferring and valuing the results of scientific research. The importance of this stems from the fact that this dimension is best positioned to explain research excellence and translate it into tangible impact both within and outside the institution.

8. Conclusion:

The study concluded that investing in intellectual capital represents an effective strategic approach to achieving research excellence in Algerian higher education institutions. This impact is manifested through the interaction of human, structural, and relational dimensions in supporting research excellence and improving its outcomes. The results also demonstrated that this impact is not balanced among the three dimensions; rather, relational capital takes precedence, followed by human capital, and then structural capital.

This means that building a more competitive research university cannot be achieved by focusing on individual or organizational resources in isolation, but rather through integrated management of knowledge, organizational, and relational assets. Therefore, any university policy aimed at enhancing research excellence should combine the development of human competencies, the improvement of institutional structures, and the expansion of collaborative and recognition networks.

The study also highlights the need to develop university governance approaches that make intellectual capital management a central pillar in strategic planning for scientific research. In this context, the current results provide a scientific basis that can be built upon in subsequent studies that expand on testing causal models or include mediating and adjusting variables that more deeply explain the pathways of intellectual capital influence on research excellence.

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