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Co-Operative Learning and Resilience to COVID-19 in a Small-Sized South African Enterprise

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Abstract: Constraints imposed by the shrinking resources and the climate change dynamics necessitate a behavioral change to increase knowledge exchange and optimize resource utilization. Existing entrepreneurship and innovation practices are therefore undergoing transformation to adapt production systems to the post-COVID-19 reality of increased risks of calamities within a context of shrinking resources. This paper uses a knowledge-centered crisis management framework to examine how enhanced knowledge sharing through co-operative learning can be applied to induce higher innovation performance and more efficient resource utilization structures during crises comparable to the current pandemic. Using the collaborative learning experiences of a small enterprise producing ecological fertilizers, this study was able to link crisis resilience enhancement to increased knowledge exchange between business entities connected through the agro-ecological value chain. New insights generated through the co-learning process were found to constitute a key input for strengthening the required capability endowments that enable the organization and its partners to weather the COVID-19 crisis and lay the foundation for the sustainability of post-COVID-19 operations.

Keywords: co-operative learning; sustainable innovation; crisis resilience; knowledge management strategies



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1. Introduction

The outbreak of the COVID-19 pandemic represents not only a formidable health crisis affecting millions across the world, but also a considerable threat to the global economy and its usual operating methods ([1]). Despite measures taken by governments throughout the world to support businesses and protect employment, many small-sized enterprises have been forced out of business because of prolonged constraints put on their operations ([2]). For many enterprises, survival under the severe economic and public health conditions of this pandemic has been a tough task, whereby knowledge-based management skills and quick adaptation became determining factors for crisis resilience.

Consequently, adaptive behavior and flexible application of emerging knowledge are critical to the strategy of addressing organizational and community demands in order to cope with the disruptions caused by this uncommon health crisis ([3–5]). The quality of an organization's response to crisis is a function of its capacity to use emerging knowledge that increases improvisation capacity, coordination, flexibility, and endurance ([6]). As a crucial process for enhancing organizational performance, knowledge management plays a central role in the formulation of strategies to ward off the disruptive dynamics of crises ([6–8]). But how do small business enterprises optimize knowledge management to survive when faced with operating constraints such as the effects of a COVID-19 lockdown? Overcoming the challenge of a massive crisis with limited enterprise resources requires an adaptive learning approach and a close co-operation between the knowledge-producing units (specialized research units within firms or external institutions) and users (resilient businesses), because the production and dissemination of knowledge is embedded in a social system ([9,10]).

Knowledge management scholars have suggested that the intensification of knowledge sharing plays a crucial role in mitigating the harmful effect of exogenous crises on business organizations ([6,11–13]). The ability of a business organization to deal with the disruptions caused by crises is indeed considerably enhanced by the development of a shared understanding among crisis management teams ([14,15]). Collaborative efforts are important because they facilitate the marshalling and the mobilization of external resources needed to strengthen organizational capacity to respond to crises ([16–18]).

A thorough understanding of strategic choices that managers can use to foster crisis resilience is crucial for predicting the survival of small business in times of prolonged strain on their operations, such as the ongoing COVID-19 pandemic. The survival of firms is in turn crucial to employment protection and economic recovery in the wake of the crisis. Responding to crisis disturbances with the command-and-control approach presents inherent limitations because of the multiple unknowns about the virus propagation and the difficulties of enforcing behaviors that considerably constrain human freedoms ([6,19–21]).

In the crisis management literature, Williams et al. ([6]) suggested five key capabilities that define the ability of organizations to adequately deal with crises and build resilience to future crises, comprising financial, cognitive, behavioral, social, and relational endowments available to them. Each of these endowments has a bearing on the way organizations survive when faced with external threats and develop the capacity to prepare for future ones. The aim of this study is to investigate how a small-sized South African enterprise used the co-operative learning strategy to activate the main capability endowments that helped it to weather the COVID-19 crisis together with its business partners. Using a qualitative analysis of key informant interview responses, this study sought to assess the role of co-operative learning participation in strengthening the five core capability endowments that are essential to the resilience of business organizations to disruptive crises. The analysis presented here is based on the argument that when traditional methods of knowledge generation and exchange are put under the strains of restrictive safety measures, increased co-operation in adaptive learning and knowledge production is key to enhancing the crisis resilience of business enterprises.

In seeking to understand the theoretical foundations of the channels through which co-operative learning enhances enterprise resilience to crises, we draw on two main strands of literature that deal with how organizations respond to crises: knowledge management theories applied to crisis management (e.g., [6,11,12]) and resilience literature (e.g., [6,16–18,22]). The co-operative learning approach, which plays a key role for bridging the cognateness gap between business partners, contributed to the generation of new knowledge and practices that were deployed to respond to the crisis in a flexible and adaptive way ([23]). It also facilitated the mobilization and sharing of organizational resources by increasing the level of trust among participating entities through repetitive interactions ([10,24]). The behavioral change, which contributes to strengthening the behavioral capacity endowment, follows from the learning experiences and the concomitant adaptation to the changing environment as the cognitive endowment and the analysis capacity is enhanced ([3]). Likewise, the relationship between co-operative learning and relationship capacity endowment can be derived from the social interdependency theory underlying the philosophy of co-operation in learning as opposed to competition ([25,26]).

The process of knowledge sharing, which underpins organizational knowledge management, is embedded in, and shaped by, the learning capability of individuals and organizations. Learning is a predominantly interactive process and is therefore socially embedded in its institutional and cultural contexts. In order to optimize learning outcomes, collaborative learning in interactive spaces is suggested as a clever perspective in understanding resilience dynamics and the ability of affected entities to develop specific responses to the disruptive crisis trigger and ultimately engage in transformative strategies that capitalize on the changed conditions [27].

As a primary source of crisis management strategy, Elsubbaugh et al. [28] and Wang [29], among many others, considered knowledge sharing and adaptive learning

to be critical to the building resilience of organizations to crises because of the strategic importance that knowledge plays as an organizational resource [30]. Knowledge generation and management is also at the core of the five key capability endowments that shape organization resilience ([6,31]). In addition to internal knowledge sharing within each organization, the benefits of external knowledge sharing for dealing with crises have been underscored by Nishiguchi and Beaudet [31], who suggested holding social activities that involve face-to-face contacts among each organization's employees and those of its business partners as a powerful means to facilitate a collective response to the crisis. The type of collaborative structure for knowledge exchange needed to adapt to sudden changes in the operating environment during times of crises such as the ongoing COVID-19 pandemic is less clearly covered by this strand of literature.

This paper is therefore an attempt to examine how co-operative learning as a knowledge management tool contributes to the mitigation of the negative effects of the crisis on business operations. Supporting organizational efforts to strengthen key capability endowments they need to build crisis resilience organization learning is indeed an essential tool of crisis management. The current study contributes to extant debates on knowledge exchange to enhance organizational performance by shedding light on the practical application of co-operative learning at the interface of knowledge exchange between value chain business partners in the context of developing adaptive resilience to an exogenous disturbance of the magnitude of the current pandemic. It provides additional evidence of the use of co-learning to overcome capacity constraints and tackle common challenges resulting from the destabilizing effects of the crisis.

The rest of the paper is structured as follows: The next section presents the empirical findings of the application of co-operative learning between a small-sized enterprise (based in the Western Cape province in South Africa) and its business partners to shape crisis resilience mechanisms and prepare the required transformation to operate under changing conditions in the post-COVID-19 era. The third section discusses the results of the deployed co-operative learning strategies. The final section provides recommendations for increased knowledge sharing through the intensification of co-learning experiences for better crisis-adjustment outcomes.

2. Materials and Methods

2.1. COVID-19 Crisis and Its Disruptive Impact on South Africa

The first case of COVID-19 infection in South Africa was reported on 1 March 2020 and confirmed on 5 March 2020 by the Minister of Health. The first contamination in the Western Cape province was confirmed on 11 March 2020. On 23 March 2020, a lockdown was announced for the whole national territory, with a stay-at-home order going into effect on 27 March 2020, with an initially expected duration of three weeks (i.e., until 16 April 2020). All non-essential activities were put on hold, with a total interdiction on the sale of tobacco and alcohol throughout the country. With the scarce knowledge on the virus transmission that was available at the time, hygiene and safety measures were recommended to the population, especially on social distancing and regular hand sanitization. After the initially expected three weeks of lockdown expired, it had become clear that the danger was not over. The government therefore decided on an extension of the lockdown period and developed a risk-adjusted strategy for a progressive ease of the stringent lockdown measures starting from 1 May 2020. Because of the disruptive effects that the imposition of a stringent lockdown would have on the economy, President Cyril Ramaphosa announced a ZAR 500 billion stimulus package to help businesses resist the crisis by being granted access to financial assistance that would help them stay afloat and protect employment (see Table 1). By 1 May 2020, South Africa had entered its first phase of risk-adjusted easing of restrictions (The country moved from risk alert level 5 to alert level 4 on a risk scale of 1 to 5, with level 1 representing the lowest risk level above total elimination of the virus threat), allowing economic activities to resume under strict hygiene and safety rules in a limited number of sectors with the lowest risk of contagion. Despite the

increasing number of contaminations, the mortality was relatively limited. The time gained with the initial period of stay-at-home orders enabled the health services to put in place the necessary capacity to handle the subsequent cases when the deterioration of economic conditions rendered untenable a prolongation of the strict restrictions that characterized the first five weeks. The restrictions were further eased and moved to risk alert level 3 on 1 June 2020, and by 17 August 2020 the country had moved to alert level 2 to allow many more economic activities to resume because of the inflection on the contamination rate (According to the Africa Centres for Disease Control and Prevention (Africa CDC) the total number of COVID-19 cases in South Africa had reached 627,041 by the end of August 2020, with a death toll of 14,149, which was the highest in Africa).

Table 1. South Africa’s COVID-19 fiscal response package.

Target Program	Amount in ZAR Million	Amount in Supplementary Budget
Credit Guarantee Scheme	200,000	200,000
Job creation and support for small and medium enterprises	100,000	6000
Tax measures for income support	70,000	70,000
Support to vulnerable households for 6 months	50,000	41,000
Wage protection	40,000	
Health services	20,000	22,000
Other frontline services		14,000
Support to municipalities	20,000	20,000
Basic and higher education		13,000
Provisional allocation for COVID-19 relief package		20,000
Other		11,000
Total	500,000	455,000

Source: National Treasury of South Africa.

KHSB Fertilisers is part of the agro-food value chain, as it supplies some of the key input needed for food production. It is therefore considered a provider of an essential service (The supply of agricultural inputs is considered to be at the upstream end of the value chain in the pre-production phase). This means that a permit could be secured for the supply of the local agricultural sector during the phases of the lockdown in South Africa. However, general destabilization of the export activities had a considerable impact on the company’s operations. The company’s response to the COVID-19 crisis should therefore be seen in the context of this risk-adjusted lockdown, whereby the stringent lockdown measures applicable to the rest of the economy had repercussions on the level of operations in all sectors, including those active in essential services.

2.2. Theoretical Anchoring

The knowledge management literature offers a plethora of arguments that affirm the crucial role that knowledge-centered strategies play in shaping efficient response to crises ([6,25,28,32–36]; etc.). Wang [29] suggested applying different portfolios of knowledge management strategies at different phases of its crisis in order to fulfill different knowledge needs at each phase of crisis management. The crisis management literature, for its part, highlighted the central role that a thorough understanding of the typology of surprising and disruptive events ([37,38]) and related crisis management practices play in the enactment of strategic responses aimed to restore the disrupted systems back into equilibrium ([20,37,39,40]). As stressed by Salter [41] and Wang [29], knowledge management is indeed crucial to mitigating the vulnerability of organizations to crises. Knowledge-based crisis management enables decision-makers within organizations to respond in a way that facilitates adjustment to the disturbance generated by the crisis by focusing attention on generating viable alternatives paths forward to adapt to the changed conditions ([29,42]).

In crisis management strategies, experiential learning plays an important role, alongside four other phases of the strategic response: detection, response planning, damage control, and organizational recovery ([43,44]). Learning serves as a basis for the conception of strategic adjustments to rapidly mobilize resources and generate novel solutions to address changing conditions ([29,45]).

The literature on resilience, on the other hand, deals with how organizations and ecosystems respond to disturbance and crises by resisting damage and recovering quickly ([21,22]). Resilience refers to the capacity of organizations, systems, or individuals to efficiently react to strain or disturbances and recover from them with minimal harmful effects on stability and functioning ([6,22]). In business organizations, resilience is related to the enterprise's capacity "to cope with unanticipated dangers as they become manifest, learning to bounce back" ([46] p. 77). The stress-inducing threats generated by crises compel organizations to find means of making rapid decisions, which necessitate the development of efficient knowledge management practices to control the disturbances and minimize their disrupting effects on organizations' operations ([27,47]). Adaptive learning is therefore crucial to the ability to bounce back from adverse events that underlie crises [16].

2.3. Methodological Approach

The data collection was designed with the purpose of understanding how the strategies of co-learning, which involved company employees, suppliers, and users of the ecological fertilizers, affect organizational resilience of the participating entities. Organizational resilience is defined here as "a firm's ability to effectively absorb, develop situation-specific responses to, and ultimately engage in transformative activities to capitalize on disruptive surprises that potentially threaten organization survival" ([27] p. 244). According to resilience scholars, such capacity is embodied in the organization's resources, ideologies, routines, and structures that enable it to absorb exogenous shocks and restore the prior order (e.g., [17] p. 520). Organizational resilience depends on key capabilities that enable those organizations and their members to mobilize the necessary means to deal with adversity and adjust to emerging circumstances created by crisis disruptions ([21,48,49]). The five main capability endowments suggested by resilience literature as key to positive adjustment ([6]) are:

1. Financial capability endowments
2. Cognitive capability endowments
3. Behavioral capability endowments
4. Emotion-regulation capability endowments
5. Relational capability endowments

Financial capability endowments are the primary enabler of resilience because they provide the organization with the means and the security it needs to respond to the crisis ([6,16,50]). Cognitive capability endowments refer to the competencies that enable people and organizations to rapidly identify the signals of potential disruptions and make use of their knowledge and critical insights to solve the problems that those disruptions bring about ([35]). Behavioral capability endowments are repertoires of behavioral decision embedded in organizational structure, which contribute to the resilience of organization by facilitating the analysis and sharing of information that helps optimize the functioning of the organization in the face of adversity ([6]). As for emotion regulation capability endowments, it refers to the mental disposition that provides employees with the psychological strength they need to persevere in the execution of their assignment with low levels of stress despite the challenges caused by the disruption ([51,52]). It helps the organization's employees cope with adversity and yet produce positive outcomes in their work ([6,53]). In the context of disruptive crises, relational capabilities play an important role in enabling positive functioning in the face of adversity by using social connections that enable organization members to access and exchange resources necessary to restore the organization to its regular functioning ([6]). Such endowments include trust and network

relationships, which are essential for the co-operation needed when responding to adverse events threatening the survival of organizations ([18]).

Among the changes to be analyzed, the study aimed to determine whether the co-learning experiences led to increasing cognateness between participants from different sides of the knowledge production process (from the enterprise, its input suppliers, and the end users of its products). An increased cognateness can be regarded as an indication of a greater preparedness of each side to use an integrated approach to innovation strategy by applying newly generated knowledge to optimize resource utilization in the crisis and build long-term mechanisms to cope with future unexpected disruptions. Equally important for the study was to probe the extent to which knowledge sharing in the co-operative learning project contributed to strengthening the key capability endowments that are key to their respective organizational resilience to the disruptions caused by the COVID-19 crisis.

Because of the restrictions imposed by pandemic containment measures, the data collection process was carried out using remote interviews, a desktop review of the company's documentation, as well as limited on-site observations of the of the production process with strict adherence to the sanitary measures. Interviews were conducted with managers, laboratory researchers involved in product innovation, as well as key partners of the collaborative learning process, i.e., input suppliers and end users of the company's ecological products. To ensure the reliability of the collected information, two online focus group discussion sessions were organized, each involving a dozen participants in the co-learning project. Co-learning participants were sampled on a voluntary participation basis from a list provided by the company management. In total, interviews were conducted with 36 people from a total of 65 who participated in the collaborative learning project. Descriptive statistics of interview respondents are presented in Table 2. Despite the heavy constraints that the drastic safety measures imposed on their operations, the company's management provided generous assistance that was decisive in supporting employees' efforts to reach co-learning participants from the company itself and those from its co-learning partners (All participants who turned up for data collection were asked to sign a consent form for taking part in individual interviews or in focus group discussion sessions, with the promise that their responses would be anonymized. No incentives or benefits were provided for participation in the focus group discussions). The interviews were conducted in September and October 2020, after the South African government had lowered the COVID-19 risk alert to Level 1, enabling most businesses to resume operations, provided that they adhered to the sanitary safety restrictions.

Table 2. Summary statistics of respondents.

	Number	Gender (Female/Male)	Age (Mean)	Education Level (Average Years of Schooling)	Position
KHSB Fertilisers	11	F: 4, M: 7	37	13	Management: 4 Operations: 7
Suppliers	10	F: 4, M: 6	41	14	Management: 3 Operations: 7
Customers	15	F: 6, M: 9	39	11	Management: 6 Operations: 9
Total	36	F: 14, M: 22	39	13	Managers: 13, Staff: 23

For participants who had managerial assignments in their respective organizations, questions were designed to inquire about the role of co-learning in the overall strategy of responding to the COVID-19 crisis and preparing for future crises, whereas co-learning participants received questions about their learning experiences during their participation under the COVID-19-related restriction measures and their perceptions of the ways in which the learning experiences helped the respective organizations weather the crisis and build the resilience capability endowments identified above ([6]). The aim of this approach was to identify observable changes in their behavior that could be associated with resilience

and crisis endurance as well as building crisis readiness mechanisms for future crises. To protect the confidentiality of the enterprise and the participating personnel, pseudonyms were utilized in the coding and analysis of the data.

With explicit permission of respondents, interviews were recorded for analysis. The aim of the analysis was to understand the various facets of behavioral change that had taken place in the involved organization as a result of their participation in the collaborative learning project. The second aspect was to gauge the perception of the participants of the contribution of the collective learning to the overall resilience of their respective enterprises in line with the stated goals of the collaborative learning strategy. The data gathered from these interviews were subsequently evaluated with the use of the outcome mapping methodology ([54]). Under this approach, emphasis is put on identifying and reflecting on observable changes in behavior that emerges as a result of the co-learning process and the subsequent adaption to the experiences or adaptations that are expected to take place in the future given the projected operations of the firm. From the large amount of information contained in interview responses, the analysis filtered out and synthesized the most recurrent observations expressed by participants regarding their perception of behavioral changes in relation to the resilience of their respective organizations as well as their preparedness for future disruptive crises.

3. Results

3.1. Co-Operative Learning as a Strategy: Company Background

This section presents the findings of the co-learning experiences used by KHSB Fertilisers as a strategy to optimize knowledge sharing with its business partners in order to ensure maximum resilience based on the stability of all participating entities. The information discussed in this case study provides additional insights into the deployment of co-operative learning as a knowledge management and crisis response strategy in a small business enterprise. KHSB Fertilisers was founded in 1984 as a family enterprise specialized in the production of organic fertilizers. KHSB Fertilisers has thus been in operation for more than 30 years and has developed a comprehensive range of plant nutrition products that revolutionized ecological fruit and vegetable production. It defines itself as an innovation leader in the plant nutrition sector.

The company produces a wide range of organic liquid micronutrition products as well as and organo-mineral macronutrition products. The originality of KHSB Fertilisers is its acute sense for detail in the plant nutrition and fertilization domain. Through its innovation-driven product development laboratory, it has developed a wide range of appropriate plant nutrition and recovery products for a multiplicity of functions involved in plant growth, pest resistance, vegetal health, and yield optimization. Its macronutrition products are especially suitable for ecologic fruit production farms because of their reinforcing effects on fruit stems. Its products are equally used for plant vivacity, better health and quality, and yield improvement in greenhouse vegetable production. Some of its products are equally suitable for helping plants recover from injuries and strains due to unexpected temperature variations. The company provides detailed guidance for the use of its products and proposes combinations of products to be used as well as detailed timelines of applications for maximum yield and optimal environmental protection. They can be used together with the irrigation and dripping system in greenhouses and outdoors. KHSB Fertilisers products are exported to different countries in Africa and the Middle East but are also distributed to the local South African market and used by farmers who wish to optimize the quality of their farm produce while protecting the ecological durability of the soil and the environment. Approximately 65% of its production is destined to the export market, where the company earns the largest portion of its sales revenues. For this reason, the company keeps an eye on the evolution of agricultural innovation in various parts of the world in order to stay abreast of any new developments and respond to changing market demands accordingly. This company was chosen for this study because of indications of its

previous experiences with co-operative learning obtained during a previous research on innovation co-creation.

3.2. Knowledge-Centered Response at KHSB Fertilisers

Before the COVID-19 pandemic spread to South Africa and prompted highly restrictive lockdown measures in March 2020, KHSB Fertilisers had grown to become an innovation leader in its field and had established a solid network of suppliers and distributors with which it worked very closely. Being an innovator mindful of the needs of its products' end users, it had already developed an informal and formal feedback structure through which it monitored the development of needs and requirements of its customers but also discussed with them the kind of strategic orientation that they may need to take in order to adjust their production methods to changing economic and environmental conditions. Likewise, the development of its wide range of products required intensive scientific communication with the input suppliers.

Continuous coordination of efforts with input suppliers was necessary to ensure a timely access to a steady provision of organic and inorganic compounds needed for the experimental work at its research and development (R&D) labs, but also for the ongoing production process. The culture of intensive communication with customers and suppliers was therefore already established. Innovation and production efficiency associated with this information management approach enabled the company to build a solid reputation of high quality for its product lines and reliability of supply to its local and overseas customers. The outbreak of COVID-19 in South Africa and the ensuing lockdown placed KHSB Fertilisers in an unusual position with formidable challenges to its operations, which threatened its very survival. The terrifying images of the fight against the deadly virus from the first countries to be affected were the primary reference that influenced the general perception on the potential damages that the pandemic could inflict not only on the health of people but also on their economic livelihoods. The initial information provided by health authorities was based on emerging and incomplete knowledge of the SARS-CoV-2 propagation mechanisms. As a result, social distancing (the virus was said to propagate from one individual to the next mainly through droplets that could be projected through the air within distances ranging from 150 to 200 cm) and regular hand sanitization were recommended as the main preventive measures to curb the risk of propagation ([55]).

KHSB Fertilisers took immediate action to ensure strict adherence to all recommended hygiene and safety measures by issuing recommendations and warnings to all its employees to abide by total compliance. When the stringent lockdown measures were first instituted with a strict stay-at-home order, it was hoped that the freeze in movement during the estimated incubation period of the virus would enable the detection of most cases of contamination and contain the propagation of the virus within a reasonable time period. Despite the apparent ease with which the recommendations could be adhered to, there were many unknowns in the propagation mechanism, so that the containment of the virus has remained elusive, despite improved knowledge of the contagion mechanism (Meanwhile, the virus has spread around the world with little success in its containment and has contaminated more than 63 million people worldwide. It has exacted a death toll of more than 1.4 million (as of 1 December 2020), with several countries experiencing surges in the forms of second waves of contamination throughout Western Europe and North America). The slowdown in business activities produced a significant destabilizing effect on the resource and knowledge management strategy of the company.

3.3. Co-Learning Experiences and COVID-19 Resilience at KHSB Fertilisers and Its Business Partners

In dealing with the consequences of the COVID-19 crisis, KHSB Fertilisers management quickly came to the realization that any destabilization in the value chain could work out a chain reaction that would propagate the distress as a domino effect. That is why it was determined that the best response to the crisis had to be designed in coordination with the value chain partners, in which an optimal exchange of information was crucial to

maximizing the resilience capacity of the firm. Being able to anticipate the behavior and the actions of the business partners became an import aspect of the strategy to control the effects of the pandemic on the operations and to pre-empt potential waves of destabilization that could emanate from any node in the agro-food value chain.

Being accustomed to monitoring new developments in science research to adjust to changing demand, the company determined that the best way to structure co-operative learning under the constraints of COVID-19 restrictions was through the institution of permanent concertation task forces involving personnel from connected entities (including foreign customers). The task force was given the mission of coordinating all knowledge management initiatives involving the company's 15 suppliers and 20 of its largest foreign and domestic distributors. For KHSB Fertilisers management and personnel, learning was motivated by the necessity to better understand the threat that the pandemic poses to each firm individually but also to the stability of their collective network. From that perspective, the permanent concertation task force was piloted by a team of five delegates who were also tasked with tracking the state of the art in medical and hygienic practices related to the prevention and treatment of this new disease. In total 65 people participated in the collective learning activities organized through this business network.

For KHSB Fertilisers, the related knowledge gathering was judged critical to ensuring a timely communication with its personnel, its customers, and its suppliers, in order to optimize the information resources necessary for the safety of all network participants. To be effective in their objective of optimizing knowledge sharing, co-operative learning sessions were structured to take advantage of the interdependence and complementarity between linked business entities. Knowledge-exchange sessions were organized on a weekly basis, whereby participants from the connected business entities shared their insights on the agreed-upon learning goals in brainstorming sessions, followed by setting new learning objectives.

The learning objectives covered in the brainstorming sessions could be subdivided into broad categories related to understanding the threats of the pandemic and marshalling the resources available to confront it, as displayed in Table 3:

Table 3. Co-learning objectives and their analysis dimension.

Objective	Dimension of Analysis
(1) Understanding COVID-19	Identifying its threat to the health of the involved participants and their respective businesses
(2) Internal and external resources	Understanding its prevention and containment measures
(3) Crisis management strategies	Identifying and accessing internal and public resources available to support business entities and protect employment
(4) Change management	Sharing resources and information management recipes
(5) Evaluation and feedback	How to manage adaptive changes required to meet the new post-COVID-19 business environment

The evaluation sessions were particularly important, as they enabled participants to draw lessons from the previous decisions and use them to adapt their crisis management strategies to the evolving situation. The travel restrictions imposed during lockdown meant that the company's interactions with its external partners had to be adjusted and carried out mainly through online meeting platforms. Interviews with managers revealed that the company had organized several rounds of consultations with its customers as well as its suppliers in order to set up a coordinated strategy to weather the crisis with a minimum of damage to the long-term viability of the enterprise. Each of the participating business entities was asked to designate one to two delegates to the taskforce, so that knowledge

exchange sessions could be regularly organized and mutual trust strengthened as the delegates multiplied their interactions. The company also organized more intensive and more frequent information sessions for its employees to provide guidance regarding the evolving safety measures, but also keep them informed of the increasing understanding of the science around the pandemic and its implications. As safety recommendations were being adjusted to the insights generated by the medical science, the newest information was shared with the personnel as quickly as it became available to ensure maximum protection and preventive behavior. The need for these adaptations has produced considerable change in the way people interact because the diminished role of body language inherent in face-to-face communication has to be compensated for with more detailed explanations and more precise description of the objects and concepts about which information is to be shared.

3.4. Co-Learning Outcomes: Participants' Perspectives

The crisis management strategy deployed by FHSB Fertilisers and its partners to deal with the impact of the pandemic brought about significant changes in the way information is managed and shared within and outside each participating entity. Concertation task force participants reported that co-operative learning through the permanent concertation enabled them to become more familiar with the dynamics of disruptions and more prepared for a collective response to future crises. From the KHSB Fertilisers perspective, participants in the permanent concertation taskforce reported that the repeated interactions with network delegates from connected business entities (suppliers and customers) in a time of crisis enhanced their understanding of the importance of tackling the crisis on the basis of the stabilization of the whole value chain instead of each company trying to go it alone. Some of the co-operative learning participants from the connected distributors reported to have benefited much from the brainstorming session and to have developed new perspectives on solving problems. Of particular importance to them was the increased capacity to analyze the problems facing their respective business units from different perspectives, which increased the likelihood of identifying the most effective responses. Information sharing also increased the sense of proximity among different participants and increase the common understanding of corporate interdependence between the different nodes of their shared network.

Putting the strategic resilience response at the level of common strategic vision made it possible to better plan the company's production schemes and adjust supply conditions in such a way that customers were offered more flexible payment terms, while their long-term commitment and customer loyalty became stronger. This resulted in the minimization of the shock created by the pandemic in the company's activities, with a relatively manageable adjustment to the lower demand level while keeping the loyalty of the customers and ensuring the job continuity of most of its employees. Table 4 summarizes the behavioral changes perceived as the most important for responding to the COVID-19 disruption (crisis management as perceived by all co-learning participants, column 1) and for strategic change to prepare for future crises (building resilience, as perceived by participants at the managerial level, column 3).

On the behavioral changes attributable to their participation in the cooperative learning project, members of the consultation task force at the managerial level reported in the key informant interviews that their participation in the brainstorming sessions broadened their perspectives of crisis management as the new common threat made their interdependency more manifest. The imminence of danger, both to collective health and to business operations, highlighted the necessity of using a collective approach for the long-run survival instead of go-it-alone escape tactics for short-term cost minimization. Some managers also reported that repetitive interactions with business partners in a time of crisis also opened their views on the human and social aspects of crisis management beyond the optimization of the financial flows between them. With the threat to health making no distinction between traditional healthy behaviors, managers reported to have experienced a stronger bond with their employees as well as their clients and suppliers, simply by

sharing their different perspectives on the dangers they collectively faced. The repeated interactions enabled participating firms to share more insights into the obstacles they faced as a result of the lockdown measures, and the ways that they had deemed most appropriate to keep functioning while maintaining a strict adherence to the imposed measures. This contributed to enhancing their mutual trust, which widened the opportunity to develop more flexible approach to their mutual transaction and created the platform for solidarity in the response to the impact of the crisis.

Table 4. Current and expected changes for organizational resilience to crises.

Adaptive Changes in Participants	Participants Reporting Observable Changes in Their Organization	Expected Long-Term Changes	Managers' Perceptions of Expected Strategic Change
Better understanding of the clinical and public health dimension of COVID-19	30 (83%)	Vaccination and enhanced preventive measures	10 (77%)
More efficient mobilization of internal and external resources	28 (78%)	Strategic collaborative programs for change management	8 (61%)
More intensive exchange and sharing of internal and external resources	32 (89%)	Flexible financing mechanisms, resilience provisions	9 (69%)
Flexibility in organizational operations to adapt to COVID-19 constraints	29 (80%)	Explore the structures for intensification of remote work here possible. Security issues of remote working	11 (84%)

Regarding the implications of their collaborative learning experiences for the key resilience capabilities of their respective business entities, a sizable majority of participants reported observing improvements in those resilience endowments, as can be seen in Table 5. Some participants reported observing no change, whereas a smaller number of participants indicated observing a deterioration of those capabilities after their participation in the co-learning project.

Table 5. Observed change in resilience capacity among participants.

Resilience Determinants	Observed Change	Respondent Perception of Change
Changes in financial capability endowments	Improvement	27 (75%)
	No change	6 (17%)
	Deterioration	3 (8%)
Change in cognitive capability	Improvement	26 (72%)
	No change	8 (22%)
	Deterioration	2 (6%)
Change in behavioral capability endowments	Improvement	28 (78%)
	No change	5 (14%)
	Deterioration	3 (8%)
Change in emotional regulation capability	Improvement	26 (72%)
	No change	7 (20%)
	Deterioration	3 (8%)
Change in social capacity endowments	Improvement	29 (80%)
	No change	5 (14%)
	Deterioration	2 (6%)

The analysis also paid attention to the changes in resilience capacity based on the four dimensions suggested by ([17]): change in organization structure, ideological orientation, daily routines, and resource utilization. Interview respondents were asked whether their

learning experiences could be related to strengthening organizational resilience through any of these four determinants. Table 6 reports the percentages of respondents who noted a connection between their learning experience and the changes in any of the resilience determinants.

Table 6. Perceptions of change in resilience resources.

Resilience Determinants	Resilience Indicators	% of Respondents Reporting Positive Connection to Co-Operative Learning
Changes in organization's structure	Organic and flexible structures linked by knowledge networks	28 (78%)
Resilience-enhancing ideological orientation	Promoting ecological agriculture, small-scale production system accessible to non-farm producers	26 (72%)
Modification of daily routines	Result-oriented production systems with more autonomy for workers	30 (83%)
Changes in resource utilization	Sustainable production technologies	31 (69%)

In all four dimensions, a clear majority of participants reported that they felt their participation in the collective learning project contributed to the positive change in the different resilience determinants, including the flexibilization of their organization's structure in response to the restrictions imposed by the pandemic containment measures.

Even though the intensity of activities at KHSB Fertilisers is still below pre-crisis production levels, the strong level of loyalty that was created through collective learning in response to the crisis offers a promise for a strong rebound as soon as the economy picks up after the health crisis is totally under control (With the promise of the new vaccines being clinically tried and authorized for vaccination campaigns, there are high expectations that the threat of COVID-19 could be considerably reduced in the course of 2021). In one of the key informant interviews, KHSB Fertilisers management reported that the increased knowledge sharing designed to enhance the safety of the response to the crisis considerably strengthened the mutual trust with business partners and enhanced the sense of interdependency, which will continue long after the crisis has been jugulated. The company managers reported a high degree of satisfaction with respect to the contribution of the co-learning experiences towards the overall resilience of their enterprise to the crisis. The reflections on the future of the agro-food sector, which were included in the co-learning brainstorming session in light of threats of future pandemics comparable to COVID-19, have contributed to accelerating the strategic changes that this innovative enterprise had already envisioned. The experiences of navigating the dangers of the COVID-19 crisis are expected to serve as a blueprint for crisis management in future crises, including those that may emanate from the predictable dangers of global warming and the gradual destruction of world biodiversity.

4. Discussion

Collaborative response to the crisis represents an interesting experimental domain to understand the benefits of a collaborative approach to problem-solving aimed at maximizing long-term benefits [56]. The outcomes of the co-operative learning experiences presented above highlight the advantage of using a collaborative approach to solving problems in the face of common threats instead of resorting to *sauve-qui-peut* tactics, in which individual entities may seek to maximize their own chances of survival. Interdependence implies that in the face of a common danger, the survival of each involved entity is conditional on the survival of interconnected entities. On the basis of positive social interdependence theory ([25]) and its resulting experimentation studies (e.g., [26,57], etc.), various innovation scholars such as Lundvall ([9]), Nahapiet and Ghoshal ([58]),

Lawson and Lorentz ([59]), and Petersen et al. ([23]) suggested that co-learning can offer a solution to overcome the hurdles posed by the complexity of the additional knowledge to be acquired.

Under the co-learning approach, members of epistemic communities engage in continuous interactions with their counterparts involved in the innovation value chain in order to sharpen their own knowledge and technical skills and use them to solve the organizational problems they face ([9,23]). Such mutual engagement between knowledge-exchange partners plays an important role in determining the ultimate success of external knowledge absorption for societal benefits ([24,60–62]). Mutual engagement also enables users of externally developed knowledge to collectively overcome the knowledge asymmetry challenges and identify the potential success of knowledge absorption as being their own success and that of their business community.

In the pre-COVID-19 era, successful exchange was more effectively facilitated by bringing holders of different types of skills and knowledge together to establish such personal relationships and share their views ([63]). This process of creating a shared understanding of the problem-solving knowledge corresponds to what Berneworth and Olmos-Penuela called the “coupling of knowledge circuits through cognateness” between knowledge creators and knowledge transformers ([64]). Cognateness is understood as a shared knowledge base and a common understanding of problems enabling actors to incorporate usable knowledge from external sources ([65,66]). In the COVID-19 era, however, the potential benefits of physical interaction are considerably diminished by the threat to health safety that it represents. The corresponding functions must therefore be performed through online interaction platforms with the hope of achieving comparable outcomes. In summary, co-operative learning therefore offers a real potential to business organizations to get the readiness necessary to absorb external sources of technological knowledge ([24]).

Collaboration within knowledge exchange structures is tedious when the level of cognateness between knowledge sharing partners is limited ([24]). The tacit character of part of the knowledge to be shared may also limit the ability of business partners to absorb it through formal exchanges ([60]). As a result, new knowledge generated by specialized research centers could fail to translate into useful solutions for responding to external disturbances if one or a combination of factors fostering collaboration are deficient. For transmission of knowledge between co-learning partners to be efficient, Nahapiet and Ghoshal ([58]) proposed a knowledge exchange mechanism consisting of networks of strong interpersonal relationships built over time, which constitute a basis for mutual trust, purposeful co-operation, and collective impact action (see also [60,63]).

The reflections garnered through the concertation sessions suggest the necessity of developing an advanced system of monitoring the effects of shrinking resources on the agro-food demand and the way the production system can anticipate those developments and reach the necessary readiness to roll out the tools necessary for an agricultural production system of the future. As a producer of ecological plant nutrition products, KHSB Fertilisers has an important role to play in encouraging the transition to a new era of food production encouraging the intensification of small-scale food production adapted to local tastes in order to limit long supply chains with a bigger carbon footprint. Co-learning also has the potential to strengthen the capacity to better monitor technological innovations across the value chain, especially those innovations that affects the property of food crops and the related demand for foodstuff. Innovations in plant nutrition systems have the potential to strengthen the evolution and the role of other agro-food innovations in building a more sustainable and crisis-resilient food-production system.

Finally, the form of mutual learning highlighted by these co-operative learning experiences implies a reduction in the cost of acquiring external knowledge and may be extended to sources of technological knowledge, which can be used to enhance the capacity of enterprises to innovate and better adapt to the changing conditions of the social structures within which they operate.

5. Conclusions

The extent to which business enterprises are able to develop an appropriate response and build resilience to a disruptive crisis such as COVID-19 is a complex issue involving managerial capabilities, the possession of or access to financial reserves, the flexibility of their organizational structures, and also the capacity to learn from the crisis and adjust to changing conditions. Because business enterprises operate in networks and connected value chains, this study argued that the capacity of firms to restore or adapt the structure of their operations is generally linked to their ability to effectively collaborate with connected partners in the business networks in order to avoid the domino effects that would emerge, where one or more connected nodes experiences financial distress under the destabilizing effects of the crisis disturbance.

As indicated by the views expressed by respondents in this study, co-operative learning is a handy strategy both as a mechanism to optimize decision-making in response to a crisis (when information about the dynamic of the crisis is scarce) and in building collective resilience as a more efficient way to mitigate the harmful impact of the current crisis and future ones. By deploying a co-operative learning strategy in which it associated its multiple business partners, the company succeeded in optimizing its knowledge resources and in mobilizing the co-operation of its business partners for adaptive change during the crisis. Such a strategy helped the enterprise in weathering the crisis with minimum damage despite resource constraints imposed by stringent pandemic containment measures.

The case of KHSB Fertilisers presented in this study shows that the success of co-learning in enabling crisis management and collective resilience depends on the readiness of the involved organization to commit to shared objectives in the recognition that collaborative learning can produce superior benefits over individual response. Establishing and strengthening bonds of mutual trust is key to bolstering the willingness of network members to combine the strengths of each organization to achieve better outcomes for all participating entities. Complementarity between the types of skills and specialized knowledge of each co-learning participant increases the mutual learning potential, especially when the objective to achieve involves much tacit knowledge (Even though information and communication Technology (ICT)-based solutions predominantly involve codified knowledge, the insights necessary to adapt the designed solutions to the local context of collaborating business entities are mostly part of the tacit, localized knowledge).

For the co-learning experience to convey the benefits of knowledge sharing to the business network more effectively, problem-solving interventions need to be contextualized according to the needs and circumstances of each involved organization. Key success factors in co-learning and knowledge management initiatives often lie in value-driven collaboration with broad networks of partners and garnering a sense of ownership of initiatives empowered by participating members.

The reported outcomes of the co-operative learning approach have three important implications for the knowledge-centered crisis management strategy. First, the ability of the participating entities to exploit their social interdependence and turn it into resilience capability endowments in the face of a common crisis shows that the advantages of knowledge-centered crisis management, such as those presented by Wang [14]), can be extended beyond the boundaries of individual business organizations and yield similar benefits to the cluster of participating entities. Secondly, the types of collaboration structures that business organizations were forced to adopt as a means to face the COVID-19 restrictions can also be advantageously used even after the crisis is over. The kind of coordination efficiency that they help generate between the connected entities can thus be turned into a permanent competitive advantage to be used routinely in companies' operations and activated to higher intensities when new crises arise. Consequently, because the collective survival of business networks and production value chains is important for the stability of the entire economy during crises, policymakers should encourage collective learning and design policy frameworks that provide incentives for collective responses.

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