

PRIMARY RESEARCH

Navigating the innovation landscape: A study on open innovation, competitive advantage, and the dual role of knowledge coupling in exploration and exploitation

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Keywords

Open innovation
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Received: 29 May 2024**Accepted:** 16 September 2024**Published:** 23 December 2024**Abstract**

This study examines the effect of open innovation on competitive advantage through knowledge exploitation and exploration and moderating role of knowledge coupling among school teachers in Bahrain. This longitudinal study employed a quantitative methodology based on survey responses from 278 Bahraini school teachers. Longitudinal 3 wave data was collected from 278 school teachers in Bahrain schools. The results confirm a significant relationship between open innovation and competitive advantage. The findings support the mediating roles of knowledge exploitation and exploration in the relationship between open innovation and competitive advantage. Furthermore, moderating role of knowledge coupling on competitive advantage with knowledge exploitation and exploration. This study demonstrates the distinct pathways of the endogenous and exogenous constructs and offers a thorough examination of the structural model's latent variables using PLS-SEM. Additionally, it provides useful advice and insights for construction firms looking to use knowledge coupling to promote open innovation in competitive advantage. Implications for research and practice are discussed.

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INTRODUCTION

In today's management literature, research on organizations' innovation strategies is highly relevant. Businesses are now compelled to continuously improve the effectiveness of their current business models while also creating radically new ideas and approaches to business to deal with the possible threats of emerging competitors due to the rapid growth of emerging digital technologies (Johnson, Laurell, Ots, & Sandström, 2022; Usman, Khan, & Khattak, 2024). Although adopting exploration or exploitation technique may improve a company's competitive advantage (Chen, Yu, & Hou, 2024), those approaches are very likely to fall into strategic traps (Zhang, Chu, Ren, & Xing, 2023). Although researchers have examined the effects of flexibility on competitive advantage (Lima Rua, Musiello-Neto, & Arias-Oliva, 2023) and exploration or exploitation (Huang, Wang, Chin, Huang, & Cheng, 2022; Johnson et al., 2022; Wen, Qualls, & Zeng, 2021), the findings vary greatly in scope and direction (Jin, Yang, Fawad Sharif, & Li, 2022), and it is still unclear

whether innovation boosts a firm's competitive advantage (Chen et al., 2024).

In the face of rapid technological development and a more globalized corporate environment, corporations are finding that the capacity to strike a balance between exploratory and exploitative activity is increasingly important. According to Johnson et al. (2022), open innovation plays a crucial role in business practice and is also increasingly relevant in management theory. In particular, Zhang et al. (2023) emphasizes in his derivation of the resource-based view the significance of striking a balance between the development of new resources and the use of current ones. Innovation is no longer a confined phenomenon with a central center of agency that is constrained by time and geography because of digitalization. As a result, researchers are looking into digital innovation management more and more. Prior research has emphasized how digital technologies impact individuals or organizations that act as innovation agents (Usman et al., 2024; Shamsuddin & Raza, 2025; Shah et al., 2024).

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According to Usman et al. (2024), because of the unique organizational setting, open innovation can be one of the most significant and long-lasting sources of competitive advantage for businesses. Because of this, research on the subject is very pertinent to practice and crucial to understanding sustainable competitive advantage, a crucial area of study for strategic management and other academic fields. Additionally, several studies have been conducted to determine the connection between the open innovation model and competitive advantage (Farida & Setiawan, 2022), organizational approach (Lima Rua et al., 2023), and business risk handling (Azeem, Ahmed, Haider, & Sajjad, 2021). Nonetheless, dynamic capabilities identify a company's ability to handle the challenges brought forth by the tactics it uses to adapt to changes in its environment (Clauss et al., 2021; Kahil, 2025). To gain a competitive edge through open innovation, an organization must recognize and comprehend new technological trends and broaden its technological expertise. According to Lima Rua et al. (2023), businesses must create new competitive advantages to stay ahead of the rapid changes in technology, consumer needs, and international competition.

By combining different subjects' expertise, knowledge coupling refers to the advancement of technological innovation through cooperative engagement (Usman et al., 2024). According to this viewpoint, the degree of knowledge coupling in the form of innovation is a crucial factor (Chen et al., 2024), and it invariably influences how well technological innovation operations perform. The majority of previous research focuses only on the role of knowledge coupling in technological innovation (Huang et al., 2022; Jin et al., 2022), and it is uncommon to examine the mechanism of knowledge coupling from the standpoint of varying interacting the magnitudes under various connections of cooperation, despite some studies finding that knowledge coupling is a key factor in technological innovation and demonstrating that the coupling between numerous academic fields can lead to new discovery of knowledge and, thus, innovation (Ba & Liang, 2021; Chen et al., 2024).

Integrating outside concepts, information, and experience into a company's innovation process is known as open innovation. According to Peris-Ortiz, García-Hurtado, and Román (2023), OI is a concept utilized to improve the performance of creative processes. A company's internal capability is also reflected through open innovation practices (Bocquier et al., 2023). It is common for businesses to draw inspiration from both internal and external sources. It signifies a shift to more flexible and open methods of creation and serves as a catalyst for long-standing companies to innovate and compete on platforms that are already thriving (Huang et al., 2022).

The literature supports the necessity and originality of the present study. Given that open innovation plays a critical role in achieving this objective, our study thus responds to the request of certain academics to find fresh and practical approaches to enhance the firm's capacity for innovation to attain competitive advantage (Chen et al., 2024). Although still underexplored in the literature, the idea that the open innovation model becomes a strategic component of innovation management has expanded its application and discussion within educational institutions (Castillo López, Llorens Montes, Braojos Gómez, et al., 2021).

By focusing on the comparatively understudied connection of knowledge coupling and open innovation in the context of knowledge exploitation and knowledge exploration, this study seeks to address this crucial research gap and contribute to the body of current literature on innovation management. Although these components have been studied separately in the past, few studies have investigated how they are related to one another. Therefore, the purpose of this study is to empirically show how open innovation enhances knowledge exploration and exploitation. Furthermore, while most prior research focuses on larger and more developed economies, this study closes a significant gap by examining teachers in Bahraini schools within a rapidly developing countries (Usman et al., 2024), providing valuable data specific to these contexts. By including a dynamic capacity that aids companies in proactively aligning their innovation processes with new market trends, this study builds upon the firm's KBV (Usman et al., 2024). This approach deepens the understanding of how knowledge coupling and forecasting, particularly in quickly evolving technology-based sectors, may promote open innovation and knowledge expansion and exploration outcomes.

LITERATURE REVIEW

This study investigates the notion of knowledge-based view theory, which is based on the knowledge of an organization as the key asset of the organization. Knowledge based view theory posits that the firm's ability to effectively create, integrate and utilize information is a key factors in knowledge exploitation, knowledge exploration, and ultimately competitive advantage (Pereira & Bamel, 2021). The firms KBV investigates the importance of using both knowledge exploration and exploitation for the growth and advancement of open innovation (Huang et al., 2022). Open innovation creates both knowledge exploration and exploitation by giving organizations access to knowledge . By interacting with external knowledge bases of suppliers, customers, learning institutions, and schools, businesses can increase their ac-

cess to ideas, technologies, and market knowledge (Martin & Javalgi, 2019). By working with other organizations can help the experience from the partners and reduce time, costs and developing new opportunities, while increasing the likelihood of success for their firm. Such external knowledge supports internal R&D, because it addresses skill shortages in the firms while speeding up the innovation process. For example, Skordoulis et al. (2020), state that organizations that deal with open innovation have a stronger ability to combine internal and external knowledge, creating more innovative

and effective product solutions.

The conceptual model shows the relationships among open innovation, competitive advantage, and knowledge exploration and exploitation (Figure 1). This model shows how knowledge coupling facilitates knowledge exploration and exploitation and mediating role of competitive advantage. It also shows that open innovation improves the competitiveness of organization and enhance knowledge exploration and exploitation.

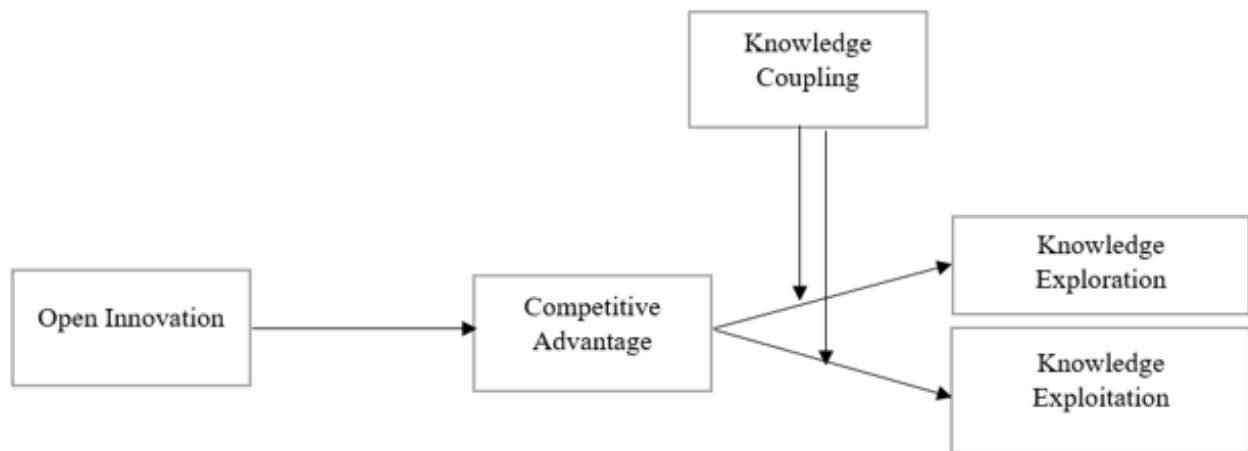


FIGURE 1. Conceptual model

HYPOTHESIS DEVELOPMENT

Open Innovation and Competitive Advantage

Scholars and practitioners are paying more attention to the open innovation paradigm because of growing competitiveness and reliance on outside partners. The notion of open innovation has not been standardized in the literature, despite growing interest in the concept of "openness" in academics. According to Usman et al. (2024), there are three main components to the open innovation process: Outside-in, inside-out, and connected. Whereas the outside-in process typically predominates, these processes can occasionally complement one another. From an outcome's standpoint, open innovation means that both internal and external creative ideas are treated equally to deliver innovation to customers as quickly and cheaply as possible, and that high-quality technical solutions can be found both inside and outside the company (Chen et al., 2024). As a result, the open innovation paradigm proposed by Zhang et al. (2023) is adhered to. The term "open innovation" describes an innovation paradigm that intentionally combines business resources and competencies with resources obtained from outside sources, creating market potential through a variety of means.

According to Lima Rua et al. (2023), open innovation methods help businesses break through barriers and capitalise on knowledge resources that flow in and out in a planned manner. As a result, they give them a long-term competitive edge in the following areas. First, according to the KBV, acquiring, integrating, and using knowledge is a company's primary responsibility. For businesses to remain competitive over the long run, knowledge is a crucial resource (Johnson et al., 2022). Innovation components can be combined and differentiated through the internal and external movement of resources, technology, and knowledge to speed up innovation and lower its risk and expense (Jin et al., 2022). Furthermore, a company's own weaknesses can be compensated for, the resource base for innovation can be enhanced, innovation output can be increased, and new markets can be opened through the efficient integration of knowledge, information, and capital in the external environment (Huang et al., 2022). Lastly, from the standpoint of the companies external network, businesses can find greater opportunities for growth and development chances by searching through the resources of the network's participants, gaining important social capital from the outside innovation network (Farida & Setiawan, 2022). Businesses can over-

come their own technology constraints and gain a competitive edge by leveraging possibilities and technological benefits from external networks (Wen et al., 2021). Clauss et al. (2021) and Wen et al. (2021) provide an accurate, thorough, and up-to-date picture of the significance of an organization's preparedness to innovate through open innovation. They also conduct a detailed examination of how open innovation affected by competitive advantage. They talked about how to incorporate open innovation in policy plans to improve competitiveness of organization. Azeem et al. (2021) assert that strategy, quality control, and innovation capacity are all favorably connected with competitive advantage. After conducting a thorough analysis, Chen et al. (2024) and Skordoulis et al. (2020) discovered a correlation between an organization's competitive advantage and its strategy.

Additionally, open innovation allows companies to use iterative product development, which continuously integrates outside input into the product development lifecycle to create products that better meet consumer needs and preferences (Clauss et al., 2021; Farida & Setiawan, 2022). This collaborative approach reduces the financial strain on individual companies while simultaneously enhancing the innovation process's overall resilience. For example, Lima Rua et al. (2023) suggest that open innovation makes it possible for companies to share advancement risks and work together on funding, which leads to more sustainable innovation processes. Furthermore, businesses can assess early product concepts with outside partners' assistance, reducing the likelihood of costly failures in later stages of knowledge exploration and exploitation (Azeem et al., 2021; Miotto, Del-Castillo-Feito, & Blanco-González, 2020; Usman et al., 2024). Consequently, the following hypothesis is proposed:

H1: Open innovation has direct impact on competitive advantage.

Mediating Role of Competitive Advantage

Optimizing the company's exploration and exploitation plan is necessary to get a competitive edge. A firm's unique assets and competencies are essential to establishing a competitive edge, offering several explanations for its competitive dynamics that create a chance for distinct strategic approaches. Zhang et al. (2023) concluded that "some organizational capabilities can be valuable sources of competitive advantage in industries." These radical breakthroughs have the potential to disrupt long-standing company structures Distanont (2020), increasing the likelihood that the company may reject new technology or drastically different goods that come from exploratory approaches. However, exploration efforts enable the company to create new sources of competitive ad-

vantage in addition to identifying shortcomings and failures in current business operations (Miotto et al., 2020). One of the main issues with exploratory activities is that it's never obvious how much of an impact they will have. Since there is a good chance of making money from incremental product innovation, this is not the case with exploitation (Skordoulis et al., 2020). Policies, procedures, and tasks are rarely standardized or formalized, and exploration activities are typically decentralized. In addition to the high level of risk and uncertainty, personnel must accept the possibility that certain exploratory procedures will fail (Azeem et al., 2021). Exploration aims to develop a broad body of knowledge in a variety of subjects, whereas exploitation concentrates on producing substantial understanding in a small number of domains.

The innovation process is critical for institutions to maintain their competitiveness and grow knowledge exploration and exploitation. Many researchers have examined innovation based on resources, accessibility and application (Usman et al., 2024). Past studies have established innovation as either exploratory or exploitative depending on how close their technology, goods and services. By examining and obtaining new and understanding resources and technologies, exploratory innovation aims to produce variations. Peris-Ortiz et al. (2023), state that exploratory knowledge includes ideas such as flexibility, risk-taking and experimentation. The amount of primary knowledge will restrict the capacity to acquire new knowledge that supports the process of innovation through inquiry. For example, open innovation can assist companies in developing new product categories, entering new markets, or offering value-added services to complement their existing product lines (Clauss et al., 2021; Pereira & Bamel, 2021). Maintaining long-term competitiveness in a global economy that is becoming more integrated and competitive requires the ability to innovate across multiple domains.

Businesses use their keen and continuously improved knowledge of the market through centralization and increasingly standardized and formalized procedures and duties. Organizational traits of exploitation include low risk and strong employee commitment to achieving short-term goals (Ting, Juan, Darun, Yao, & Kweh, 2020). Exploration seeks more adaptability and the discovery of new information, whereas exploitation promotes efficiency, improvement, and summarization across the board. The foundation of the Resource-Based View (RBV) is the idea that enterprises can obtain a competitive edge by utilizing strategic resources (Bocquier et al., 2023; Pereira & Bamel, 2021). When resources are used to carry out a business function,

they transform into capabilities. One of the most important precursors of a company's competitive advantage is innovation. According to Usman et al. (2024), open innovation techniques will help businesses gain a competitive edge by enhancing their dynamic capabilities; as a result, the value proposition of the business will shift. Open innovation and competitive strategy, at different intensities, have been demonstrated to be positively correlated by empirical research (Azeem et al., 2021; Usman et al., 2024). Therefore, we propose the following concepts:

H2: Competitive advantage has mediating impact between open innovations and knowledge exploration.

H3: Competitive advantage has mediating impact between open innovations and knowledge exploitation.

Moderating Role of Knowledge Coupling

The process of knowledge coupling leads to innovation (Huang et al., 2022). Jin et al. (2022) divided knowledge cross-border searching into two categories "architectural knowledge coupling searching" and domain knowledge searching. Together, these form a system dynamics model. The study found that technological resources and digital dynamic capabilities have a beneficial impact on the "knowledge coupling" mechanism, which influences a company's innovation outcomes. Chen et al. (2024) examined at how network cohesiveness and "knowledge couplings" can boost innovation performance. The process of knowledge coupling leads to innovation. Usman et al. (2024) divided knowledge cross-border searching into two categories "architectural knowledge coupling searching" and domain knowledge searching. Together, they produced a "model of system dynamics." The study found that technological resources and digital dynamic capabilities have a beneficial impact on the "knowledge coupling" mechanism, which influences a company's innovation outcomes.

Knowledge is a company's greatest strategic asset, according to the knowledge base view. One efficient method of integrating knowledge across organizational boundaries is through inter-company collaboration (Gonzalez & de Melo, 2018). The company's collection of knowledge elements and the connections between its many knowledge domains make up its knowledge base. Rearranging knowledge components inside the knowledge base is a component of innovation (Ritala, Osiyevskyy, & Shirokova, 2020; Jam, Singh, Ng, & Aziz, 2018). Businesses can establish technical differentiation by taking use of various connections between knowledge aspects. Physics is where the idea of "coupling" first appeared. Coupling highlights the level of reliance and interaction between systems or parts in organizational man-

agement (Pereira & Bamel, 2021). According to Bocquier et al. (2023), KC is the extent to which knowledge components from several domains are combined, or it can be described as a dynamic, complimentary connection with fit characteristics. Businesses use exploration tactics to find new market opportunities, determine client demands, or generate new demand by predicting future wants.

According to Peris-Ortiz et al. (2023), the focus of exploration is on disruptive innovation processes, goods, and technology. Exploration includes the quest for new discoveries and unexplored talents because it enables businesses to build and gain knowledge and information from any angle of their environment (Chen et al., 2024; Mohan, 2024). New knowledge is obtained via cooperation and communication with other people, businesses, and partners. This leads to creativity and, eventually, radical ideas (Farida & Setiawan, 2022; Huang et al., 2022). Exploitation is defined as the process of continuously improving current goods and services through small-scale innovation. Businesses engage in exploitation operations to adapt to market demands by making small adjustments to current practices, goods, and technologies (Wen et al., 2021). By making small adjustments, exploitation enables businesses to maintain current procedures while boosting resource efficiency and cutting expenses (Johnson et al., 2022). By updating current products and services, utilizing existing knowledge while boosting productivity, reducing failure, and continuously growing existing knowledge, this helps businesses to remain competitive and consistently meet expectations (Pereira & Bamel, 2021; Zhang et al., 2023). Consequently, the following hypothesis is proposed:

H4: Knowledge coupling has moderating relationship on competitive advantage and knowledge exploration.

H5: Knowledge coupling has moderating relationship on competitive advantage and knowledge exploitation.

METHODOLOGY

Sampling and Data Collection

The links between open innovation, competitive advantage, knowledge coupling, and knowledge exploration and exploitation were examined in this study using a quantitative methodology. A questionnaire containing validated scales from the body of existing research was used to gather data to guarantee the validity and reliability of the measurements. Purposive sampling was employed to speed up the data collection process, with an emphasis on Bahraini school teachers. A longitudinal approach was used for data collection in three waves, in 1st wave researcher gathered baseline information from participants, in 2nd wave data collected

from related variables IV (open innovation) and DV (knowledge exploration and exploitation) and in last wave data collected from related variables mediation (competitive advantage) and moderation (knowledge coupling). Data from 278 school instructors in total were gathered, and they underwent thorough analysis using SEM, where the firm is the unit of analysis. Because SEM can evaluate intricate correlations between several characteristics at once, it was deemed suitable for analysis and a good fit for verifying the study's hypotheses.

Measures

A 5-point Likert scale is used in an online survey to collect data. However, open innovation was measured five item scale adopted by Hung and Chou (2013). Sample items include "In our firm, for our new product development, we constantly scan the external environment for inputs such as technology, information, ideas, knowledge" and "In our firm, for our new product development, we actively seek out external sources (e.g., research groups, universities, suppliers, customers, competitors, etc.) of knowledge and technology when developing new products". Competitive advantage was measured five item scale adopted by Mahmood and Hanafi (2013). Example item "our response to competitive moves in the marketplace is good" and "Our ability to track changes in customer needs and wants is good". A four-item scale was measured knowledge coupling by Huang et al. (2022). Items include "new knowledge acquired by our company can be continuously matched to complete the knowledge system" and "our company can acquire new knowledge through agent interaction to support technological innovation". Knowledge exploitation was taken 3-item scale

adopted by Gonzalez and de Melo (2018). Example items include: "Employees use their knowledge and skills in incremental improvement activities and problem-solving" and "Employees use their knowledge and skills in order to solve problems". Knowledge exploration was taken 3-item scale adopted by Gonzalez and de Melo (2018). Example items include: "The Company invests in the research and development of new technologies to improve or develop products/processes" and "the company can easily introduce new technologies into its processes or products without significant resistance to change".

RESULTS AND ANALYSIS

Reliability, Validity and AVE of Measurement Model

The measurement model was evaluated using convergent validity, composite reliability, Cronbach alpha and AVE. Initially, each construct's indicator factor loadings were examined. Strong concordance between the indicators and their corresponding constructs was indicated by the loadings of all constructs, which were determined to be greater than 0.70 and within acceptable bounds (Hair et al., 2024). Cronbach's alpha was then used to evaluate the constructs' internal consistency, and all values were higher than the acceptable cutoff of 0.70, as advised by Hair et al. (2024). The Composite Reliability (CR) values for each construct were subsequently examined, and the results showed that they were substantially higher than the recommended cutoff of 0.70, as recommended by Hair et al. (2024). However, when convergent validity was assessed using the Average Variance Extracted (AVE), all constructs had values above the suitable cutoff of 0.50. The results of this analysis is shown in Table 1.

TABLE 1. Results of measurement model

Constructs	Cronbach Alpha	Composite Reliability	AVE	Mini. Loadings
Competitive Advantage	0.899	0.926	0.714	0.766
Knowledge Coupling	0.892	0.925	0.756	0.795
Knowledge Exploitation	0.919	0.949	0.860	0.924
Knowledge Exploration	0.897	0.936	0.830	0.881
Open Innovation	0.826	0.878	0.591	0.717

Discriminant Validity

The structural model's validity depends on each construct representing a distinct and sufficiently unique concept from other constructs, which is ensured by discriminant validity. The HTMT (Heterotrait-Monotrait) values and the Fornell-Larker criterion was used to test for and demonstrate that

discriminant validity had been attained. The open innovation AVE was assigned a distinctive role as a forward-looking ability required in the innovation of knowledge, and its square root of 0.90 was indeed greater than its correlations with any of the other constructs (Hair et al., 2024). The results of the Fornell-Larcker are presented in Table 2.

TABLE 2. Results of discriminant validity

	1	2	3	4	5
Competitive Advantage	0.845				
Knowledge Coupling	0.529	0.869			
Knowledge Exploitation	0.632	0.750	0.927		
Knowledge Exploration	0.718	0.766	0.707	0.911	
Open Innovation	0.649	0.470	0.406	0.474	0.769

HTMT

In addition, the HTMT values presented in Table 3, demonstrate the discriminant validity of the variables in the model of this research. HTMT values lower than .85 demonstrate acceptable discriminant validity, which strongly implies that

the constructs are different enough for their definition to be understood according to Hair et al. (2024). The current study had all HTMT significantly below the conservative cut-off point of .85, indicating that the constructs were statistically enough for a discriminant validity determination.

TABLE 3. Results of HTMT

	1	2	3	4	5
Competitive Advantage					
Knowledge Coupling	0.593				
Knowledge Exploitation	0.695	0.817			
Knowledge Exploration	0.800	0.807	0.776		
Open Innovation	0.749	0.548	0.458	0.547	

Direct and In-direct Hypothesis Testing

The findings of the structural model show connections between knowledge coupling, open innovation, competitive advantage, and knowledge exploration and exploitation. These connections highlight the different levels of influence these components have in addition to highlighting their significance in innovation. The result shows that open innovation has positive and significant impact on competitive advantage

($t = 25.429, p = 0.000$). Also, a significant mediating role of competitive advantage between open innovation and knowledge exploitation ($t = 7.242, p = 0.000$) and knowledge exploration ($t = 13.504, p = 0.000$). Therefore, a significant moderating role of knowledge coupling on competitive advantage and knowledge exploitation ($t = 3.543, p = 0.000$) and knowledge exploration ($t = 5.382, p = 0.000$).

TABLE 4. Result of direct and indirect hypothesis

Relationships	Path Coefficient	Mean	Standard Deviation	<i>T</i> Value	<i>p</i> Value
Open Innovation -> Competitive Advantage	0.649	0.651	0.026	25.429	0.000
Open Innovation -> Competitive Advantage -> Knowledge Exploitation	0.282	0.282	0.021	13.504	0.000
Open Innovation -> Competitive Advantage -> Knowledge Exploitation	0.212	0.213	0.029	7.242	0.000
Knowledge Coupling * Competitive Advantage -> Knowledge Exploration	0.235	0.234	0.044	5.382	0.000
Knowledge Coupling * Competitive Advantage -> Knowledge Exploitation	0.168	0.169	0.047	3.543	0.000

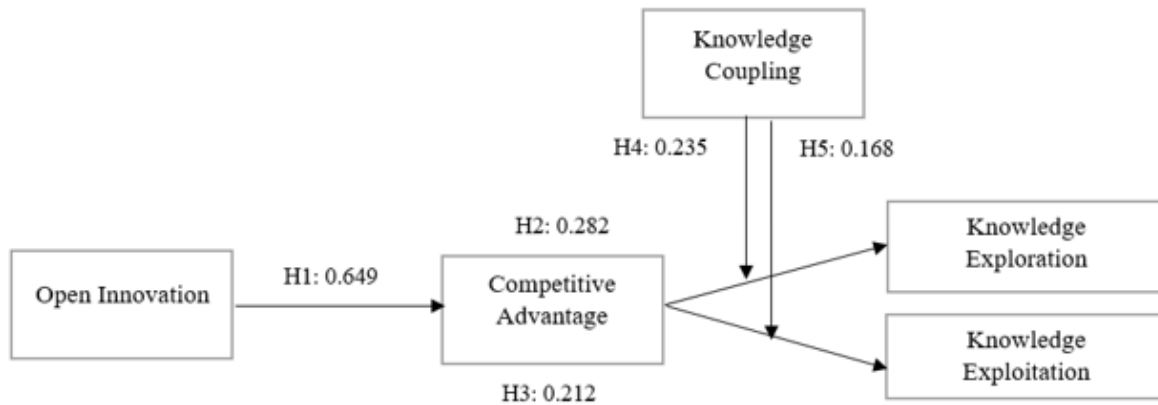


FIGURE 2. Structural model

DISCUSSION

The current study's findings are consistent with other studies, showing that open innovation greatly enhances knowledge exploitation and exploration. But this study adds to the body of research by presenting empirical proof that open innovation practices and knowledge coupling as a moderator increase the efficacy of knowledge exploration and exploitation, which in turn improves the mediating effect of competitive advantage. This study emphasizes the crucial role of open innovation as an approach for incorporating outside information sources into internal knowledge coupling, thus enhancing the synergy between knowledge exploration and exploitation to achieve open innovation, in contrast to earlier research that stressed the importance of striking a balance between exploration and exploitation (Johnson et al., 2022; Wang, Wang, & Fujita, 2020). In order to develop and retain innovative technologies that provide them a competitive edge, businesses must broaden their technical expertise base and recognize and comprehend trends in new technologies (Lima Rua et al., 2023; Skordoulis et al., 2020). By combining knowledge, technological expertise, creativity, experience, and expansion through the introduction of novel concepts in creative products, procedures, and business models, a sound strategic strategy enables businesses to create a sustained competitive advantage. Both the organization and the economy gain from these insights (Clauss et al., 2021). The results indicate that open innovation has a substantial, favorable, direct, and indirect impact on competitive advantage. These results are in line with a number of earlier research that emphasis and validate the advantages of open innovation (Farida & Setiawan, 2022; Huang et al., 2022; Jin et al., 2022). Prior studies by (Chen et al., 2024; Zhang et al., 2023) have emphasized the critical role that open innovation plays in fostering knowledge exploitation and exploration, especially in the area of competitive advantage. The

current study supports the conclusions of existing studies and offers fresh information by showing that open innovation combined with competitive advantage improves the results of knowledge exploration and exploitation. Open innovation enables businesses to more accurately predict future market trends, locate pertinent external knowledge sources, and successfully apply these insights, bolstering recent efforts to match innovation strategies with consumer needs.

By offering distinctive resource combinations, exploration enables businesses to develop distinctive goods and services that capitalize on new market opportunities. Additionally, it aids businesses in addressing the flaws in current procedures (Clauss et al., 2021). Businesses' capacity for innovation is increased when new information is created and acquired through exploratory activities (Farida & Setiawan, 2022; Wen et al., 2021). Despite the high risk and frequent failure of exploratory efforts, successful outputs are likely to be described as radical innovations (Castillo López et al., 2021). Since radical innovation satisfies the requirements of value and rarity for competitive advantage, it suggests that a company is ahead of its rivals and can take advantage of new product-market opportunities. Conversely, exploitative practices are more cost-effective and output-maximizing procedures used by businesses. It includes the continuation and expansion of previously effective product-market combinations as well as the predictable, incremental improvement of current products and competencies. Compared to explorative activities, exploitative processes provide quantifiable outcomes considerably more quickly (Ritala et al., 2020). Because it enables businesses to produce goods with a higher perceived quality (Osiyevskyy, Shirokova, & Ritala, 2020) at lower prices than their rivals due to increased cost-efficiency (Wen et al., 2021) evidence suggests that exploitation is a performance driver (Farida & Setiawan, 2022). Additionally, exploitation allows businesses to adopt a cost-leadership ap-

proach. According to the knowledge base view, a company's most asset is its knowledge. The sharing and exchange of knowledge is at the heart of business-to-business interactions. A high KC indicates that businesses can effectively synergize the knowledge aspects between the agents who engage and have a great potential to integrate exploration and exploitation knowledge. Exploration and exploitation are thus possible for KC (Chen et al., 2024; Jin et al., 2022; Usman et al., 2024).

Theoretical Implications

This study extends the firm's KBV in several significant ways that advance the theoretical knowledge of innovation management. Important gaps in existing research are filled by this investigation. It draws attention to the crucial part that open innovation plays in pursuing a competitive edge; this is seen as a major source of innovation and is mentioned in several studies with an educational focus. Ultimately, using Partial Least Squares-Structural Equations Modelling (PLS-SEM), this study offers a thorough examination of the psychometric qualities of the latent variables in the structural model. To produce a more reliable analytical measurement tool, the study model makes use of many scales. It displays how the independent and dependent variables follow different paths. A novel perspective on how businesses might effectively position themselves to achieve a competitive advantage is provided by the combination of exploitation as an innovation approach to boost a firm's competitive advantage. Thus, by offering an expanded model for the context of the instructors in Bahraini schools, our work adds to the body of literature on knowledge-based view theory (Wang et al., 2020). Additionally, this study adds to the body of research on knowledge coupling by demonstrating that open innovation will be especially advantageous for businesses that pursue exploration and exploitation (Jin et al., 2022). Nonetheless, the findings support the claim that exploration even boosts a company's competitive edge, which is quite interesting new data. Even though exploration operations take a lot of time, it is true that businesses can position themselves ahead of their competitors with excessive, new expertise in technology, open innovation, competitive advantage, and new ways of gaining fresh clients and increase the fulfillment of current ones. This study empirically demonstrate that the development of new combinations and modifications to knowledge domains lead to creativity. By separating couplings between existing domains from the recently discovered couplings, focusing on knowledge couplings enhances the comprehension. They behave differently; therefore, this segregation is relevant. By utilizing these poten-

tial advantages and assets internally, open innovation helps businesses become more aware of their surroundings and take advantage of the potential resource pools that exist inside their networks. Consequently, open innovation is made possible by the firm's ability to access technological advances and skills through partnerships with other businesses, which aids in its successful implementation.

Practical Implications

Approaches, plans, and programs to enhance school activities in the educational sector can be developed with the help of this research. Top management will be able to enhance knowledge exploitation and exploration to support school teachers' plans for Bahrain if they have an in depth knowledge of how open innovation and competitive advantage relate. This study finds that enterprises' competitive advantage benefits from an exploratory mindset. Managers can therefore evaluate their capability for exploration. This information could provide competitive advantages without additional strategic adjustments if they are mostly exploratory. However, things can be different if a company's main function is exploitation. Since strategic orientations are ingrained in the organizational mission and culture, it has been demonstrated that altering them is challenging and time-consuming (Castillo López et al., 2021). As a result, switching to an exploration approach may be challenging or even difficult. The ability of the company to sustain and grow external relationships is the first crucial enabler that explains higher levels of success, even though there is general evidence for the beneficial benefits of open innovation on competitive advantage. Managers must concentrate on innovation in tandem with their knowledge exploitation and exploration since partnerships take time to build. In this context, relational capability can be thought of as the "net" that can be thrown to gather environmental inputs. Open innovation projects are less likely to succeed if a large and effective "net" has not been established. They must first gain knowledge about how to start a relationship, which includes finding and getting in touch with reliable and promising companions. However, they must enhance their interpersonal abilities, including their ability to collaborate, negotiate, and solve problems. Lastly, they must be fully aware of the goals they hope to accomplish through working with other businesses, such as cutting costs or expediting deliveries. Additionally, educational institutions and colleges are becoming more aggressive in releasing their intellectual property by creating new goods and services, which will give businesses that use them a stronger competitive edge. In the end, the findings of this study will enable national, regional, and local governments

to develop programs, regulations, and incentives to support businesses in implementing or expanding the open innovation model to improve the knowledge exploitation and exploration.

Limitations and Future Research

There are several limitations to this study that could be fixed in subsequent research on the subject. Initially, the sample frame for this study is restricted to Bahraini school teachers. It is highly recommended that more research be conducted globally to increase the generalizability of the current findings. Furthermore, although the measure of resource slack as a stand-in for flexibility followed a recognized methodology, the intricacy of slack-related discoveries keeps increasing. The results of this study indicate a new, intricate moderating effect that was not supported by previous studies. Therefore, more research is necessary to address the problem of nonlinearity, especially regulated nonlinearity. Following that, some measurements may be limited using survey data. Problems with common method bias were reduced by supplementing these data with secondary data for the performance measure and other important variables and controls, but as with all research, the findings should be interpreted appropriately. Additionally, the phenomenon of open innovation is complicated. Although this study captures important enabling and facilitating elements,

other effects might affect how effective it is as a means of exploring and exploiting information. Lastly, open innovation may change over time, as may its ramifications and environmental impacts. With time-series or longitudinal techniques, more could be discovered about this significant phenomenon.

CONCLUSION

The study examined how open innovation affected competitive advantage when knowledge coupling was present regarding Bahraini school teachers.

The study's conclusions show that open innovation is essential for gaining a competitive edge. Open innovation is a practical strategy for outperforming rivals, according to several research on the connection between open innovation and competitive advantage. The study's findings are consistent with earlier research that proposed using open innovation tactics to get a competitive edge and improve knowledge exploitation and exploration. By combining different perspectives and technologies, organizations may stay ahead of the competition by tackling challenging problems and reacting to market developments faster. The results align with those of other research investigations. How well a business uses open innovation to boost its competitiveness depends on how effectively it integrates exploitation and exploration knowledge.

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