O Estado da Arte Sobre Interações Sociais em Equipes Virtuais de Projetos

The State of the Art on Social Interactions in Virtual Project Teams

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Objetivo do estudo
Esta pesquisa analisa o estado da arte sobre interações sociais em equipes virtuais de projetos, por meio de uma revisão sistemática da literatura

Relevância/originalidade
This research analyzes the state of the art on social interactions in virtual project teams, through a systematic literature review.

Metodologia/abordagem
Por meio de uma revisão sistemática da literatura, uma amostra de 62 artigos foi coletada nas bases ISI Web of Science e Scopus, abrangendo o período de 2016 até janeiro de 2023

Principais resultados
Os resultados evidenciam que compartilhamento de conhecimento, identidade social, cognição de equipe, segurança psicológica e capacidade absortiva são frequentemente adotados para melhorar o entendimento das interações sociais em equipes virtuais de projetos

Contribuições teóricas/metodológicas
As agendas de pesquisa identificadas estão pouco desenvolvidas, apresentando oportunidade para aprofundamento, com destaque para o entendimento da identidade social, levando a um aumento na produtividade, na criatividade e na qualidade do trabalho.

Contribuições sociais/para a gestão
A partir desta pesquisa, o campo de Gestão de Projetos recebe uma visão panorâmica do estado da arte sobre interações sociais em equipes virtuais de projetos.

Palavras-chave: Interação Social, Ambientes Virtuais, Equipes Virtuais, Projetos, Gestão

The State of the Art on Social Interactions in Virtual Project Teams

Study purpose

This research analyzes the state of the art on social interactions in virtual project teams, through a systematic literature review.

Relevance / originality

This research analyzes the state of the art on social interactions in virtual project teams, through a systematic literature review.

Methodology / approach

Through a systematic literature review, a sample of 62 articles was collected from the ISI Web of Science and Scopus databases, covering the period from 2016 to January 2023

Main results

The results show that knowledge sharing, social identity, team cognition, psychological safety and absorptive capacity are often adopted to improve the understanding of social interactions in virtual project teams

Theoretical / methodological contributions

The identified research agendas are underdeveloped, presenting opportunities for deepening, with emphasis on the understanding of social identity, leading to an increase in productivity, creativity and quality of work.

Social / management contributions

From this research, the field of Project Management receives a panoramic view of the state of the art on social interactions in virtual project teams.

Keywords: Social Interaction, Virtual Environments, Virtual Teams, Projects, Management

THE STATE OF THE ART ON SOCIAL INTERACTIONS IN VIRTUAL PROJECT TEAMS

1. Introduction

Nothing will be like it was before the COVID-19 pandemic, however, the crisis offers us opportunities. In the organizational context, digital communication becomes a useful and increasingly necessary tool, with remote work becoming essential (Gaudecker et al., 2020). Despite the increased use of remote work, this was already perceived long before this pandemic, when the globalizing organizational expansion demanded flexible virtual teams (Peters, 1992; Stewart, 1994), with low costs and quick response capacity, effective in environments of change and dynamic and turbulent markets (Mowshowitz, 1997; Snow et al., 1996).

Virtual teams use technology to interact between members beyond geographic and organizational boundaries and increase their effectiveness from repeated and shared social interactions (Jarvenpaa and Leidner, 2006). The transformation from face-to-face to virtual work is a procedural change in which the team needs time to adapt, and communication between members must be accurate, concise, and without room for doubt (Bakshi and Krishna, 2008). Lin and Roan (2022) highlight the importance of strengthening the development of virtual teams, providing better management, and seeking efficient and effective teams.

In a literature review, Weigel et al. (2020) identified the relevance of establishing face-to-face meetings during the initial steps of transitioning to virtual teams, to encourage discussions and ensure technical support for communication technologies. Later, Gibbs et al. (2021) concluded that interpersonal interactions are rich sources of encouragement, in which members develop an extra effort, aiming at greater knowledge sharing. Complementarily, intercultural competence is fundamental for the construction of knowledge. Enrique and Joel (2020) cite this characteristic of participants in virtual teams as a competitive advantage in the search for results.

Between 2016 and January 2023, there are five systematic literature reviews (SLR) in which the authors suggest lines of research with the themes: social identity, social capital, and media. Approaches on the theme of social identity are highlighted in two of the five SLRs analyzed in this research. Building team identity, its positive impact on building trust and team performance, associated with the best forms of media, are relevant themes in the SLRs analyzed.

This research is original in that it seeks a better understanding of social interactions in virtual teams. The need for in-depth studies in the construction of a group identity has been a concern for decades (Walther, 1997) but currently needs to be investigated in the environment of virtual teams (Weigel et al., 2020).

This study proposes to answer the following research question: What is the state of of the art on social interactions in projects with virtual teams?

To answer this question, we adopted the systematic literature review (SLR) methodology, producing academic knowledge resulting from an objective approach, ensuring transparency and replicability (Tranfield et al., 2003). Using free access, we searched in the Scopus and Web of Science databases in January 2023, among works published from January 2016 to January 2023. Out of a total of 191 publications available, after applying inclusion/exclusion criteria, we selected 62 publications addressing the topics of this study.

In response to the research question, we present five theories and concepts with additional approaches and citations: knowledge sharing, social identity, team cognition, psychological safety, and absorptive capacity. Knowledge sharing had 23 incidences, which

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reinforces the importance of retaining and transmitting information in remote work. Social identity contains 17 incidences of theories, which signals the search for understanding about how virtual teams interact and seek efficiency.

2. Theoretical Framework

2.1 Virtual teams

"A team is a collection of individuals who are interdependent in their tasks, share responsibility for outcomes, see themselves and are seen by others as an intact social entity embedded in one or more larger social systems, and manage their relationship across organizational boundaries" (Cohen and Baily, 1997, p. 241). Although broad, this definition is sufficient to encompass virtual and traditional teams when it identifies team-defining factors: common purpose, identity as a social structure, and responsibility shared by participants (Powell et al., 2004).

The concept of virtuality raises the idea of permeable borders and connections (Mowshowitz, 1997; Kristof et al., 1995) as project teams are formed, reorganized, and dissolved quickly. Miles and Snow (1986) show that virtual teams are a progression of network organizations, made possible by technological advances in information and communications, in which individuals with different skills are located across time, space, and cultures (Jarvenpaa and Leidner, 2006).

These teams offer flexibility, responsiveness, lower costs, and better resource utilization to meet growing needs and changing task requirements in highly turbulent and dynamic global business environments (Mowshowitz, 1997; Snow et al., 1996). Present in different workplaces, members of hybrid teams can prioritize which colleagues they will meet, and at what times, via different platforms (Gilstrap et al., 2022).

Studies on virtual teams have significantly increased in recent years, Lin and Roan (2022) show the pertinence of research, relating communication mediated by an information system and its effects on relationships with the team. Gibbs et al. (2021) similarly show the importance of dialogic communication in the interpersonal interaction of teams and suggest that dialogue is an efficient way to promote engagement and overcome barriers. While Alsharo et al. (2017) conclude that the performance of virtual teams is disconnected from social ties, although Rogers et al. (2021) teach that social interactions are fundamental to creating satisfactory experiences among team members.

2.2 Social interactions

In sociology, social interaction is the most elementary partition, committed to studying the organization of individuals, although Turner (1988) points out that there is no appropriate conceptualization of the construct. Since social interaction is closely linked to positive social identity (Dutton et al., 1994), such relationships promote increased productivity and efficiency in information sharing (Chiu et al., 2006). Their links are like rivers for torrents of resources and knowledge (Tsai and Ghoshal, 1998), and their strength is a combination of emotional intensity, amount of time, and mutual trust (Granovetter, 1973).

Organizations must realize the differences between virtual and co-located teams under penalty of loss of efficiency, lower performance, and low member satisfaction (Holding Eagle, 2020). Schröder et al. (2021) confirm the idea by emphasizing that the different cultures of the members are a demand to be assimilated by the teams, and, consequently, their absence can be an opportunity to be developed. Team leaders can remedy this deficiency (Enrique and Joel, 2020), as they need to seek progressive improvement in intercultural relations.

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3. Method

The systematic literature review (SLR) methodology allows the construction of academic research from metadata without the need for empirical data (Kraus et al., 2020). The technique makes it possible to unify and integrate the knowledge in the scientific literature on topics of interest, in an objective and clear way (Rowley and Slack, 2004). It proposes to answer a research question (Okoli and Schabram, 2010), usually about the status quo of a chosen field of study (Kraus et al., 2020).

This research followed the guidelines of Okoli and Schabram (2010), searching in the ISI Web of Knowledge and Scopus databases, among articles with full access allowed free of charge. To include the largest possible number of articles in the databases, minimizing the risk of unintentional exclusion, we selected the "Topic" option in the search key. We utilized this option as it will search for theories, concepts, and current research proposals. We also set the time interval for the selection of articles at six years. To include all publications related to the topic, we defined a comprehensive search algorithm (string) based on the wording of the objective:

("Social Interactio*") AND ("Virtual Team*") AND ("Project*")

Figure 1 shows the application of the protocol for this research, based on Pollock and Berge (2018).

Figure 1: Protocol application
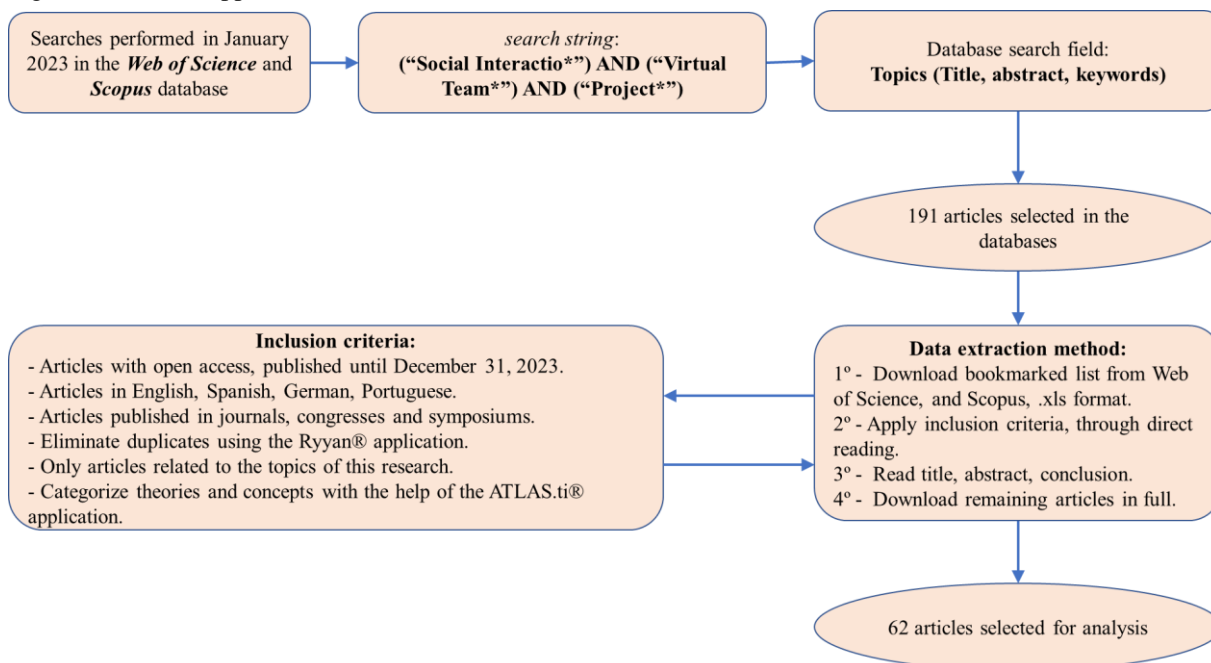
Source: the authors

4. Analysis of results

4.1 Characterization of the Sample of selected articles

After compiling the studies, we identified that the publications are dispersed in several journals and conferences/symposia, presenting only one journal with a concentration of 6% of

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the research, as shown in Table 1. Within the 51 publications, 15 (29%) belong to conference/symposium annals, indicating that research on the topics is current and relevant. The publications are related to information systems (18%) and management (16%), concentrating more than 30% of the total, indicating value in the search for understanding how social relations interact with virtual teams. The relevance in the study of subjects is shown by the impact index of the two journals that most publish them, which is 11% of the total:
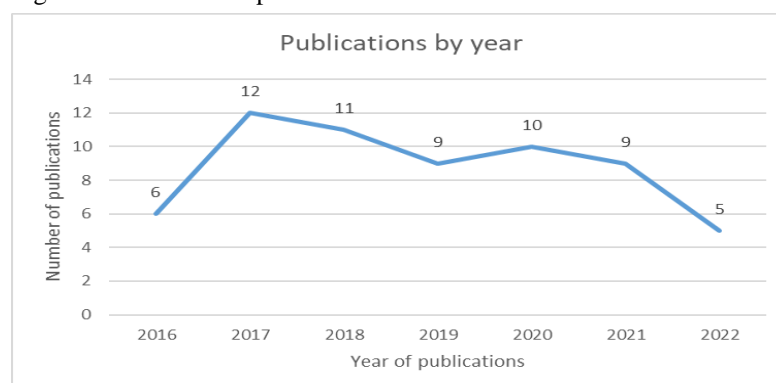
Table 1: Which journals publish the most.

Amt	Journals	H index	%	Amt	Journals	H index	%
4	International Journal of Project Management	153	6%	1	International Journal of Mobile Communications	46	2%
3	Int. Journal of Environmental Research and Public Health	138	5%	1	Int. Journal of Technology and Design Education	46	2%
3	Team Performance Management	37	5%	1	Int. Journal on Interactive Design and Manufacturing	28	2%
2	ASEE Annual Conference and Exposition	25	3%	1	Internet Research	94	2%
2	Construction Management and Economics	99	3%	1	Journal of Agricultural Science and Tecnology	34	2%
2	Journal of Universal Computer Science	54	3%	1	Journal of Asian Finance Economics and Business	20	2%
2	Proceeding of the 33rd Annual ARCOM Conference		3%	1	Journal of Computer Science and Technology	51	2%
1	25th Americas Conf. on Information Systems	28	2%	1	Journal of Information Systems Education	20	2%
1	4th International Conf. on Prod. Economics and Project Eval.		2%	1	Journal of Knowledge Management	124	2%
1	52nd Hawaii International Conference on System Sciences		2%	1	Journal of Management in Engineering	79	2%
1	Acta Structilia		2%	1	Journal of the Association for Information Systems	85	2%
1	Advances in Intelligent Systems and Computing	48	2%	1	Lecture Notes in Computer Science	415	2%
1	Alexandria Engineering Journal	68	2%	1	Management Decision journal	106	2%
1	AMCIS 2017 - America's Conference on Information Syst.		2%	1	Management Science Letters	22	2%
1	Computer Applications in Engeneering Education	32	2%	1	Proceeding of the 34th Annual ARCOM Conference		2%
1	Computers and Education	197	2%	1	2020 2nd Int. Conference on Control Systems		2%
1	European Journal of Work and Organizational Psychology	72	2%	1	Proceedings of the 32nd Annual ARCOM Conference		2%
1	Frontiers in ICT	19	2%	1	Int. Conference on Business Excellence	14	2%
1	Frontiers in Psychology	133	2%	1	Project Management Journal	48	2%
1	Future Internet	38	2%	1	Research-Technology Management	73	2%
1	ICIS 2017: Transforming Society with Digital Innovation		2%	1	Revista GEINTEC-Gestão e Tecnologias		2%
1	Information Systems Journal	94	2%	1	Society of Petroleum Engineers	108	2%
1	Information Technology and People	64	2%	1	The Journal of Systems and Software	113	2%
1	Int. Conference on Information Systems (ICIS 2013)	14	2%	1	22º Americas Conference on Information Systems		2%
1	International Conference on Project MANagement / Hcist		2%	1	VINE Journal of Informat. and Knowledge Manag. Syst.	33	2%
1	International Journal of Information Management	132	2%				

Source: Web of Science and Scopus databases, compiled by the authors

Figure 2 shows the evolution of publications over the period studied, showing a decline in the number of articles accepted by journals. The fluctuations in the number of publications over the years can be partially explained by the study by Horbach (2020) who observed the agility of journals in their peer review and publication processes, allowing for faster dissemination of research related to COVID-19.

Figure 2: Evolution of publications over time

Source: Web of Science and Scopus, compiled by the authors

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4.2 Characterization of Methodologies and Approaches

The search for understanding social interactions in virtual teams is indicated by the fact that 48% of the methodologies adopted questionnaires and a single case study for research development (Table 2). Reinforcing this idea, 55% of the studies are qualitative, a typical approach for the perception of factors, causes, and agents in the phenomena studied (Table 3). Creswell (2010) clarifies that a qualitative study aims to understand the meaning of a social or human phenomenon. A quantitative approach lends itself to deductively testing relationships and theories. Studies adopting deductive, descriptive, or exploratory approaches (87%) demonstrate the investigative nature of research (Table 4).

Table 2: Method

Amt	Methodology	%
20	Survey	32%
10	Single case study	16%
10	Others	16%
7	Mixed methods	11%
5	Experiment	8%
4	Ground Theory	6%
2	Action search	3%
2	Multiple case studies	3%
1	Delphi	2%
1	Not applicable	2%

Source: Authors

Tabule 3: Research nature

Amt	Nature of Research	%
34	Qualitative	55%
19	Quantitative	31%
7	Not applicable	11%
2	Mixed methods	3%

Source: Authors

Table 4: Approaches

Amt	scientific approach	%
30	Deductive	48%
14	Descriptive	23%
10	Exploratory	16%
5	Abductive	8%
3	Explanatory	5%

Source: Authors

4.3 Authors and Publications

Table 5 presents the most prolific authors in subjects related to the research themes, a total of three, each with two articles published.

Table 5: Most Published Authors

Amt	Authors with more publications	Published articles
2	Borgatto, A.F.	Effectiveness of Games in Software Project Management Education: Am Experimental Study (2019) Games for Teaching Software Project Management: An Analysis of the Benefits of Digital and Non-Digital Games (2018)
2	Lingard, H.	Exploring the Dynamic Social Interactions that Underpin Work Health and Safety Related Design Decision-making (2017) Understanding the Dynamics of Construction Decision Making and the Impact on Work Health and Safety (2017)
2	Pirzadeh, P.	Exploring the Dynamic Social Interactions that Underpin Work Health and Safety Related Design Decision-making (2017) Understanding the Dynamics of Construction Decision Making and the Impact on Work Health and Safety (2017)

Source: the authors

This analysis identified the occurrence of co-authorship in the selected articles. Table 6 presents published authors and studies.

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Table 6: Grouping of co-authored authors publication.

Clusters		Co-authored articles or co-citations
1	Lingard, H	Understanding the Dynamics of Construction Decision Making and the Impact on Work Health and Safety (2017)
	Pirzadeh, P	Healthy, Happy Workers? The Consequences of Commuting between Northern Ireland and Great Britain (2018)
		Exploring the Dynamic Social Interactions that Underpin Work Health and Safety Related Design Decision-making (2017)
2	Chan, P W	Opening Up Risk Management Through Goffman's Dramaturgical Approach (2016)
	Neilson, C J	Sizwe Banzi is Dead: the Aberrant Case of Construction Sector Identity (2017)
		Exploring the Dynamic Social Interactions that Underpin Work Health and Safety Related Design Decision-Making (2017)
		Healthy, Happy Workers? The Consequences of Commuting between Northern Ireland and Great Britain (2018)
3	Bittner, E A C Brugger, M Tavanapour, N	Theory-Driven-Design for Open Digital Human Collaboration Systems (2019)

Source: the authors

Although the survey shows there are no outstanding authors in terms of number of publications, Table 7 presents the two researchers with the highest number of publications and co-citations (Tables 5 and 6), their study topics, and proposals for the research agenda (Table 9).

Table 7: Most productive authors

Authors	Publications	Co-authors	H Index	Research topics	Proposals for future studies
Lingard, H.	2	3	37	Mental health	Further research is recommended to ensure that the impacts of work patterns on worker well-being are mitigated as much as possible.
Pirzadeh, P.	2	3	9		

Source: the authors

4.4 Theories and Concepts

To understand which concepts and theories about interpersonal relationships in virtual teams are trending in studies, we used the VOSviewer® application to identify the co-occurrence of terms. Table 8 presents the research focus and cited authors; listed in the 62 analyzed articles. For that, we only list theories and concepts related to social interactions; listed in the theoretical references, conclusions, and proposals for future research in the selected studies. Thus, we guarantee fidelity to the proposal of this research.

Table 8: Theories and concepts

Amt	Theories and concepts	Cited authors
23	knowledge sharing	Nonaka e Takeuchi (1995); Goffin e Koners (2011); Mueller (2015)
17	Social Identity	Tajfel (1972); Erikson (1968)
16	team cognition	Hansen et al. (2012; Hollan et al. (2000); Nemeth et al. (2006)
7	Psychological Safety	Edmondson (1999)
4	absorptive capacity	Duffield e Whitty (2016); Ali et al. (2018)

Source: authors

Below we highlight how the theories and concepts are used in the listed articles, highlighting the main foundations used in the studies.

4.4.1 Knowledge sharing

Fauzi (2022) claims in the twentieth century, competition is natural in business. Competition combined with digitized globalization demands synergy between team members and sharing of knowledge in companies. Knowledge is a crucial asset in companies, as it

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promotes competitive advantages in virtual teams, directly relating to the understanding and awareness of social connections, conceived and negotiated through social interactions (Olaisen and Revang, 2017). The construct represents action and development, and Nonaka (1994) conceptualizes it as dynamic, personal, and subjective of a socially constructed nature and, even with limited social ties, it is relevant for knowledge sharing (Granovetter, 1973).

4.4.2 Social identity

In 1972 Henri Tajfel proposed an understanding of identity through sociology, showing that it is a component of the self-concept defined by our belonging to social groups (Akhilesh et al., 2013). Tajfel (1972, p. 292) states that social identity is an "individual's knowledge that he belongs to certain social groups, along with some emotional and value meaning for him as a member of that group". Thus, social identity can be described as a configuration that gradually integrates constitutional data, peculiar libidinal needs, favored capacities, meaningful identifications, effective defenses, successful sublimations, and consistent roles (Erikson, 1968).

Group identification can have even greater significance in virtual teams (Walther, 1997). Weigel et al. (2020) highlight the leader's role in this construction, as their responsibility is to foster a culture of belonging, listening, and empathy. In the team, managers must develop the capacity for communication, internal conflict resolution, and awareness of goals (Lin and Roan, 2022). In a broader sense, human resource management must be able to plan the preparation of a remote team for the project, as emphasized by Gallego et al. (2021).

4.4.3 Team cognition

Team cognition is understood as the act of sharing knowledge of the project team among team members, with their processes and task-specific information, directly impacting team performance (Fiore and Salas, 2004). Oliveira, Marques, and Machado (2020, p. 80) highlight the importance of team cognition in efficiency in virtual teams, defined as "the set of knowledge, beliefs, values, norms, and expectations shared by team members that influence how the team processes information and makes decisions". Sharari et al. (2022) concluded that fragmented information is a source of divergence and cognitive limitation, limiting team members from making safe decisions, although trust and strong ties are resources to minimize misunderstandings and eliminate cognitive gaps in teams.

4.4.4 Psychological safety

Edmondson (1999, p. 354) presents psychological safety as: "a belief shared by team members that the team is safe to take interpersonal risks". This concept has helped researchers in the study of organizational learning behavior (Nembhard and Edmondson, 2006). It is a collective event, in which team members can think independently, feeling protected from taking risks, because there is trust and mutual respect in the team (Edmondson, 2004). Effective virtual teams develop and maintain trust and psychological safety, resulting in enhancing connections between colleagues and providing determination that the task can be completed and any doubts can be raised (Sumathipala, 2020).

4.4.5 Absorptive capacities

Absorptive capacity (AC) is the ability of a company to absorb knowledge from various sources and employ it in the management of upcoming projects (Duffield and Whitty, 2016). The relevance of AC stands out in the fields of strategic management (Lane and Lubatkin, 1998; Nahapiet and Ghoshal, 1998), technology management (Schilling, 1998), and global markets (Glass and Saggi, 1998). Although increasingly used, the AC construct is ambiguous in its definitions (Zahra and George, 2002). Joglekar et al. (1997) corroborate the thought by

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declaring that there is a demand for a greater understanding of the domain and its operationalization.

A study by Gao et al. (2021) investigated the relationship between absorptive capabilities and efficiency in virtual teams. The authors claim that AC is positively related to the efficiency of virtual teams. The authors go further, suggesting that open communication and collaboration among team members are crucial to improving AC in virtual teams. In a similar survey, Cabrera et al. (2002) examined how absorptive capabilities affect performance in virtual teams. They conclude that the combination of individual and team absorptive capacities is a significant indicator of performance in virtual teams.

4.5 Research Trends and future agenda

Snyder (2019) highlights the assertive character of all SLRs. This approach must present research agendas relevant to the listed themes, or propositions on which researchers develop the field of study. This methodology needs to offer the opportunity to build a theoretical basis for future research (Alves-Mazzotti, 2002). The analysis summarized the research proposals in the selected articles, based on the criterion of clearly perceiving the research question or objective and methodology, together with the suggestions for future studies presented by the authors, always associated with the relationship between virtual teams and social interaction (Table 9).

Table 9: Research agendas proposed in the sample of articles analyzed.

Purpose or Research Question	Methodology and approaches	Proposal for future studies
Understanding the design-based learning context (DBL) and the associated emotional experience. (Zhang et al. 2022)	Exploratory qualitative questionnaire	Pursue a more refined understanding of the dynamic DBL process, such as the level of iteration and multitasking.
Help project managers understand and manage fuzziness and create lasting front-end value. (Sharari et al., 2022)	Multiple case study, qualitative, exploratory	Provide more sophisticated social theories and relevant practices that deliver better stakeholder value and higher success rates; exploit inaccuracies throughout the project lifecycle.
Has the South African construction sector supported the development of professional identity? What other identity surveys can improve the performance of the construction sector? (Hammond and Cattell, 2017)	Literature review, qualitative, descriptive	The authors' suggestion is to improve project management results, again concluding the need for more research on the relationship between identity and performance.
The aim is to understand the use, role and impact of humor by the interacting group members of a construction project. (Ponton et al., 2020)	Single case study, qualitative, exploratory	Future research should allow for greater understanding of participants' perceptions or feelings and member differences, eg personality, which may shape the areas of humour, innovation and decision-making.
How does distributed cognition (DCog) in ASD teams change as an iteration progresses? How do team members' interactions with each other and the cognitive artifacts used by the team change as the team's DCog changes? (Drury-Grogan, 2021)	Multiple case study, qualitative, exploratory	Future research could examine the concepts studied here with other ASD (agile software development) teams to validate the team's cognition changes.
Examine whether and how the gender composition of virtual communities (VCs) interacts with identity-related needs, ie identity identification and confirmation affecting VC participation. (Shen et al., 2017)	Questionnaire, quantitative, exploratory	How or under what conditions would identity confirmation strengthen/weaken the identification of members in a virtual community?

Source: the authors

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Table 9: Research agendas proposed in the sample of articles analyzed (Continuation).

Purpose or Research Question	Methodology and approaches	Proposal for future studies
How are global team members oriented towards participation? How are guidelines for participation developed? How are participation guidelines related to team effectiveness? (Gibbs et al., 2021)	Mixed methods, quantitative, descriptive.	Systematically examine a larger sample of diverse teams to confirm the unique characteristics of the three orientations: helping, learning, and engaging and their implications for team effectiveness.
Determine the compatibility of the theories' central principles and propositions to explain and predict changes in perceptions, attitudes and behaviors resulting from computer-mediated interaction. (Santucci, 2021)	Literature review, qualitative, descriptive	Test the SIDE (Social Identity of Deindividuation Effects) theory in the specific situation to find out how particular media characteristics affect changes in self-concept.
The study aims to advance the theoretical understanding of the association of interpersonally mediated social interactions with the sharing of interpersonal knowledge at the dyadic level. (Qureshi et al., 2018)	Questionnaire, quantitative, descriptive	Designing emerging technologies useful for creating social ties mediated by interpersonalityI, such as the organizational adoption of SNS (social networking sites).
The article proposes a model for understanding the joint effects of design and social interaction theories on cooperative behavior versus self-interest in distributed teams (in different media). (Håkonsson et al., 2016)	Literature review, qualitative, descriptive	Given that more and more companies communicate through different media, it seems a subject worthy of future studies.
The aim of this study is to empirically investigate the factors that are capable of influencing knowledge sharing within the OSMA (Open Source Mobile Application) development project in project sharing. (Widjaja et al., 2017)	Literature review, qualitative, descriptive	Future research may incorporate different dimensions of social capital theory to empirically investigate the knowledge of OSMA (Open Source Mobile Application) developers in sharing projects.
The purpose of the study is to expand current understanding of the willingness of virtual team (VT) workers to continue working in VTs and the forces that drive their affective reactions to teamwork. (Rogers et al., 2021)	Questionnaire, quantitative, descriptive	Future research can explore the impact of skills, interactions, and processes on repeated team experiences to uncover teams' adaptation and experiences over time (Dulebohn and Hoch, 2017).
A review of academic literature along with news sources, observations and interviews with individuals working in GVTs (Global Virtual Teams) in the oilfield. (Holding Eagle, 2020)	Literature review, qualitative, descriptive	To maximize their effectiveness, oilfield producers and service organizations need to provide training and resources for their GVTs that help overcome cultural differences and the challenges inherent in remote and asynchronous working.

Source: the authors

In addition to incorporating the state of the listed topics, literature reviews should offer recommendations for future research (Kraus et al., 2020); this genre of academic research makes it possible to conduct subsequent studies, offering research agendas in the addressed fields (Webster and Watson, 2002). In this research, five SLRs were found (Table 9), and below we develop the themes highlighted in the observed proposals.

4.5.1 Social identity

Shen et al. (2017) state that social identity is the composition that outlines communication strategies and norms of social interaction in participants of virtual communities. The authors conclude by stating that the construct is the composition of gender that influences the expectations of identification and confirmation of identity in virtual communities. They highlight the need for further studies on how identity confirmation would or would not strengthen members' identification with a virtual community.

Although team members bring their own creative identities to organizations, these identities are shaped by the organizational environment in which they interact (Uddin et al.,

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2019). This statement motivated Awe and Church (2021) to conduct a study showing the influence of mutual trust and social interaction on the flexibility and creativity of projects. Alternatively, Han (2018) showed that previous ties are a potential threat to group identity, making it difficult to build team identification and develop interpersonal relationships.

4.5.2 Social capital

Social capital can be defined as "the characteristics of social organizations, such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit" (Putnam, 1995, p. 67). Tsai et al. (2014, p. 17) complement the idea, claiming that "relationships between people are the invisible synthesis that holds social networks together, motivating cooperation aimed at a shared goal". Naik et al. (2010) specify social interaction formed by socio-emotional and decision-making processes as determining factors for the effectiveness of the virtual team. Cecchi et al. (2022) develop the concept of "half-life of tacit knowledge", indicating the need to maintain the potentially fragile aspect of global teamwork as a critical point for product development, highlighting the priority in developing social capital to make remote work effective.
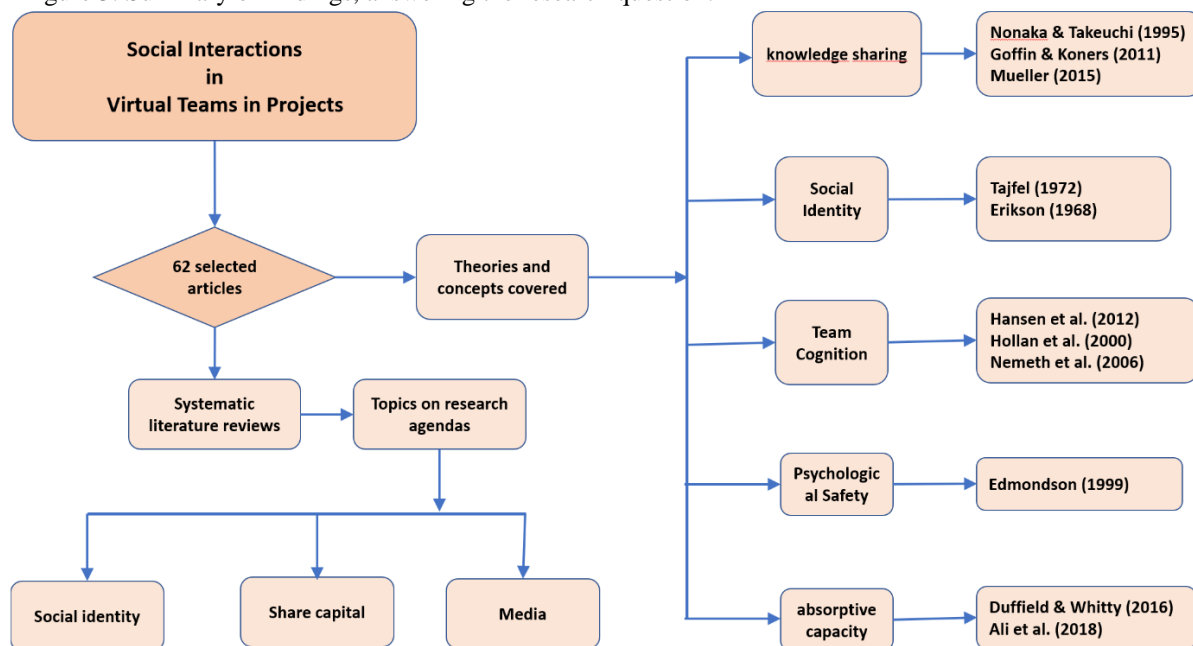
4.5.3 Medias

Social networks are an excellent way to improve communication and increase empathy among team members (Orta-Castañon et al., 2018). Interactive communication and collaboration occur when using social media tools, helping engineering and designers to have synchronous communication with the team, and allowing for interactive responses to questions. Social media can promote the formation of employees' social capital, indicated by network ties, shared vision, and trust, and in turn facilitate knowledge transfer (Cao et al., 2016).

4.5.4 Schematic Synthesis of Results

Figure 4 schematically summarizes the answer to the research question proposed in this study: What is the state of social interactions in projects with virtual teams?

Figure 3: Summary of findings, answering the research question.

Source: the authors

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4. Discussion

This research reinforces that the effectiveness of virtual project teams is closely associated with developing their own behavioral characteristics, which, if improved, lead the teams to excellence. When team members strongly identify with the group, they can perceive the team's success as a direct reflection on their self-esteem and self-concept. This can lead to an increase in individual effort and performance to contribute to team success (D Robert Worley, 2021).

For Hertel, Geister, and Konradt (2018), factors such as trust between team members, clear communication, and defining clear objectives are fundamental to the success of a virtual team. People tend to be more cooperative and work better together when creating opportunities for creative solutions based on knowledge sharing (Zhang et al., 2020; Haslam et al., 2009). The concept of sharing knowledge in virtual teams appears in 23 of the 62 articles studied. The authors suggest encouraging this distribution through rewards and recognition, developing a culture, and valuing collaboration and group work (Zhang et al., 2020). Xu and Li (2021) highlight the importance of positive feedback as a facilitator of these exchanges, improving problem-solving and decision-making. Considering the organizational side, Li et al. (2020) advocate implementing easy-to-use and accessible knowledge-sharing systems, improving communication, collaboration, and coordination among members of virtual teams.

Building social identity in virtual teams can be an important tool for building team efficiency. Lo Presti and Zizzo (2021) mention that constructing social identity in virtual teams is a factor in improving communication and collaboration between team members. The authors suggest that creating a sense of belonging and shared identity can help overcome virtual communication barriers and improve team efficiency. Complementarily, Guo et al. (2020) teach that building social identity in virtual teams can improve the trust and commitment of team members. They highlight that creating a shared identity can help establish shared norms and values, reducing the probability of deviant behavior.

Team cognition is a crucial factor for efficiency in virtual teams, formed by the interaction between team members and influenced by the diversity of knowledge, skills, and experiences (Oliveira, Marques and Machado, 2020). Although it raises challenges in communication and coordination, making it necessary to improve shared cognition (Kuziemsky, Maeder and Zhang, 2019), cognition can be improved using collaboration and communication technologies. Specifically, cognitive diversity enhances team conflicts, increasing the responsibility of leaders, who must promote such diversity while simultaneously being able to manage such conflicts (Kim and Hinds, 2021).

Associated with team cognition, media plays a key role in promoting efficiency in virtual teams. According to Liang and Li (2020), virtual communication is one of the main tools used to coordinate activities and maintain collaboration between members of virtual teams. Wang et al. (2021) identified that using virtual communication platforms, such as Zoom® and Microsoft Teams®, can improve the efficiency of virtual teams. These platforms allow for real-time communication, file sharing, and virtual meetings, enabling greater interaction between team members and faster decision-making. In addition, using collaborative tools, such as Google Drive® and Trello®, can facilitate project management in virtual teams, allowing all team members to have access to information and updates in real-time (Alnuaimiet al., 2010).

5. Final considerations

Our analysis identified five groupings of theories and concepts most discussed in the articles. In reviewed studies, five articles developed a systematic literature review, from which

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we present a synthesis of proposals for future research. As for the future research agenda, our analysis of the 62 articles identified several suggestions. However, it is possible to highlight that the search for understanding social identity in virtual teams is a relevant topic. The concept of social identity, present in 17 articles studied, is proposed as an agenda for studies in systematic literature reviews.

Liu et al. (2021) also advocate further research on the relationship between team identity and virtual team efficiency in software projects. The authors identified that a strong team identity is positively related to virtual team efficiency, measured in terms of product quality, project completion time, and customer satisfaction. Liu et al. (2021) suggest further studies developing the idea of the team identity constructed through activities to promote social interaction between virtual team members, such as regular meetings via videoconference and creating a shared virtual work environment.

In a systematic review of the literature, Van Bavel et al. (2018) claim that identity is a critical factor for virtual teams' performance. When team members share a common identity, they are more likely to cooperate, communicate effectively, and coordinate their activities more efficiently. In the same year, Hertel et al. (2018) examined impacting factors on the efficiency of virtual teams, concluding that team identity is a critical element affecting the cohesion and effectiveness of teams. Both surveys suggest the continuity of studies exploring these relationships.

As a contribution, this systematic literature review adds to theoretical knowledge a state-of-the-art synthesis of the relationship between social interactions in virtual teams in projects. We identify the concepts and theories addressed by the authors dedicated to the study of the themes and highlight research agendas in the selected articles and specifically in the literature reviews listed in the analyzed period.

Research on social interactions in virtual teams is essential because it helps to understand how social interactions can be adapted to the virtual environment, improving the effectiveness and efficiency of teams, as well as contributing to the health and well-being of its members. Forming a strong team identity can be particularly important for the performance of virtual teams, helping to create a sense of shared purpose and a sense of belonging, even in geographically dispersed teams. It is extremely relevant for teams to understand how social interactions can be adapted to the virtual environment to improve the effectiveness and efficiency of teams. There is a gap in this research in not exploring the possible synonyms for the topics addressed.

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