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Relationship of Quality Control Circles and Organizational Learning Process in Santa Catarina Companies: How does this analysis provide clues about potential contributions to the ESG process?

Relação dos Círculos de Controle de Qualidade e Processo de Aprendizagem Organizacional nas Empresas Catarinenses: Como esta análise fornece pistas sobre potenciais contribuições para o processo ESG?

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Abstract
This study demonstrates how Quality Control Circles (QCC) facilitate organizational learning (OL) in companies associated with the Núcleo de Círculos de Controle de Qualidade in Santa Catarina, Brazil. The research was based on the "4I's" model and the eight dimensions of OL, as outlined in the questionnaire and subsequent quantitative analysis. Four hundred nineteen forms were distributed to 5,855 members of 28 companies, covering the three levels of participants. Of these, 272 were returned, and 242 were validated. The results demonstrated that the QCC supports three dimensions of OL, with members and coordinators perceiving these contributions differently from leaders. The study revealed how QCCs promote OL, boost employee development, and assist decision-makers. In the light of recent literature, it has been possible to show how this community of practice can cooperate with ESG (Environment, Social and Governance) through some dimensions of OL mediated by knowledge management.
Keywords: improvement programs; learning process; knowledge management.

Resumo
Este trabalho aponta como os Círculos de Controle de Qualidade (QCC) contribuem para o processo de aprendizagem organizacional (AO) em empresas associadas ao Núcleo de Círculos de Controle de Qualidade em Santa Catarina, Brasil. A pesquisa baseou-se no modelo “4I’s” e em oito dimensões de AO por meio de questionário e análise quantitativa. Dos 5.855 membros de 28 empresas distribui-se 419 formulários englobando os três níveis de participantes; 272 retornaram e 242 foram validados. Os resultados demonstraram que o QCC subsidia três dimensões da AO; os membros e coordenadores percebem essas contribuições de forma distinta dos líderes. Revelou como os QCC promovem a AO, impulsionam o desenvolvimento dos empregados e auxiliam os tomadores de decisão. À luz da literatura de vanguarda, foi possível revelar como essa comunidade de prática pode cooperar com ESG (Meio ambiente, social e governança) via algumas dimensões de AO mediadas pela gestão do conhecimento.
Palavras-chave: programa de melhoria; processos de aprendizagem; gestão do conhecimento.

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1 Introduction

One of the Total Quality Management (TQM) practices is the Quality Control Circle (QCC). The QCC methodology, introduced by Deming, Juran, Crosby, and others over 70 years ago, aims to improve the quality of processes and products, provide a motivational force for workers, create a pleasant environment that contributes to the development of professionals, increase companies' growth potential and competitiveness (Aljaffan, 2017; Reza, 2020; Hamaguchi & Ramos, 2023).

In Brazil, the TQM system, mainly the QCC practices, continues to play an important role in industries because it is ingrained in organizational culture (Hamaguchi & Ramos, 2023). Especially for workers at the shop floor level, QCC participation helps in the perception of belonging to the company, allows the workers' involvement, encourages them to think about solutions, and shares ideas and initiatives that keep them motivated (Lagares, 2011). Additionally, the QCC adaptation that Brazil did, configuring the organization, promotes the engagement of workers and managers (Ferro & Grande, 1997).

Otherwise, one can consider QCCs accustomed to being challenged to think about solutions cooperatively, look for alternatives for the company's internal processes, and remain engaged in analyzing new challenges presented in this century, such as the ESG agenda (Xia, 2022).

Maiti (2021) underscores the profound impact of financial economics studies, which delve into the realm of sustainable investing, surpassing the conventional notion of maximizing shareholder wealth. These studies, crucially intertwined with organizational performance, are based on three key pillars: environmental footprints, responsibility, and corporate governance. The acronym ESG (Environmental, Social and Governance) is often employed to encapsulate the performance of organizations in these parameters in financial analysis.

Thus, Xia (2022) provides the first comprehensive assessment of the relationship between organizational learning and ESG, highlighting that organizational learning related to ESG is essential to ESG performance. Strengthening organizational learning makes engaging in ESG practices in companies effectively possible, and it is only possible with the support of senior management. This transcends to the conduct of other employees and consequently to the results.

In a scenario where the decay of the expectation of lifetime employment and increase in temporary and non-permanent workers, volunteerism to participate in QCC has reduced, and employees' resistance to being required to participate in unpaid QCC has increased (Hamaguchi & Ramos, 2023). Ensuring that recording events within the QCC can be crucial to reduce the gap between the create/readapt and innovation process and keep an OL strong.

The OL process begins when someone acquires and shares knowledge with other people or groups in the organization, followed by a recording of these ideas that can be discussed and tested (Vera & Crossan, 2003; Manfredini, Vinotti, Rosa & Santos, 2017). Hence, OL is understood as a social construction in which the knowledge developed at the individual level will be directed towards organizational aims and, at times of "deconstruction", developing the need to unlearn to learn. Organizations only learn thanks to individuals' experiences and actions. Further, personal knowledge does not transfer immediately or independently to an organization, meaning people are the key (Steil, 2006; Antunes & Pinheiro, 2020).

Furthermore, it is possible to see the convergence between QCC methodology and OL. Through QCC activities, employees acquire knowledge about working together to improve their organization activities, resulting in the possibility of the development of the individual's abilities within the groups that share their knowledge, allowing to generate an improvement of

the processes, contributing to the learning processes and cost reduction (Blaga & Jozsef, 2014). These groups can be considered an environment for individual and group learning and development, and knowledge can flow from the individual to the organization and vice-versa. It is consistent with the OL model Crossan, Lane and White (1999). Moreover, OL is a complex construct based on a set of dimensions. Considering this, it was recognized as a measure for the OL construct developed by Templeton, Lewis and Snyder (2002) because this model had already been validated in the Brazilian context.

Previously, a survey carried out by Fodra (2019) identified few studies that analyzed the relationship between QCC and OL in Brazil (Melo & Vasconcelos, 2007; Chiva, Alegre & Lapiedra, 2007; Campos, 2004; Souza, Bresciani, Oliveir, Johann & Silva, 2020).

Although these groups have been organized to contribute to quality in the manufacturing workplace (Mittal, Gupta, Kumar & Ki Chan, 2023), healthcare services (McDermott, Antony, Sony, Rosa, Hickey & Grant, 2023), and other areas, this work sought to highlight the potential that these groups of engaged people, promoters of improvements and with a more systemic view of the business, can contribute to OL in general and to support ESG guidelines.

Hence, this work aimed to assess whether there is a relationship between the QCC and the OL process within the QCCN/SC scope and shed light on how these groups can cooperate to overcome some challenges, specifically ESG.

2 Theoretical Background and Hypotheses

Companies need to serve customers satisfactorily and change and transform the vision of quality for the customer, associating with the organizations' aims and the continuous improvement (CI) philosophy disseminates and promotes this quality (Carpinetti, Miguel & Gerólamo, 2007). CI is a systematic process in the company that involves, from the physical resources, the learning of the employees with a focus on their best performance, providing autonomous analytical and managerial tools to reassess and achieve their goals (Vivone & Júnior, 2017; Manfredini et al., 2017). The QCC is one of these instruments.

The advantages of applying the QCC methodology, beyond the financial gains, assist in health, safety, quality, and internal satisfaction when improving employees' activities or external when improving product quality (Hommerding, 2011).

QCC teams are small groups containing 5 to 12 members who may be from the same area (Sato, 2019). The groups are formed by:

- Leader: Its main activity is to guarantee conditions for meetings, provide explanatory material about the QCC, conduct meetings, and encourage the participation of all.
- Members: employees who voluntarily carry out project studies identifying the possible causes of the problems, suggesting opportunities for improvement;
- Secretary: a member responsible for recording, reporting and filing all meeting matters.
- Coordinator: Responsible for organizing events and training in QCC, monitoring the projects, and consolidating the data and results of the program.

For the teams' progress, QCCs are engaged and encouraged to increase their training, and QCC activities embolden individual members to develop work-related creativity and group-based innovation (Chen & Kuo, 2011). The development of each activity requires a level of knowledge that is enriched in the applicability of quality tools, instigating personal growth and enabling the evolution of skills, whether to analyze, plan, make changes in the work environment, participate or act in the process and in supporting the formation of work teams

that have an above-average productive potential concerning homogeneous teams, as they have different experiences and perspectives, facilitating the emergence of new ideas and initiatives (Adler & Gundersen, 2008; Moinhos & Mattioda, 2011).

Therefore, companies seek to form more agile teams to help achieve the goals and streamline their processes. In a recent study that analyzed the challenges of three teams from two multinational companies and addressed questions about leadership, national culture, and learning, it was possible to identify that the diversity experienced between them was essential in stimulating the project results (Moraes, Bueno & Domingues, 2020). They observed a) the plurality of age of group, religion, sex, and academic experience, and b) that the differences in opinions generate debates and more dynamism, contributing to selecting the best ideas and results.

In the OL literature, we sought to verify possible relationships between this theme and the QCC and identify some models and scales. OL is multidisciplinary, creating a need for more consensus to act in several fields: product innovation, change, strategy, organizational culture, and information processing (Crossan et al., 1999).

There are two views on OL, one as a process and the other as a result (Tsang, 1997). This article considers the OL as a process in which the individual becomes a learning agent, accumulating information and knowledge that makes it possible to explain how groups and associations learn (Antonello & Godoy, 2011).

The OL in this context of the QCC brings several perceptions about these contributions, as it uses analysis tools, making it possible to identify a root cause and using a problem-solving method, guaranteeing its effectiveness (Campos, 2004), and contributing to the institutionalization of processes and record in the organization's memory (Fischer & Silva, 2004). This learning provided by environments was identified as movements that contribute to the continuous improvement of the processes in organizations maintaining experiences in the following factors: persistence, leadership, learning, flexibility, commitment to company guidelines, autonomy, and recognition (Lizarelli & Alliprandini, 2006; Melo & Vasconcelos, 2007). In this context, the QCC is a favorable environment for OL treating information helps manage individual experiences, as this process in organizations contributes systemically to knowledge, together with companies' needs, and focuses on competitive advantages (Matthews, Maccarthy & Braziotis, 2017; Mittal et al., 2023). The success of TQM execution, or any other organizational practice as QCC groups, is contingent upon many individual factors and eventualities (Ashraf, Iqbal, Bazmi, Munir & Azeem, 2023).

Companies with high levels of learning have a high potential for overcoming, especially companies in developing economies that have the potential to join already proven favorable solutions in advanced economies, reducing the cost of development for new knowledge (Santos-Vijande, Lopez-Sánchez & Trespalacios, 2012; Zhao, Li, Lee & Chen, 2011).

Besides, the literature indicates that quality control systems, including the QCC, have already been shown to contribute to organizational performance, at least in the service sector, mediated by organizational learning (Saud, 2019; McDermott et al., 2023).

In this sense, the learning of new individual competencies has the potential to leverage the learning of the organization when: a) these individuals can transform the abstract knowledge learned cognitively into actions or behaviors aimed at organizational purposes, b) the knowledge is shared or distributed among the members of the organization, c) the learning results (the skills developed) are incorporated into the processes, structure or organizational culture (Steil, 2006).

Assessing the OL occurs with the development of each individual's routine tasks and, in the majority, with a realistic character occurring formally and informally, depending on

individuals' needs and activities (Souza et al., 2020). Formal learning befalls with structure and an intention directed to the company's interests or the employee, and informal learning occurs in everyday life and is associated with immediate demands related to work performance.

Campos (2004) reinforced that the QCC is an opportunity for personal and team training. Melo and Vasconcelos (2007) identified the QCC as a dynamic environment favorable to OL, evaluating how OL occurs at a motorcycle dealership. It was possible to confirm that employees learned through the relationships between them, either in the informality of activities or when they bring quick solutions provided with the availability of company information and in-service training, technical magazines, and manuals, showing that individual learning occurs from tacit to tacit, through the interaction that occurs between them (Souza et al., 2020). Additionally, Udin (2023) offers theoretical and practical implications for strengthening organizational learning culture in the workplace to improve employees' sustainable performance.

Considering OL and the QCC as central themes, Fodra (2019), through a survey from 1997 to 2017, emphasizes the works carried out in Brazil. This synthesis showed that studies relating the QCC to the OL in Brazil are evident (e.g., Melo & Vasconcelos, 2007; Chiva et al., 2007), although the QCC has recognized its contribution to the manufacturing environment. In general, all the works indicate CI in the processes, and for all companies, the audience involved was exclusively the Members of the QCC's groups.

In their study, Correia-Lima, Loiola & Leopoldino (2017) observed that OL scales are composed of items that measure individual or social behavior and organizational characteristics with different scales to measure the same concepts differently, using theoretical operational dimensions that vary. They identified 24 scales and 11 classified in the category that measures OL processes and results, enabling them to bring methods and measures that evaluate, measure gradually, and verify the phenomenon that occurred. It is strategic because using scales reduces the theoretical and empirical problems, making it possible to generate instruments with accuracy and precision, comparability, and accumulating empirical research results. From the practitioners' perspective, research results with greater precision contribute to increasing the effectiveness of decisions and practices related to learning in organizations.

When developing a scale for empirical evaluation of the organizational learning process, Templeton et al., (2002) established and tested a unifactorial scale in the North American context, developing a study on 119 high technology companies. This scale evaluates OL's multidimensional character. Table 1 summarizes the variables that comprise each dimension and explains their meaning.

Table 1

The variables that based on eight dimensions and their description

VARIABLES	DIMENSIONS	DESCRIPTION OF THE ITEMS
Understanding knowledge sources; organizational self appraisal; focused searching; integrating disparate knowledge; understanding information needs	Consciousness	It concerns the extent to which members of the organization are aware of the sources of key organizational information and its applicability to the problems in each area.

Electronic documenting; media choice; language framing	Communication	It concerns the extent of existing communication (including the use and accessibility of communication technologies) between members of the organization).
Monitoring performance; storing; managing data; cognitive making influence	Performance evaluation	The comparison of performance related to processes and results with organizational goals.
Human memory; imitating alliance organizational practices; technology-based disseminating; noticing	Intellectual cultivation	It is related to the development of experience, expertise, and skills among employee
Educating and training; electronic storing; structural unlearning; retrieving	Environmental adaptability	Consider the relation between the organizational responses to environmental changes.
Sharing; behavioral unlearning; unintentional or unsystematic learning	Social learning	Refers to how members learn about organizational interests through social channels..
Adopting organizational forms; strategic human resources turnover; adopting new members	Intellectual capital management	Reflects how the organization manages knowledge, skills or other intellectual capital for long-term strategic gain.
Practicing corporate intelligence; adopting intelligence	Organizational effort	Reflects the extent to which the organization capitalizes on other organizations' knowledge, practices and internal capabilities.

Source: Adapted from Templeton et al., (2002)

Souza & Trez (2006) adapted and validated this scale for the Brazilian environment, making it possible to assess the perception of those involved and how much they perceive each of the dimensions taking place.

When assessing the involvement of the individual, group, and organization levels, describe how personal knowledge is distributed across an organization, outlining and enabling OL. This model's four interrelated processes build the OL: intuition, interpretation, integration, and institutionalization. "Intuition" is related to the pre-awareness of the patterns and possibilities of individual experiences. The "Interpretation" explains actions, insights, or ideas for the participant or other people, acting in the process at an individual and group level. "Integrating" is the action of understanding and development sharing among the participants, so the dialogue is crucial. "Institutionalizing" is the process of ensuring that routine actions take place. Incorporating learning occurs through individuals and groups with systems, structures, procedures, and strategies. It is known as the "4Is" (Crossan et al., 1999) and adapted to the Brazilian context by Branquehais and Garcia (2016). This adaptation allowed the authors to make statements that identify the processes between levels, resulting in: "individual" There is a satisfactory level of insights, new ideas, and intuitions in the QCC groups); "group" The experiences of individuals and groups help in the development of knowledge shared in the QCC and "organizational" The ideas and insights of the QCC individuals become shared, integrated and institutionalized knowledge in the organization; the knowledge generated from the experiences of individuals and groups at the QCC is used in the development of the organization's strategy, processes, routines and systems.

According to Vera and Crossan (2003), OL begins when individuals share their knowledge with others; some happens in QCC teams.

It is similarly crucial to examine the relationship between OL and ESG performance. Both processes involve integrating strategies and operational procedures. This integration can be viewed as a process through which experience is converted into tacit and explicit knowledge. In the context of ESG, this knowledge can inform future ESG performance (Argote, Lee & Park, 2021). It is recommended that the organization prioritize enhancing its learning aspects (Adi, Haryadi, Wiadi, Mayasari, Mudrika, & Mila, 2023). It illustrates that ESG orientation can be conceptualized as a type of OL process. The implementation of ESG, which encompasses the enhancement of long-term performance, the cultivation of an excellent corporate image and reputation, the reduction of investment risk, compliance with regulations, the consideration of stakeholder interests, the attraction of new talent, the strengthening of altruistic value, the fulfillment of investor demands, and the encouragement of the company's ability to diversify its business (Boffo & Patalano, 2020), engages with the premises of OL.

Little attention has been given to analyzing how ESG can be embraced throughout the organization. It was observed in a review which covers 57 peer-reviewed academic journal articles published from 2001 to 2021. Xia (2022) structured a comprehensive assessment of the relationship between OL and ESG, highlighting that organizational learning related to ESG is crucial to ESG performance. To better facilitate ESG strategy through people and process, he based on single-loop learning about the process (i.e., control system, decision-making, ethics, gender balance, human resource management, knowledge management, risk management, and training) and double-loop learning about the roles of people (i.e., practitioners, professionals, managers, and the top management team). Furthermore, environmental governance and strategy represent significant challenges that require attention and resolution from companies that adopt a proactive environmental approach (Ren & Chin, 2024). These challenges are pervasive within the QCC and manifest through OL.

For the relationship between continuous improvement and OL, Souza (2018) identifies the maintenance sector's individual, group, and organizational processes, evidencing this learning and evaluating this contribution. Fodra (2019) assessed from the QCC participants that this program contributes to OL's dimensions in a company in the Textile segment in SC. The SC State presents a diversified economy, enhancing its development (Freitas, 2019). A QCCN was founded in Santa Catarina (SC) State in 1999. It is a non-profit institution and believes in valuing work between teams for sustainable development (QCCSC, 2019).

Given the above, this study assumed the following hypotheses:

H1: QCC groups operate on the "4Is" model.

H2: The contribution of the QCC groups to the OL is perceived by the coordinators differently from these groups' members. The hypothesis was based on the assumption that coordinators possess a deeper knowledge of the company's management than other members of the QCC. This is due to their proximity to senior management and more comprehensive business view, an aspect analyzed previously by Fodra, Alano & Silva (2021).

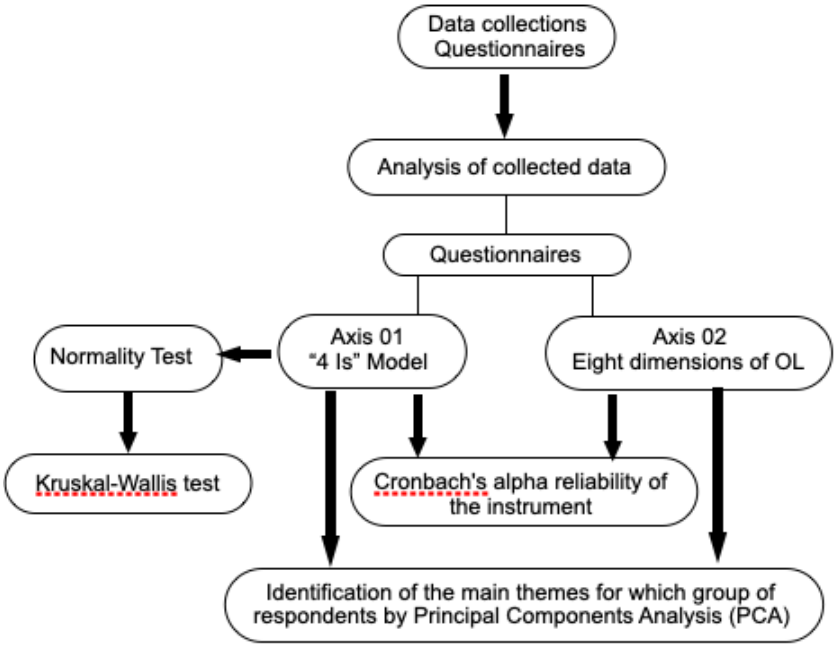
H3: The contribution of the QCC groups to OL occurs in some but only in some eight dimensions established by Templeton et al. (2002).

Beyond that, in light of the theoretical findings that OL can support the fundamental factors and mechanisms to drive ESG performance (Xia, 2022), it became possible to exploit the main results of this work to see how QCC groups could help the companies to integrate ESG factors.

3 Methodology

The research was conceived and developed by a flowchart in Figure 1 to address the relationship between OL and the QCC and assess how the QCC participants that make up the QCCN realize their contributions to the OL process. A quantitative approach dealt with 4I's model (axis 01) and the eight dimensions (axis 02) within the scope of the three types of QCC participants nominated by QCC coordinators, leaders, and members through a survey. Subsections 3.1 and 3.2 provide details of the data collection and statistical analysis used.

Figure 1
Research Flowchart



3.1 Research Procedures and sample delimitation

Using the terms OL, QCC, Improvement Programs, Learning Processes, ESG, and some combinations in English and Portuguese supported the bibliographic review.

The invitations were made through a telephone call to the regional offices' coordinators and by email. To detail and clarify how the research instrument should be applied and how it should return, a schedule with the nucleus president on the state meeting took place in February 2019. After this, the coordinators distributed the questionnaires to the members and the leaders of their companies. The research population sample consisted of 5,855 QCC participants from 28 enterprises belonging to QCCN. Considering that "N" is known in this case, this allowed for determining a sample size of 227 people (Gonçalves et al., 2014).

Beyond the 31 items of the learning scale proposed by Templeton et al. (2002), the questionnaire consisted of a set of phrases (items), also included nine questions for obtaining demographic data and four questions related to the "4Is" model (Attachment 1). Using a 5-level Likert scale expressing the degree of agreement from "totally disagree" to "totally agree". To apply the survey, the Committee on Ethics in Research with Human Beings authorized this work (nº 3.088.397).

3.2 Data Analysis

Out of 419 distributed questionnaires, 272 were returned and used as the exclusion criteria: forms that were not filled out or without the signatures of the Informed Consent Form authorizing the use of the data allowed validates only 234 forms. Each OL's dimension and the "4Is" model answers were submitted to the reliability test using Cronbach's alpha coefficient (α). These analyses run in Minitab® 2018 and are divided into two axes.

Axis 01: Regarding the levels and processes in the "4Is" model. In this axis, besides the α coefficient, the Normality test supports the choice of the statistical test to be used considering the significance level of $\alpha = 0.05$. Subsequently, the Kruskal-Wallis test was used to compare the coordinators' responses, leaders, and members of the QCC to assess these respondents' profiles and the perception of the contribution of the QCC to OL, including the correlation analysis between the categories of the participants.

Axis 02: Concerning eight dimensions of OL. OL's degrees of reliability results were distributed on the graph using the red center to indicate the minimum to present reliability, $\alpha = 0.6$ (Hair, Anderson, Tatham & Black,, 2009).

After verifying the reliability of the questionnaire and discussing these results, to help identify the main themes for which group of respondents has applied Principal Components Analysis (PCA) using software RStudio 4.0.3 (R Core Team, 2020) and a set of sentences expressing each PC was organized in a table.

4 Results and Discussion

4.1 Survey results and analysis

In this phase, 23 companies participated. From the 272 that gave back, ruling out 38 representing a return of 86% of the survey and corresponds to 56% of the total questionnaires applied. Also, the number of valid instruments for the analysis (234) was 3% above the 227 initially calculated.

Looking into the valid answers, Axis 01 and 02 helped understand the relationship between QCC and OL.

Axis 01 - Perceptions of the 4I's Model

Table 2 summarizes the results, considering the set of the answers and classified by size companies. Regarding the reliability regarding the specific issues of the "4Is" model $\alpha \geq 0.7$, it suggests that QCC operates according to the "4Is" model, regardless of the companies' size.

Table 2
Reliability indices (α) by all respondents and classified by company size.

CRONBACH'S ALPHA			
All sample	Scale of companies		
	Big	Medium	Small
0.76	**0.71**	**0.82**	**0.75**

For this same issue, Fodra, Alano and Silva (2021) presented similar results when applied to QCC groups in the textile industry context in Santa Catarina. In fact, during the pre-test and in the main study, the reliability indexes achieved were 0.72 and 0.77, respectively, indicating that both reached a safe level of reliability.

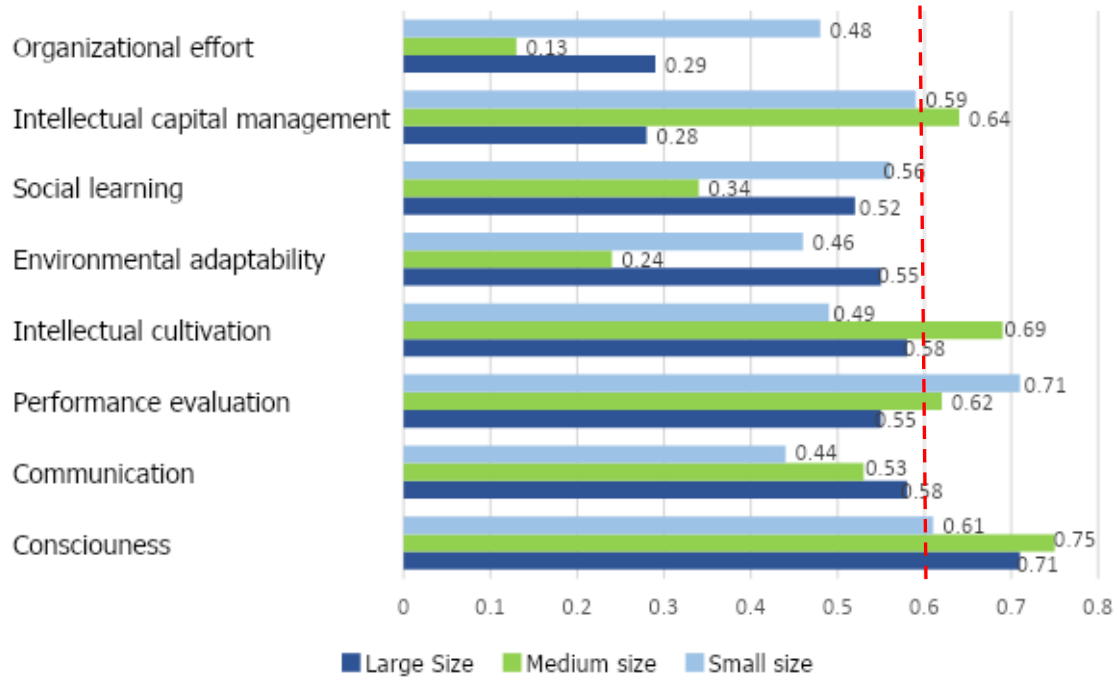
In agreement with the purpose of the QCC methodology, group participation allows employees in a purposeful environment to experience leadership (Melo & Vasconcelos, 2007). After each cycle's end, the members are evaluated by peers about their performance and appoint someone to assume leadership. This dynamic generates leadership competencies, which means that QCC contributes to OL, validating the "H1" hypothesis suggested in this work, as Campos (2004) noted, who reinforced that the QCC is an opportunity for personal and team training. Melo and Vasconcelos (2007) identified the QCC as a dynamic environment favorable to OL, evaluating how OL occurs at a motorcycle dealership.

The Normality Test reached the p-value = 0.02868 for the set of respondents, indicating that the samples do not follow a normal distribution but a non-parametric one. The Kruskal-Wallis test comparing the means of the coordinators' and members' p-values were less than 0.05, 6.118e-05 and 0.0079, respectively, and the leaders' p-values were 0.0639. The members and coordinators presented p-values lower than 0.05, suggesting that they perceived the OL process was occurring between the three levels and through the 4I processes. The leaders' results drew attention since these individuals link the coordinators and the members. Usually, they have a more profound knowledge of the company's management and seem not to identify the OL process. Besides, an understanding and alignment between managers and employees positively contribute to workers' performance (Tafvelin, Schwarz & Hasson, 2017). These results reject the "H2" hypothesis.

Axis 2 - The eight dimensions of OL

Concerning the OL dimension, Figure 2 shows the variations in the degree of reliability by dimension and the companies' size that make up the QCCN. These results highlighted three dimensions: "Consciousness", "Performance evaluation", and "Intellectual cultivation".

Figure 2
Distribution of Cronbach's alpha for each OL dimension classified by company size.



Independent of the companies' size, "Consciousness" presented an α ≥ 0.61. These results suggest that QCC participants are aware of their knowledge to serve the company. When necessary, they seek information from the organization and orient the problems to the teams to bring solutions. Souza and Trez (2006) highlighted "Consciousness" in large companies. The employees have a structure for managing information and controlling processes, enabling QCC participants to access information provided by the company, and they know where to find it. QCC groups of medium and small companies learned that in large ones, a positive contribution of this Nucleus to SC companies.

"Performance evaluation" emerged both in QCC of the medium size (α = 0.62) and in small size companies (α = 0.61). This dimension shows how much the quality of the detailed process information shared with members of QCC helps develop the program and the members, encouraged by managers, and the project results in the company. "Intellectual cultivation" emerged in the QCC of the medium-sized companies (α = 0.69), confirming that the members perceive the interaction taking place with the company's customers or suppliers, as well as with the QCC teams of other companies, in addition to their contribution to the development of technicians/specialists in the organization.

The last two dimensions show the importance of tacit knowledge to improve the companies' performance and corroborate another study with small and medium companies (Venkatachalam, Marshall, Ojiako & Chanshi, 2020).

Considering the degree of reliability by the OL dimension, Figure 3, the "Consciousness" dimension was identified by the three categories, evidencing that they perceive knowledge serving the company and confirming that they have access to information and know where to look for to seek solutions to different organizations' problems. Markedly,

consciousness is an essential item in building paths for implementing ESG practices. Research indicates that as ESG awareness increases, companies with higher ESG performance tend to overinvest less in some sectors (Irawan & Okimoto, 2021).

"Communication" was highlighted by coordinators (α = 0.66) and leaders (α = 0.62), suggesting that they have more access to means of communication as well as being encouraged to communicate, in addition to having more support than members, possibly due to the representation that these members have within the teams.

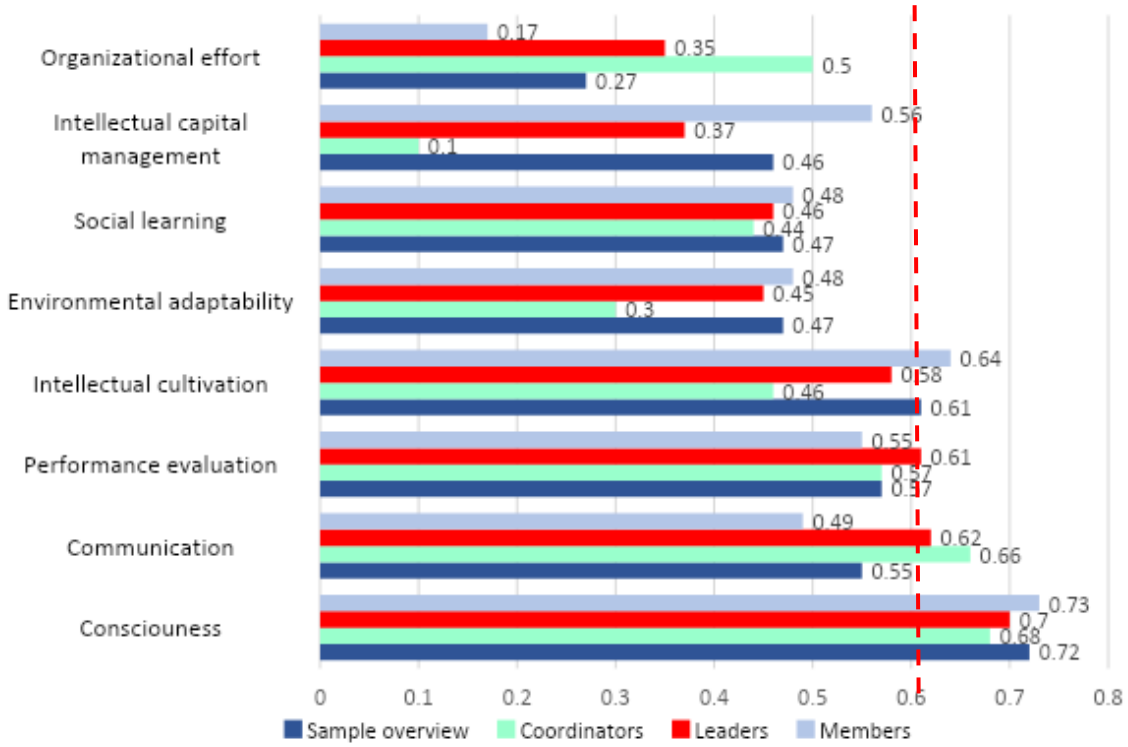
Just QCC members validate the "Intellectual cultivation" (α=0.64). It steps up that they realize that the QCC contributes to the development of technicians and internal specialists in the company, conducting training in other areas in which they operate and showing the relationship between customers, suppliers, and other QCC members of other companies.

On the other hand, leaders validate the "Performance evaluation" (α=0.61); they realize that the QCC keeps detailed information about the program's development. As the person responsible for the program, they have access to company data and are encouraged to use structured tools for more structured decision-making.

These results indicate that QCC contributes to OL by some and not all verified dimensions and confirmed the "H3".

Figure 3

The set of a degree of reliability for each OL dimension compiled to all samples and by category of QCC participants.



The validated dimensions support one or more of the four dimensions of knowledge management (KM): acquisition, creation, sharing and application (Zhang et al., 2021). "Consciousness" is related to the acquisition, once the essential information disposable helps to solve problems; "Communication" includes the different means for this process are based on

acquisition and sharing; while "Performance evaluation" drives the process performance to results can be linked to the application and for last, "Intellectual cultivation" that assumes an environment that allows to develop specialized abilities by experiences contribute hardly to acquisition and sharing, in a broad look, contributes to four KM dimensions.

4.2 Highlights from PCA - What can be used to drive QCC groups to cooperate with ESG?

In agreement with the respondents' category, it was possible to produce sentences (Table 3) based on PCA and produce highlights that elucidate how acting on specific points in the QCC group dynamic can improve their collaboration with OL in SC industries.

Table 3
Summary of the sentences structured based on PCA analysis.

	Sentences structures based on PCA analysis
Members (M)	RC1M- The exchange of experiences and knowledge in the QCC groups contributes to developing work teams and institutionalizing activities. However, there is a certain discomfort of the members in receiving problems from the administration for resolution through the QCC (due to the low correlation of the statement corresponding to this item).
	RC5M - The administration is willing to provide tools for interaction and knowledge, and members perceive this openness.
	RC2M - Certain information and ideas remain shared only between QCC members and information stored by them.
	RC4M - The feedback obtained by management through the QCC supports the growth of companies.
	RC9M - The indicators they generate help in the development of the company.
	RC10M - The indicators generated in the QCC are relevant for the company.
	RC8M - They access essential training for the company.
	RC3M - Communication between members is facilitated.
	RC6M - It is clear to members who manage the information.
	RC7M - The company must communicate clearly about recent developments with members, and the QCC does not provide in-house training for members
Leaders (L)	RC1L - Communication and ideas flow among members, encouraged by management.
	RC3L - There is encouragement for training QCC members and interaction with customers and suppliers, but it needs to pay attention to the strategies of its competitors.
	RC2L - It is necessary to communicate better information, such as achievements, spreadsheets and ideas to associates.
	RC4L - Information is available, but sharing this information needs to be improved.
	RC10L - Members are aware of the importance of the QCC groups for the company.
	RC9L - There are enough tools for team communication and no resistance to technology changes.
	RC5L - There is awareness among the leaders that there are qualified people in the QCC to be in the company.
	RC7L - There is no relevance regarding individual and group experiences; shared knowledge is based on company data.

	Sentences structures based on PCA analysis
Coordinators (C)	RC1C -Communication between members is encouraged by management, and the necessary information is available.
	RC2C - There is no stimulus for internal training of QCC members, prioritizing the incorporation of new participants who are already trained, and there is some retention of some information for these managers.
	RC4C - QCC members know their importance to the company and have the appropriate communication tools.
	RC3C - There are opportunities for personal development of QCC participants in areas other than those currently working.
	RC8C - There is a sharing of information about results, customers and suppliers.
	RC5C - QCC has a team with important skills for the company.
	RC7C- There is information sharing because there are people designated to manage this flow.
	RC6C - Changing some practices still generates resistance among members.
	RC9C - There needs to be formal communication about the progress achieved by the company.
	RC10C - There is no incentive for QCC participants' contributions to the company's growth.

Looking at the PCA members' results face to 4I's processes and OL constructs, it is verifiable that the main themes were focused on "Consciousness" (RC5M, RC4M, RC9M and RC 10M); "Communication" considering the RC3M, RC6M and RC7M sentences and, evidencing the "Integration" and "Institutionalization" processes through RC1M and RC2M. RC1M, in a way, individuals perceive the value of knowledge generated in the group.

Leaders also perceive "Communication" (RC1L, RC2L and RC9L), even as "Consciousness" RC9L, RC10L and RC5L.

The coordinators assume that the management supports the communication between members (RC1C) and offers tools for that (RC4C). However, part of communications from management to members occurs informally (RC9C). They recognize that members know their value for companies (RC5C), but this needs to be clarified for them (RC10C). Facing OL constructs, a plan about "Intellectual cultivation" could be an essential strategy and RC2C and RC3C support it.

Comparing the results by kind of QCC participant drew attention to RC2C x RC3L and RC6C x RC9L par sentences. These opposite perceptions demonstrate the performance of leaders to identify some dissatisfaction among members and mediate this while recognizing some resistance to change. Furthermore, confronting RC8C with RC4L evidence that leaders identify some hindrances in the socialization process in the QCC groups that coordinators did not perceive or externalize.

Beyond that, RC1 for both leaders and coordinators drives the same way and denotes that in the QCC leadership context, there is the same understanding, i.e., it is their role to encourage direct and transparent communication between the groups' members in order to facilitate the solution of problems and generate new opportunities. This convergence can be a) attributed to the condition of leaders in the QCC hierarchy, since they act as moderators between members and coordinators and b) even if from different companies and micro-regions of the SC/Brazil, all respondents belong to the QCCN sharing many experiences in their meetings. According to Kalogiannidis (2020), the effect of business communication on employee performance is not a determining factor.

When it comes to communication, RC5M and RC6C demonstrate recognition by the responding members that the group leaders are the bridge between them and the company's top management. They also recognize that it is from the encouragement of managers that new results can be reached, as pointed out by RC9M. The critical point in RC2M is "information" and indicates the collaborative nature of the analyzing, selecting and storing process.

As evidenced by members (RC5M) and coordinators (RC4C), the theme "tools for interaction and communications" provided by companies deserves attention. Internal communication tools are traditional in enterprises. The highlight here is that it is not the use of electronics but digital forms of communication that have gained more expression after the COVID-19 pandemic. In a Chinese financial services firm, Song, Wang, Chen, Benitez, & Hu, (2019) registered that digital media used for social media, when oriented towards socialization, are complementary resources that generate synergies to improve team and individual performance.

The effect of sharing information and knowledge has been described, and it was found to have an impact not only on the performance of people and groups but on beyond-convention work-related, e.g., team climate and employees' life satisfaction (Ahmad & Karim, 2019). A recent study with information processing groups identified that leaders do not always serve as information integrators but may instead compete with their team members by focusing on their position rather than promoting consideration of others' knowledge (Sauer, Rodgers & Thomas-Hunt, 2021).

In short, PCA's primary results disclosed information, knowledge and access to them, the importance of interaction and communication tools as a strategy for results, as well as the relevant alignment between tactic and strategic management and the perception of the value of the group. According to the constructs proposed by Xia (2022) to compose the framework that can evaluate the relationship between OL and ESG, it appears that among the QCC groups of Santa Catarina companies, this contribution can be made through constructs Training, KM, Intellectual capital, Human resources management in Process dimension, mainly by internal management. Likewise, these results involve managements of different levels, professionals and practitioners (in agreement with Xia's vocabulary), suggesting that the QCC group and other community of practices teams can contribute through OL dimensions to ESG ones based on KM dimensions. As Ren & Lin (2024) observe, corporations that develop forward-looking environmental strategies prioritize stakeholder integration, organizational learning, and green innovation. This approach can significantly enhance a company's cost advantage, social reputation, and social performance.

5 Conclusion

The results showed that the QCC groups operate in the "4Is" model, independent of the size of companies, soon confirming the "H1" hypothesis and the hypothesis "H3" that the contribution of the QCC groups to the OL occurs in some and not in all dimensions. On the other hand, this study unauthenticated the "H2" hypothesis. This hypothesis was evaluated based on the hierarchic structure established in the QCC methodology. The gap found needs to be clarified as to why it took place and needs to be explored.

It is possible to conclude that there is a relationship between QCC and OL, and the limits of this study are established by the "Consciousness", "Communication", "Performance evaluation," and "Intellectual cultivation", dimensions evaluated further, the processes of "4Is" between the three levels described in that model. Additionally, the PCA analysis helped to

identify specific points to be explored to improve QCC groups' contributions to OL companies and suggested that these groups have the potential to contribute, through OL dimensions, to ESG factors based on KM dimensions.

In essence, the evidence presented in this study offers theoretical and practical implications for strengthening organizational learning in the workplace. This should lead to improved sustainable QCC member relationships and performance. At the same time, the findings of this study can help the QCC nucleus drive their QQC groups to contribute to the ESG performance of the SC organizations.

Two areas for improvement of the present study are: Firstly, this study focused on the relationship between QCC and contributions to the organizational learning process (OL) in companies associated with the Nucleus of Quality Control Circles in Santa Catarina (SC), Brazil. However, there are many other influencing factors that this paper has not exhausted. Future research could explore additional factors, such as corporate culture and the pressure on the performance of the groups. Secondly, the analysis in this paper is based on QCC data from companies in SC, Brazil. Future research could be extended to investigate variations in the relationship between QCC and OL, their impact on ESG performance, and the reasons for it in other states in Brazil, Latin America, and worldwide.

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Attachment 1

Dimension of Organizational Learning

Consciousness
· QCC members are aware of where their knowledge can serve the company (question 17).
· When QCC members need specific information, they know where to get it (question 19).
· Management addresses problems so that QCC teams can seek alternative solutions (question 21)
· Management monitors important QC Program performance variable (question 22)
· Management provides the QCC with access to information from different areas of the organization (question 25).

Communication
· QCC members have access and / or support for the use of electronic means to communicate (question 11).
· QCC members have a wide variety of communication tools (telephone, email, internet and others) available to continue with their projects (question 12).
· QCC members are encouraged to communicate clearly (question 20).

Organizational effort
· When the internal capacities in the QCC groups are deficient, the aim is to supply with the incorporation of new team members (question 10).
· The administration, when knowing about QCC strategies developed by competitors, ignores them (question 27).

Performance evaluation
· The QCC stores detailed information on processes that are important for program development (question 2).
· There is a person in the company identified as responsible for the management of the information relevant to the QCC (question 3).
· The QCC has access to data and information on different results of projects in the company (question 8).
· Management encourages QCC members to make use of structures and models to support decision making (question 29)

Intellectual Cultivation
· QCC contributes to the development of technicians / specialists internally within the organization (question 1).
· The administration gives QCC members the opportunity to conduct training in areas other than those in which they operate (question 24).
· The management facilitates the relationship of QCC members with company partners (customers, suppliers) or even with QCC groups from other companies (question 26).
· Management learns new things about the company through direct observation of QCC members and / or program indicators (question 28).

Environmental adaptability
The QCC is slow to react to technological change (question 4).
· QCC makes extensive use of electronic storage (such as databases, data warehousing, electronic documents) (question 7).
· QCC members seek to retrieve archived information for decision-making (question 15).
· QCC members make extensive use of the Information System as a support tool in conducting projects (question 16).

Social learning
· QCC members are reluctant to move to new ways of doing things (question 13). · QCC members learn about the company's recent developments through informal means (such as news, hall conversations and gossip) (question 14).
· QCC members keep information (such as numbers, spreadsheets, and ideas) away from other

employees (question 18).

Intellectual capital management

· In the QCC are part of the employees with key skills for the company (question 5) · The QCC has among its participants, highly specialized or highly educated people (question 6).

· The company seeks to implement the QCC in other units, including acquisitions of new companies, envisioning short-term financial gains (question 9).

"4Is" Model

Individual

-There is a satisfactory level of insights, new ideas, and intuitions in the QCC groups (question32).

Group

- The experiences of individuals and groups help in the development of knowledge shared in the QCC (question33).

Organizational

- The ideas and insights of the QCC individuals become shared, integrated and institutionalized knowledge in the organization (question 34).

-The knowledge generated from the experiences of individuals and groups at the QCC is used in the development of the organization's strategy, processes, routines and systems (question 35).

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