LEARNING TO (CO)EVOLVE: A CONCEPTUAL REVIEW AND TYPOLOGY OF NETWORK DESIGN IN GLOBAL HEALTH VIRTUAL COMMUNITIES OF PRACTICE

Kari Eller*	University of Georgia, Department of Lifelong Education, Administration, and Policy, Athens, GA, United States	Kari.eller@uga.edu

* Corresponding author

ABSTRACT

Aim/Purpose	This conceptual review analyzes the designs of global health virtual communities of practice (VCoPs) programming reported in the empirical literature and proposes a new typology of their functioning. The purpose of this review is to provide clarity on VCoP learning stages of (co)evolution and insight into VCoP (re)development efforts to best meet member, organization, and network needs against an ever-evolving landscape of complexity in global health.
Background	Since the COVID-19 pandemic, the field of global health has seen an uptick in the use of VCoPs to support continuous learning and improve health outcomes. However, evidence of how different combinations of programmatic designs impact opportunities for learning and development is lacking, and how VCoPs evolve as learning networks has yet to be explored.
Methodology	Following an extensive search for literature in six databases, thematic analysis was conducted on 13 articles meeting the inclusion criteria. This led to the development and discussion of a new typology of VCoP phases of learning (co)evolution.
Contribution	Knowledge gained from this review and the new categorization of VCoPs can support the functioning and evaluation of global health training programs. It can also provide a foundation for future research on how VCoPs influence the culture of learning organizations and networks.

Findings	Synthesis of findings resulted in the categorization of global health VCoPs into five stages (slightly evolving, somewhat revolving, moderately revolving, highly revolving, and coevolving) across four design domains (network development, general member engagement before/after sessions, general member engagement during sessions, and session leadership). All global health VCoPs reviewed showed signs of adaptation and recommended future evolution.
Recommendations for Practitioners	VCoP practitioners should pay close attention to how the structured flexibility of partnerships, design, and relationship development/accountability may promote or hinder VcoP's continued evolution. Practitioners should shift perspective from short to mid- and long-term VCoP planning.
Recommendations for Researchers	The new typology can stimulate further research to strengthen the clarity of language and findings related to VCoP functioning.
Impact on Society	VCoPs are utilized by academic institutions, the private sector, non-profit organizations, the government, and other entities to fill gaps in adult learning at scale. The contextual implementation of findings from this study may impact VCoP design and drive improvements in opportunities for learning, global health, and well-being.
Future Research	Moving forward, future research could explore how VCoP evaluations relate to different stages of learning, consider evaluation stages across the totality of VCoP programming design, and explore how best to capture VCoP (long-term) impact attributed to health outcomes and the culture of learning organizations and networks.
Keywords	global health, virtual community of practice, continuous learning, complexity

INTRODUCTION

For over two decades, Virtual Communities of Practice (VCoPs) have served across societal sectors as mechanisms to manage knowledge and sustain innovation (Dubé et al., 2006). Using primarily digital interactions like videoconferencing and discussion boards, VCoPs "transcend space and time" (Dubé et al., 2006, p. 69; Wenger-Trayner & Wenger-Trayner, 2015), connecting people in different geographical areas around a shared domain and practice. Open-ended responses about engagement in VCoP events and activities like the ones below provide a snapshot of the value participants may assign to their programming.

- "The experience sharing, the discussion on a peer challenge, the different interventions (facilitators, peers) allowed me throughout the session to improve my work (the way to performance). This sharing was very rewarding, because we learn a lot by helping others and/or by sharing with others" (K. E. Watkins et al., 2022, p. 5).
- "It was about the knowledge sharing … advocacy … the support roles and … trying to collate information from various authoritative sources" (Mullan et al., 2022, p. 266).
- [The program was helpful because …] "Explaining an idea to others helps to identify its most important aspects" (Nguyen et al., 2023, p. 6).
- "This was the best! So cool to hear what everyone is doing! Lots of innovation during this difficult time. Seriously-this should be happening more often to share ideas" (Silverstein et al., 2022, p. 5).

Like learning in Communities of Practice (CoPs), learning in VCoPs can be informal, incidental, and span local to international levels (K. E. Watkins et al., 2018; Wenger-Trayner & Wenger-Trayner, 2015). Thus, the nature of VCoPs makes it easy to bridge the gap between "typically resource-rich,

usually urban, academic centers and those in resource-scarce, usually remote and rural areas" (Masroori et al., 2022, p. 2). As such, VCoPs have been utilized by academic institutions, the private sector, non-profit organizations, the government, and other entities to fill gaps in adult learning, providing opportunities like continuing professional development, interprofessional education, and continuing medical education (Masroori et al., 2022; Shaw et al., 2022; Wenger-Trayner & Wenger-Trayner, 2015).

In the field of global health, VCoPs have sought to unite and support health professionals in their collective efforts to improve healthcare processes and outcomes (Barnett et al., 2012; Masroori et al., 2022; Shaw et al., 2022). Individuals participating in global health VCoPs may be community health workers, nurses, doctors, allied health professionals, or other positions connected to or supporting healthcare. These individuals may operate in local to international contexts and work privately or for healthcare entities like hospitals, consulting firms, educational/research centers, epidemiology offices, ministries of health, or global health organizations/alliances (Shaw et al., 2022). While global health VCoPs offer new possibilities to fill the structural holes (Burt, 2004) dug by wicked challenges like climate change, no one community is the same, and their designs vary from more formal to informal learning experiences (Dubé et al., 2006; Shaw et al., 2022; Wenger-Trayner & Wenger-Trayner, 2015). Numerous frameworks and guiding principles have supported the development and evaluation of global health VCoPs across various healthcare challenges. However, even among VCoPs with similar healthcare challenges, methodological and theoretical differences are not well documented (Shaw et al., 2022), and a typology of how they function amid complexity is lacking (Sibbald et al., 2022). Furthermore, VCoPs promote networked learning in the community, but how they evolve as learning networks (Carvalho & Goodyear, 2014) has yet to be explored.

Given the versatility of VCoPs to serve a variety of purposes and the seemingly endless possibilities of their composition, numerous interdisciplinary studies have documented different aspects of the VCoP design process. These studies discuss VCoP design concepts, such as the need for emerging designs (Amaratunga, 2014), learner-centered considerations (Murad et al., 2016), iterative, systemic development (D. R. Watkins et al., 2017), community-based principles (Romero-Mas et al., 2020), and the pillars of technology-based learning environments (Fragou, 2020). Dubé et al. (2006) created a typology of VCoP "key structuring characteristics" (p. 70). Their work built upon that of other CoP models, sharing the stages of development and maturation (Wenger et al., 2002) and moved beyond generalized descriptions of VCoPs to distinguish them as "unique personalities" (Dubé et al., 2006, p. 69). Whether spontaneously emerging or intentionally fostered by organizations, the authors outlined how VCoPs may be described characteristically (i.e., age, membership size) and categorized along a continuum of increasing complexity (Dubé et al., 2006, p. 72). However, while the typology created by Dubé et al. (2006) offers great insight to 'set the scene' through characteristics indicative of potential life cycle shifts of VCoPs, it does not focus on how combinations of their diverse designs may impact opportunities for learning and development. This conceptual review and typology build on the recommendation of Dubé and colleagues for future research to "cluster the VCoPs into generic types leading to the identification of different configurations of VCoPs" (Dubé et al., 2006, p. 89). By analyzing their functioning in global health, an area that saw a surge of VCoPs during the COVID-19 pandemic (Shaw et al., 2022), it aims to provide complementary and necessary information for evaluation. As the authors stated, such knowledge is needed to "analyze the challenges that specific configurations of VCoPs are more likely to face and investigate the management decisions/actions that can be taken" (Dubé et al., 2006, p. 89).

This paper begins by stating the purpose and methods for conducting a conceptual review of the empirical literature on global health VCoPs. It proceeds by presenting the findings from a thematic analysis of global health VCoP designs. Next, it uses the findings from the review as a foundation to propose a new typology of VCoP functioning and uses the typology to categorize the evolution of the global health VCoPs conceptually reviewed. Then, a discussion integrates information from the conceptual review and typology and links findings to the broader literature on learning organizations and

networks. Finally, the paper concludes with the limitations of the study, future directions for its extension, and a summary of all findings.

RESEARCH PURPOSE AND METHODS

The purpose of this conceptual review is to provide clarity on VCoP learning stages of (co)evolution and insight into VCoP (re)development efforts to best meet member, organization, and network needs against an ever-evolving landscape.

To search for articles, I developed a Boolean search query that contained combinations of the search terms: (1) informal/incidental/non-formal learning/education, (2) virtual/online/digital/global community* of practice/network/learning/meeting/exchange*/peer to peer exchange*/learning experience*, and (3) global/international/world/transnational/universal/cross-cultural (public) health (sphere/education). I searched independently in the following databases/AI: EBSCO, PubMed, Google Scholar, EBSCO, Semantic Scholar, and SciSpace in September 2023. Articles meeting the following criteria were eligible for inclusion: (a) English/Spanish language, (b) published in a peer-reviewed journal, (c) empirically based, and (d) published within the last five years (2018-2023). I independently collated and screened the initial database yield of 983 returns. Following the removal of duplicates and a title/abstract review for at least two of the three main investigation areas (global health, informal and/or incidental learning, virtual/online community/exchange/experience), a total of 72 articles were considered for full-text review. After a full-text review to focus only on articles directly related to the topic, 58 articles were excluded. Excluded articles did not discuss VCoPs with synchronous activities, include VCoP data collection/evaluation information, or reflect global health (not formal education). Of the 14 remaining articles, one additional was removed as it was referenced in a scoping review selected for this study; thus, 13 articles were included in the current review.
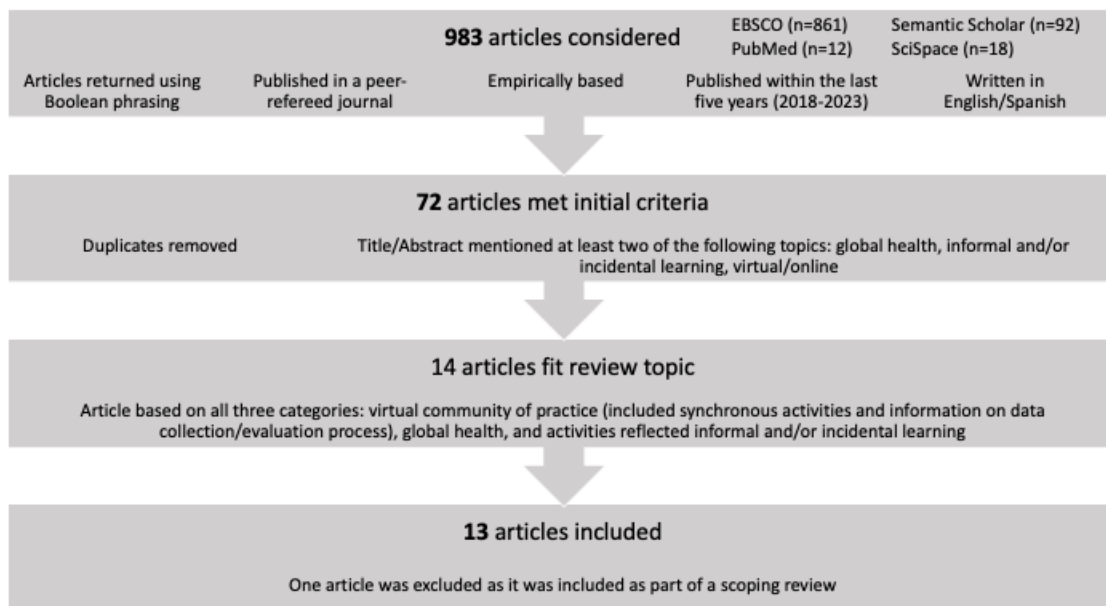
Figure 1. Diagram of the article selection process

Thematic analysis was exploratory, critical, and inductive, following a six-phase process (Braun & Clarke, 2006). To minimize the risk of personal bias throughout all phases, I regularly sought and incorporated feedback from university colleagues on the review process (article search, steps, analysis) and products (codes, themes, phases, stages). All findings were grounded in verbatim quotes to further mitigate potential bias/conflict of interest. In step one (data familiarization), I read, re-read, and took notes on VCoP characteristics and design in each article. In step two (coding), I inductively

compiled a list of different VCoP design categories shared across all literature. Using the summarized list of codes, I created several spreadsheets (Tables 1-3) of VCoP design with a critical lens, viewing what was (not) shared in each study to constitute VCoP design. In step three (initial theme generation), I reviewed all collated data to see the broad VCoP design patterns and sub-patterns (i.e., (re)development). In step four (developing and reviewing themes), I combined information from all initial themes to outline a new typology of three VCoP phases of learning (i.e., evolving). In step five (refining, defining, and naming themes), I further defined and delineated the three phases into five stages (i.e., complexly coevolving) according to the collated data. Completing the analysis in step six (writing up), I used the typology to map the studies according to the stage. Additionally, I discussed the typology in reference to learning organizations and learning networks, sharing how VCoP phases are social (re)constructions of open and closed systems. The review concludes with limitations, future directions, and a summary of all findings and connections.

THEMATIC ANALYSIS

Thematic analysis revealed two major themes. The first theme, structured flexibility, encompasses the array of VCoP designs and the redevelopment of (a)synchronous activities. The second theme, a hierarchy of learning in VCoPs, relates their designs to opportunities for learner engagement.

STRUCTURED FLEXIBILITY

Throughout the literature, structured flexibility was evidenced in VCoPs (1) (re)development, (2) meeting frequency, (3) (a)synchronous activities, and (4) reflection on current practice. While some VCoPs leaned more heavily on the structured side, others demonstrated great flexibility to adapt to the global scene, members' needs, and network goals. All VCoPs reviewed showed signs of adaptation and recommended future evolution based on findings, whether more bent toward structure or flexibility.

(Re)development

The VCoP described in Gould et al. (2019), was established in 2016 when the National Syndromic Surveillance Program recognized the need to build local and state capacity beyond its technical infrastructure. However, the majority of VCoPs developed/reorganized as a result of the COVID-19 pandemic, a time in our global history characterized by a heightened need for health education to bridge research and practice on the frontlines of care (Erklauer et al., 2022; Hunt et al., 2021; Lucero et al., 2020; Masroori et al., 2022; Mullan et al., 2022; Shaw et al., 2022; Sibbald et al., 2022; Silverstein et al., 2022; Swords et al., 2021; K. E. Watkins et al., 2022; Wilson et al., 2021). Some previously established in-person CoPs flexed their structure to virtually connect with health leaders already participating in their networks (Erklauer et al., 2022; Shaw et al., 2022) while others began virtually to address contextual circumstances and goals (Hunt et al., 2021; Lucero et al., 2020; Masroori et al., 2022; Mullan et al., 2022; Nguyen et al., 2023; Shaw et al., 2022; Sibbald et al., 2022; Silverstein et al., 2022; Swords et al., 2021; K. E. Watkins et al., 2022; Wilson et al., 2021). The (re)development of VCoPs also provided structured but flexible opportunities for VCoPs to expand their networks through specific, more cost-effective ways of engagement. For example, VCoPs were more accessible to health leaders in rural areas and to health leaders who lacked transportation, funding, or the ability to travel due to reasons such as time, personal, or financial constraints (Hunt et al., 2021; Lucero et al., 2020; Masroori et al., 2022; Mullan et al., 2022; Shaw et al., 2022; Silverstein et al., 2022).

Meeting frequency

In addition to expanding network structures and access, global health VCoPs demonstrated structured flexibility in meeting frequency to meet member needs and community goals. Studies reflected VCoPs either meeting quarterly (n=1), monthly (n=3), one to two times per week or once every two weeks (n=5), for a set number of times (n=2), or shared gathering regularly but did not state meeting

frequency (n=2). Special ad hoc sessions/events also demonstrated VCoP meeting flexibility to alter sessions in response to (global) needs.

(A)synchronous activities

VCoP's structured (a)synchronous activities flexibly provided members with various points of connection to networked knowledge. On top of virtual meetings, several studies mentioned other opportunities for VCoP synchronous engagement, including self-directed individual networking (n=2), small groups/workgroups/committees (n=2), telementoring (n=2), and ad hoc virtual or in-person sessions/events (n=6). Small groups/workgroups/committees could collaborate synchronously or asynchronously per group need/interest. In all studies (n=13), opportunities for VCoP asynchronous engagement were provided through website/repository access, with participants having access to curated resources like recorded sessions, technical references, literature, project information, and messaging/discussion boards. Other opportunities for asynchronous engagement included online forums/discussion boards and online data sharing such as emails, newsletters, and social media exchanges (n=8), and one VCoP described members' access to institutional online courses.

Table 1. (A)synchronous activities

Study information	Synchronous activities						Asynchronous activities		
First author and year	Meeting frequency [q]uarterly, [m]onthly, [w]eekly, [r]egularly, [bw] bi-weekly, [s#] set number	Webinar/videoconference call/virtual meeting/virtual session/podcast	Individual networking	Workgroup/committee/small group *Note: collaboration could be (a)synchronous	Telementoring	Special or ad hoc (virtual or in-person) sessions/events/conferences	Website/repository	Forum/discussion board/email or data sharing	Online courses
Erklauer et al. (2022)	[M]	[X]					[X]	[X]	
Gould et al. (2019)	[M]	[X]	[X]	[X]			[X]	[X]	
Hunt et al. (2021)	[W]	[X]				[X]	[X]		
Lucero et al. (2020)	[S7]	[X]				[X]	[X]		
Masroori et al. (2022)	[W]	[X]					[X]		
Mullan et al. (2022)	[R]	[X]					[X]	[X]	
Nguyen et al. (2023)	[BW]	[X]		[X]		[X]	[X]	[X]	
Shaw et al. (2022)	[R] varied per study	[X]			[X]		[X]	[X]	
Sibbald et al. (2022)	[Q]	[X]	[X]		[X]	[X]	[X]	[X]	[X]

Study information	Synchronous activities					Asynchronous activities		
Silverstein et al. (2022)	[M] regular series [W] special ad hoc	[X]				[X]	[X]		
Swords et al. (2021)	[S5]	[X]					[X]	[X]	
K. E. Watkins et al. (2022)	[W]x2	[X]				[X]	[X]	[X]	
Wilson et al. (2021)	[W]	[X]					[X]		

Future practice recommendations

Based on study findings, partnerships, design, and relationship development/accountability were understood as essential in VCoP processes. For future VCoP practice, studies recommended their continued evolution to reflect more structured flexibility. Recommendations for the continued evolution of these areas imply a shift in perspective from short to mid- and long-term VCoP planning.

Partnerships. Focusing on new/deepened partnerships with like-minded organizations was one recommendation to support VCoP growth and lower resource intensity through technical, logistical, and accreditation support (Erklauer et al., 2022). In this regard, partnering could be understood as creating a branded platform that several organizations can use as needs arise on the same topic. As explained, this arrangement could promote social cohesion and collaboration while developing unique VCoP identities (Shaw et al., 2022). Flexible and delineated (structured) partnership was therefore seen to increase VCoP sustainability (Wilson et al., 2021).

Design. Nguyen et al. (2023) recommended that VCoPs consider frameworks that support "distributed, purpose-driven, self-organized teams" to promote cross-disciplinary mentoring/resource sharing. It was also recommended that VCoPs focus activities on community engagement (K. E. Watkins et al., 2022) in ways that promote a collaborative, team-based approach (Swords et al., 2021). Building in sufficient time for participant active engagement was further noted as needed to build community, get feedback, promote relevant topics, and make modifications (Shaw et al., 2022; Wilson et al., 2021), such as customizing online knowledge repositories to members' wants and needs (Silverstein et al., 2022).

Relationship development and accountability. The literature revealed a variety of perspectives about VCoP leadership accountability to relationship development with its members. Three studies contributed that VCoP leadership should focus on respect, reciprocity, and non-competitiveness (Hunt et al., 2021; Lucero et al., 2020; Shaw et al., 2022). K. E. Watkins et al. (2022) stated the importance of brokering in continuing to connect people on different healthcare system levels in knowledge exchange. Silverstein et al. (2022) highlighted the need for VCoPs to consider how members may continue interactions in between meetings, and Sibbald et al. (2022) how they may stay connected after the conclusion of programming. Silverstein et al. (2022) also shared the importance of simultaneous interpretation so that all participants can follow conversations in real time. Speaking to mentorship, Swords et al. (2021) suggested that VCoPs consider generational approaches. Another topic discussed by several studies was the need to regularly revisit/check in with participants about concerns (Hunt et al., 2021) while simultaneously being conscientious of their motivation/dedication (Shaw et al., 2022) and strain due to issues like webinar fatigue or current global events (Wilson et al., 2021).

HIERARCHY OF LEARNING

General member engagement was influenced by VCoP design. Evidence of general member engagement was found through session analysis, and other potential (a)synchronous activities were offered.

The structured flexibility of the VCoP design influenced the degree of general members' possible engagement/interaction before, during, and after synchronous sessions. The leadership of sessions indicated the directional exchange of knowledge and provided insight into the VCoP hierarchy of learning.

General VCoP member engagement before/after sessions

Notwithstanding general member assessment of knowledge used for VCoP evaluation or their use of resources via a VCoP website, all studies shared some level of opportunities for engagement before and after sessions. VCoPs in two studies encouraged general members to submit questions to presenters in advance of sessions (Hunt et al., 2021; Wilson et al., 2021), while one other study encouraged members to not only email questions but also future topics and feedback (Erklauer et al., 2022). Two additional VCoPs encouraged general members to take advantage of other network (a)synchronous activities, such as individual networking and serving on workgroups/committees (Gould et al., 2019), as well as telementoring, online courses, and ad hoc opportunities (Sibbald et al., 2022). General members in another VCoP were invited to submit a training challenge before the initial session and to support peers' plans (K. E. Watkins et al., 2022). In a small grouping of different VCoPs, general members completed a scholarship competency inventory and collaborated in small groups (Nguyen et al., 2023). VCoP general member engagement before and after sessions varied per study reviewed by Shaw et al. (2022) and was not reported for all studies. In one study reviewed by Shaw et al. (2022), general members could submit a case for discussion and prepare before the session by reviewing the case materials (Friberger & Falkman, 2013). General member post-session engagement in another review by Shaw et al. (2022) included possible interaction through a discussion forum on a weekly question/topic (Alary Gauvreau et al., 2019). In Lucero et al. (2020), VCoP members requested session topics, and in Masroori et al. (2022), members came prepared to discuss cases on the given topic. In Silverstein et al. (2022), VCoP members discussed topics with clinical leads who invited them to the session, as well as answered questions before/after programming. Two studies reported using discussion boards for members to pose questions (Swords et al., 2021) and to create an advocacy voice (Mullan et al., 2022).

General VCoP member engagement during sessions

During VCoP sessions, general members' levels of interaction varied from listening and responding to polling questions (Erklauer et al., 2022) to participating in knowledge exchange (Gould et al., 2019). Seven studies described VCoPs where the primary form of general member engagement was knowledge exchange through a facilitated (spoken) discussion, often following a presentation (Gould et al., 2019; Lucero et al., 2020; Masroori et al., 2022; Mullan et al., 2022; Nguyen et al., 2023; Sibbald et al., 2022; Silverstein et al., 2022). In Nguyen et al. (2023), VCoP general members, during small group sessions, also self-organized into working groups where they provided each other with mutual support. VCoP general members in two studies were encouraged to listen and respond to polling questions and to ask questions/share comments via the chat and built-in features of the platform (Hunt et al., 2021; Wilson et al., 2021). In K. E. Watkins et al. (2022), general members may have been chosen as responders and, if not, listened and participated in knowledge exchange via the chat function. In Swords et al. (2021), general members listened to a presentation, after which they had an opportunity to verbally ask speakers questions and share their ideas. Shaw et al. (2022) reported varied general participant engagement during sessions for some, but not all, of the studies reviewed. Friberger and Falkman (2013), as cited in Shaw et al. (2022), stated that VCoP members engage in knowledge exchange by discussing cases presented and suggesting potential diagnoses and treatments.

Table 2. General VCoP member possible engagement

First author and year	Before and/or after sessions	During sessions
Erklauer et al. (2022)	Email questions/topics/feedback: "Participants were encouraged to email questions, feedback, and topic/case recommendations for future sessions" (p. 4).	Listen and respond to polling questions: "The educational series used audience polling questions to optimize the engagement of participants and launch expert discussion" (p. 3).
Gould et al. (2019)	Contact other VCoP members for knowledge exchange; serve on workgroups/committees "… the NSSP CoP membership directory … makes it possible for members to locate and contact other members … thus facilitating discussions … Members access the NSSP CoP through the ISDS website (healthsurveillance.org), which provides access to forums for problem-solving, subject-matter experts for technical assistance, a surveillance knowledge repository, online webinars and training, and the opportunity to join workgroups and committees …" (p. 224).	[Entire session] Participate in knowledge exchange "learn from each other … share guidance, resources, technical assistance" (p. 224).
Hunt et al. (2021)	Submit questions in advance for presenters. "Participants can submit questions in advance …" (p. 224).	Listen and respond to polling questions; ask questions/share comments via chat. "… participants using multipoint videoconferencing as well as real-time polling, chat, and Q&A functions" (p. 224).
Lucero et al. (2020)	Consider questions in advance. "Gathering Grounds members support these meetings by deciding what the community focuses on and communicating what information would be most helpful at the time. Community members have requested conversations …" (p. 55).	[Entire session] Participate in knowledge exchange "they shared their experiences in their communities" (p. 54).
Masroori et al. (2022)	Not mentioned directly in the article; however, in ECHO studies with similar models the article referenced, participants come to the conversation prepared to share a case on the topic in advance.	Listen to a presentation and then listen in on a knowledge exchange. "The sessions include a case presentation by a member of the community, followed by a facilitated discussion" (p. 2). Other studies referenced by the article that also use the ECHO model provided additional information "UNMHSC specialists … provide advice and clinical mentoring … Working together, the community providers and specialists manage patients following evidence-based protocols … discussions are supplemented with short didactic presentations by inter-disciplinary experts …" (Arora et al., 2011).

First author and year	Before and/or after sessions	During sessions
Mullan et al. (2022)	Basecamp discussion board. "Participants expressed that the communication channels, developed with a broad range of stakeholders, gave GP members an advocacy voice across the health sector. The two-way dissemination of information was a critical feature" (p. 267).	[~Half session] Participate in knowledge exchange. "VCoP leaders perceived that their responsibilities were to provide advocacy and support, and to share information, including evidence-based information, with their members" (p. 255). "[T]he VCoP facilitated communication between themselves and other key stakeholders about what worked, what did not work, and how they were feeling" (p. 266).
Nguyen et al. (2023)	Complete scholarship competency inventory; participate in knowledge exchange. "Openness to sharing and flexibility with work culture and time diversity enabled each writing group to develop realistic expectations and timelines for themselves" (p. 7).	[Entire session] "… facilitators fostered open dialogue in large and small groups, encouraging active participation and enabling brainstorming" (p. 4). "… smaller CoPs to form by setting up sub-communities with shared interests (the domain), who improved their practices as they interacted regularly" (p. 2).
Shaw et al. (2022)	Varied (see Table S4 of the study)	Varied (see Table S4 of the study)
Sibbald et al. (2022)	Participate in other events/activities. "This competitive year-long program provides opportunities to take advantage of CFHI programming, to participate in virtual mentoring, and to collaborate with peers. Through the Policy Circle, members gain access to a curated resource listing (academic research, literature, and newsletters), the Institute for Healthcare Improvement's (IHI) online courses, and receive financial support to attend a national event or conference" (p. 4).	[Entire session] Participate in knowledge exchange "share stories and learn from each other's experiences, as well as discuss 'hot topics' and current events" (p. 4).
Silverstein et al. (2022)	Participants discussed VCoP participation/topics with clinical leads; participants answered survey questions about knowledge and program (used for both evaluation and program adaptation) (p. 3).	[Entire session] Participate in knowledge exchange. "The discussion was framed as the core component of the CLF, whose richness depended on the exchange among participants" (p. 2).
Swords et al. (2021)	Discussion boards "pose questions to discussants or to the larger forum via message boards or email" (p. 263).	Listen, ask questions to speakers, and share ideas. "The question and answer period at the end of each session allowed participants to share their own ideas and pose questions to the speakers, enabling interactive participant engagement" (p. 268).

First author and year	Before and/or after sessions	During sessions
K. E. Watkins et al. (2022)	Identify and reflect on an immunization training challenge; participate in a larger Teach to Reach (T2R) program. "The formal learning objectives of the Teach to Reach Level 1 certification were to develop an action plan to improve an immunization training program in relation to an immunization challenge, and then to peer review the plans of other participants to help others improve" (p. 2).	[Entire session] Listen and participate in knowledge exchange. "During each ITCH session, a 'challenge owner' was identified and the information submitted in their application was shown on screen to all participants. Peers were then invited to share their experiences in relation to this immunization training challenge ... In addition to the challenge presenters and respondents, 526 scholars were online as active listeners …" (p. 3). Also see Fig. 1: observers' section "listen and respond in chat" (p. 4).
Wilson et al. (2021)	Submit questions in advance for presenters. "Panelists provided additional expertise and perspective during the panel discussion by answering questions submitted in advance by participants during registration" (p. s100).	Listen and respond to polling questions; ask questions/share comments via chat/built-in feature. "Participants responded to each polling question on their device ... Participants submitted questions during the session through the question and answer feature (Q&A), where a team of subject matter experts from the CDC and WHO and the session's speakers and panelists could type answers. The team responsible for monitoring the Q&As during the session would inform session moderators if any submitted questions should be answered during the panel discussion. Participants used the Chat feature for any questions or comments on logistics or connectivity" (p. s100).

Note: General member engagement is not considered to be members' evaluation of sessions, (knowledge) assessments used for VCoP evaluation, or access/use of resources via a website.

Leadership of sessions

Analysis of session leadership provided indicators of VCoP hierarchical structure in practice. Studies described sessions to be led/presented by members with different types/levels of authority/expertise (n=3) or a combination of experts and members (n=9). In VCoPs combining expert and general member voices, there was variance in the voice(s), with some being heard more loudly than others (n=4) and, in five cases, heard more equally through the shared distribution of leadership tasks. In Erklauer et al. (2022), session speakers were chosen content experts, and panelists were members selected by the speakers tacitly understood to have expertise on the topic. In Lucero et al. (2020), sessions were member-driven, and all were encouraged to share. Based on members' interests, the VCoP also invited community experts to share; however, only one presentation led by an expert was described. The VCoP described in Masroori et al. (2022) outlined how interprofessional clinicians in rural areas connected hub team members who discussed cases with members and provided expert advice. Mullan et al. (2022) explained that the VCoP structure has "bi-directional knowledge translation" (p. 268), with conversations exchanged between leaders from the top-down and the bottom-up. In Nguyen et al. (2023), the VCoP hosted a core series of webinars and workshops (led by multidisciplinary staff) and small group sessions (led by members). General VCoP members described in Sibbald et al. (2022) both exchanged and received information from health leaders who were members

and health leaders connected to the larger program. In Silverstein et al. (2022), healthcare professionals/experts were recruited to facilitate and present. However, they later led a discussion among all general VCoP members. The VCoP reported by Wilson et al. (2021) incorporated expert speakers to discuss guidelines/norms, field-based speakers on implementing guidelines, and panelists with subject matter expertise for additional perspective. VCoP general members could submit questions before and during the session, which experts answered. Hunt et al. (2021) emphasized that presenters and panelists were "recruited based on their lived experiences;" however, the moderated discussion included "a panel of experts," which extended to "professional organization leaders" (p. 224). In three VCoPs, session leadership was only member-driven (Gould et al., 2019; Swords et al., 2021; K. E. Watkins et al., 2022). In these VCoPs, member conversations/actions were centered around sharing guidance/advice, resources, technical assistance, lived experiences/interests, and needs/challenges. In the studies reviewed by Shaw et al. (2022), session leadership again showed variance between experts and leaders. For example, VCoP general members/participants were co-researchers and co-facilitators (Galheigo et al., 2019), and experts were invited to be session speakers (Wolbrink et al., 2017).

Table 3. Leadership of sessions

First author and year	Sessions led /presented by	Leader/presenter description
Erklauer et al. (2022)	EXPERTS and MEMBERS	"Lead speakers for each session were identified through group consensus by the planning committee based on their contributions to the literature or participation in the development of PNCC clinical guidelines. Along with the planning committee, the lead speakers selected members to serve as the panelists for the subsequent case-based discussion, delineate learning objectives, and identify clinical cases … The first session was a didactic lecture delivered by a content expert … This was followed by a second session, an in-depth expert panel discussion … led by the previous session's speaker." (p. 3)
Gould et al. (2019)	MEMBERS	"Monthly conference calls are member-driven and bring together various stakeholders to spark collaborative efforts and to share guidance, resources, and technical assistance …" (p.226)
Hunt et al. (2021)	MEMBERS and EXPERTS	"COVID-19 Clinical Rounds presenters and panelists are recruited based on their lived experiences, not their reputation as experts or speakers … Presentations are followed by a moderated discussion with a panel of experts consisting of the presenters, previous presenters, and professional organization leaders" (p. 224).
Lucero et al. (2020)	MEMBERS and EXPERTS	"We have worked to integrate a mixture of expert knowledge sharing and more fluid community conversations through online meetings to balance the requests and interests of I-CP members" (p.57). Only one expert session was described (pp. 54-55).
Masroori et al. (2022)	EXPERTS and MEMBERS	"It connects interprofessional expert clinicians (hub team members) … with interprofessional clinicians in rural, remote and underserved areas. The sessions include a case presentation by a member of the community, followed by a facilitated discussion. The facilitator rotates weekly and is selected from the expert hub" (p. 2).

First author and year	Sessions led /presented by	Leader/presenter description
Mullan et al. (2022)	EXPERTS and MEMBERS	"The VCoP was conceptualized as a network of networks of GP and general practices (or community of communities) … A tiered structure was used to facilitate the movement of information from centralized authorities out to local networks, and just as importantly, sharing of experience concerning guideline and policy application among the VCoP members" (p. 264).
Nguyen et al. (2023)	EXPERTS and MEMBERS	"The CPD program consisted of virtual sessions hosted twice monthly: a Core Series of webinars and workshops … and a CoPs session of small group activities for exploration of inquiries, formation of collaborations, and scholarship consultations …" (p. 3). "At the start of the GHS-CoP, members completed a scholarship-competency inventory, adapted from the Academic Competencies for Medical Faculty by Harris et al. (2007), to advise member baseline skills and identify members with expertise to serve as coaches for small group activities, collaborative projects, and RAISE Symposium activities" (p. 3).
Shaw et al. (2022)	VARIED	"Facilitators or leaders were reported to drive the community and encourage members to participate. They may, for example, coordinate the preparation and conduction of meetings [46]. The Swedish Oral Medicine Network's monthly meetings were led by a chairperson, but the meeting's facilitation rotated among core members [43]. For a VCoP formed for the purpose of General Practitioners' continuing professional development, the facilitation team comprised specialist physicians, senior GPs, a dedicated content facilitator, and an information technology administrator [48] …" (p. 7).
Sibbald et al. (2022)	EXPERTS and MEMBERS	"One of the most important aspects of the Policy Circle is the regular opportunities to connect with and learn from peers and healthcare leaders across Canada [31] … Each Policy Circle member is matched with a mentor who is aligned with their interests or goals and has extensive policy and practice experience and expertise" (p. 4).
Silverstein et al. (2022)	EXPERTS and MEMBERS	"Clinical Leads recruited health care professionals from their site to facilitate. Facilitators had demonstrated knowledge, experience, or leadership related to the topic, and the facilitator role rotated between NGOs. Facilitators presented at the start of a session, establishing a foundation of knowledge before encouraging a discussion among participants by having them share their personal experiences, successes, and challenges … With the emergence of the COVID-19…invited content experts facilitated these sessions …" (p. 2)
Swords et al. (2021)	MEMBERS	Each webinar was presented by members representing different levels and roles within the health system (i.e., surgeons, nursing directors, intensive care consultants, speech pathologists, patients, and families).

First author and year	Sessions led /presented by	Leader/presenter description
K. E. Watkins et al. (2022)	MEMBERS	"A typical 30-min session involved one T2R participant presenting their challenge and the other attendees problem solving or providing counsel from their own experience or context … Facilitators kept the momentum and helped focus the learning" (p. 3).
Wilson et al. (2021)	EXPERTS and MEMBERS	"Speakers from the WHO and CDC focused on normative guidance and operational considerations, and field-based speakers shared their experiences in implementing IPC recommendations in their local healthcare context...Panelists provided additional expertise and perspective during the panel discussion by answering questions submitted in advance by participants during registration or submitted live during the session. Participants submitted questions during the session through the question and answer feature (Q&A), where a team of subject matter experts from the CDC and WHO and the session's speakers and panelists could type answers" (p. s100).

Note: Primary contributions/guidance are capitalized. [MEMBERS] and [members] listed are understood to possess different types/levels of authority/expertise.

A TYPOLOGY OF VCOP LEARNING (CO)EVOLUTION

A new typology of VCoP learning (co)evolution was created by combining general member engagement and leadership of sessions. This new typology maps VCoP structured flexibility along a continuum of three phases (evolving VCoPs, revolving VCoPs, and coevolving VCoPs) and five stages (slightly evolving, somewhat revolving, moderately revolving, highly revolving, and coevolving). Categorization of VCoPs' stage of (co)evolution considers their design across the four domains of network development, general member engagement before/after sessions, general member engagement during sessions, and session leadership.

SLIGHTLY EVOLVING VCOPS

On the far-left end of the continuum are "slightly evolving" VCoPs. VCoPs in this stage retain a more top-down/cascade approach, digitalizing traditional training sessions and resources offered. At this end of the continuum, VCoPs are led by individuals/groups considered experts in the field with/without authoritative power. In this stage, general member engagement before/after sessions involves members contacting experts or leader(ship) through email. Alternatively, members may individually prepare for sessions by considering questions and topics. During sessions, general member engagement is closed and occurs through non-verbal sharing during sessions.

SOMEWHAT REVOLVING

In "somewhat revolving" VCoPs, the network shows elements of moving from digitalization of training to adaptation of training as leadership provides one additional (a)synchronous connection beyond a website or repository to better meet member/network needs. Leadership of sessions is primarily directed by experts, with some leadership tasks directed by members. In this stage, general member engagement before/after sessions involves members discussing and reaching out to experts/leader(ship) about topics, questions, and feedback. During sessions, general member engagement may be either closed or open but continues to be non-verbal.

MODERATELY REVOLVING

In "moderately revolving" VCoPs, the network reflects adaptive elements as leadership provides two additional (a)synchronous connections beyond a website or repository to better meet member/network needs. Leadership of sessions in moderately revolving VCoPs is equally tasked to experts and members. In this stage, general members may engage before/after sessions through discussion boards open to all involved in the VCoP. During sessions, general member engagement may occur through closed/open or non-verbal/verbal communication.

HIGHLY REVOLVING

In "highly revolving" VCoPs, three additional (a)synchronous connections beyond a website or repository are provided as the network reflects a movement toward coevolution to better meet member/network needs. Leadership of sessions in highly revolving VCoPs is led primarily by members, with some leadership from experts. In this stage, before/after the session, general member engagement occurs (non)verbally through sharing as part of a larger program. For general members in highly revolving VCoPs, approximately half of sessions center on sharing.

COMPLEXLY COEVOLVING

On the far-right end of the continuum are "complexly coevolving" VCoPs that respond to paradoxical challenges by operating fully as complex adaptive systems (Dooley, 1997; Dugan, 2017; Obolensky, 2014). In this stage of VCoP learning, all members are seen as leaders, and the network embraces the power of ongoing feedback loops, spanning boundaries and self-organizing to meet members' needs. Collectively, the VCoP coevolves four or more additional (a)synchronous connections beyond a website or repository to meet member/network needs. In this stage of VCoPs, before/after sessions, general member engagement and collaboration occur as part of a larger program, and the entirety of member engagement during sessions centers on sharing.
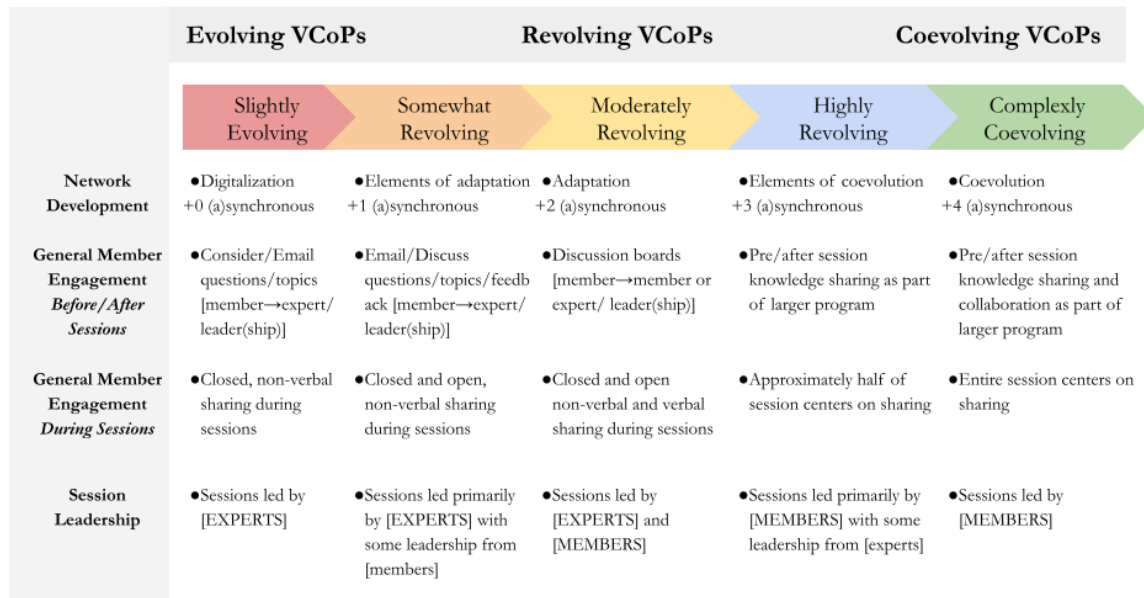
	Evolving VCoPs		Revolving VCoPs	Coevolving VCoPs	
	Slightly Evolving	Somewhat Revolving	Moderately Revolving	Highly Revolving	Complexly Coevolving
Network Development	●Digitalization +0 (a)synchronous	●Elements of adaptation +1 (a)synchronous	●Adaptation +2 (a)synchronous	●Elements of coevolution +3 (a)synchronous	●Coevolution +4 (a)synchronous
General Member Engagement *Before/After Sessions*	●Consider/Email questions/topics [member→expert/ leader(ship)]	●Email/Discuss questions/topics/feedback [member→expert/ leader(ship)]	●Discussion boards [member→member or expert/ leader(ship)]	●Pre/after session knowledge sharing as part of larger program	●Pre/after session knowledge sharing and collaboration as part of larger program
General Member Engagement *During Sessions*	●Closed, non-verbal sharing during sessions	●Closed and open, non-verbal sharing during sessions	●Closed and open non-verbal and verbal sharing during sessions	●Approximately half of session centers on sharing	●Entire session centers on sharing
Session Leadership	●Sessions led by [EXPERTS]	●Sessions led primarily by [EXPERTS] with some leadership from [members]	●Sessions led by [EXPERTS] and [MEMBERS]	●Sessions led primarily by [MEMBERS] with some leadership from [experts]	●Sessions led by [MEMBERS]

Figure 2. Continuum of VCoP learning (co)evolution

Note: Experts are understood to be content specialists with/without authoritative power. Members are understood to have varying types/levels of expertise/authority. Capitalization within the figure indicates primary leadership/focus.

VCoP Categorization

With this groundwork, VCoPs, as described in studies for this review, were categorized for each of the four domains. An overall designation was calculated by averaging their categorization across domains. The overall designation of three VCoPs fell into the slightly evolving stage (Erklauer et al., 2022; Masroori et al., 2022; Wilson et al., 2021), one into the somewhat revolving stage (Hunt et al., 2021), four into the moderately revolving stage (Lucero et al., 2020; Mullan et al., 2022; Silverstein et al., 2022; Swords et al., 2021), and four into the complexly coevolving stage (Gould et al., 2019; Nguyen et al., 2023; Sibbald et al., 2022; K. E. Watkins et al., 2022). No VCoPs were found to enter the highly revolving stage as an overall designation; however, five studies were highly revolving for one or more domains (Gould et al., 2019; Lucero et al., 2020; Mullan et al., 2022; Nguyen et al., 2023; Silverstein et al., 2022). One article (Shaw et al., 2022) was excluded from categorization as the VCoPs it reviewed covered many different types of design.

Overall, 83% of studies categorized (n=10 studies; Erklauer et al., 2022; Gould et al., 2019; Hunt et al., 2021; Masroori et al., 2022; Mullan et al., 2022; Nguyen et al., 2023; Sibbald et al., 2022; Silverstein et al., 2022; K. E. Watkins et al., 2022; Wilson et al., 2021) were within one standard deviation of the mean (M=3.02) and 17% of studies categorized (n=2 studies; Lucero et al., 2020; Swords et al., 2021) were within two standard deviations of the mean. Studies within two standard deviations of the mean showed higher categorization in the domains of general member engagement during sessions and session leadership. Lucero et al. (2020) received lower categorization on network development (2 - somewhat revolving) and general member engagement before/after sessions (1 - slightly revolving) and higher categorization on general member engagement during sessions (5 - complexly coevolving) and session leadership (4 - highly revolving). This VCoP began registration in January 2020 and held its first meeting in April 2020. Between VCoP initiation and publication of the article (June 2020), the community had little time to determine and develop (a)synchronous activities to meet member/network needs. Although this community of practice was virtual and is included as such within the current review, it is described within the article as an Indigenous community of practice (I-CP). Describing the development of the I-CP, the authors discuss the importance of indigenous methods and ways of knowing/being, as well as factors that could have influenced how general member engagement was approached before/after sessions. Swords et al. (2021) categorized in three out of four domains as somewhat and moderately revolving; however, the VCoP broke from the structure as session presentations were led by all membership levels.

Discussion

VCoP analysis was based on what was reported within each article; however, it is possible their design could be more complex than what was shared. Across articles, numerous terms were used to describe session leadership roles (i.e., facilitator, leader, expert, presenter, lead speaker, panelist, centralized authorities, governance). As VCoPs continue to develop toward complex coevolution, where each member is understood to be a leader/expert in their context, the choice of terms to use is challenging. Given differences in VCoP design, agreement upon leadership terms is not as important as having clear descriptions of how leadership is involved (their contributions) and how much time they are involved compared to general members. For example, if a VCoP description shares "panelists presented at the start of the session on a given topic, following which participants were encouraged to ask questions and share their ideas," this sentence does not share who the panelists were.

Furthermore, it does not reveal the content of their presentation, leaving room for misinterpretation of what the discussion looked like. Did the discussion afterward last for five or fifty minutes? Did what was presented drive the discussion (all subsequent conversations referred to only what was shared), or did it kick-start the discussion, allowing question posers to expand the brief by making connections to their contexts and other areas? All judgment calls made for the current review were

based on verbatim text using a critical approach and conducted in consultation with university colleagues. How VCoP leadership and engagement are worded can paint a more open or closed picture of its design, potentially confusing readers and masking how practices are designed.

Each stage of VCoP learning shows an evolution from traditional, in-person, continued professional development. However, it is important to consider how VCoP categorization may be affected by (the lack of) partnerships. For example, partnerships that support VCoPs with additional funding and technological/logistical support may be able to handle larger numbers of participants/members and resources to support additional (a)synchronous opportunities. Partnership hierarchical structure and openness to flex their structure may also reinforce VCoP design regarding who and how many members/participants are invited to join, what is (not) shared, how sessions are conducted, and who leads them. Additionally, the categorization of VCoPs' learning (co)evolution will change as VCoPs change their designs. VCoP categorization should not be seen as a fixed classification but rather as a starting place for VCoPs to consider their next steps. To best meet member/network needs, recommendations include consultation sessions, formative assessments, and summative evaluations (Amaratunga, 2014; D. R. Watkins et al., 2017). Although it is easy to imagine VCoPs taking progressive steps toward complexly coevolving on the continuum, contextual circumstances may mean taking more slightly evolving ones instead; the process is a dance of many entangled factors. Pairing VCoP categorization and member evaluation/feedback with the Cynefin Framework (Snowden & Boone, 2007) may help VCoP leadership make evidence-based decisions (Meagher-Stewart et al., 2012) on what changes in design could be helpful as contexts evolve. For example, during the chaos of the COVID-19 pandemic, in one study, sessions shifted from monthly to weekly sessions, and "invited content experts facilitated these sessions to offset the responsibility of facilitation from overly burdened frontline health care professionals at the NGOs" (Silverstein et al., 2022, pp. 2–3). To make changes to VCoP design, leadership must navigate "boundaries, loyalties, and power dynamics" inherent in the social landscape. This is a process that is easier said than done (Wenger-Trayner & Wenger-Trayner, 2015). Yet, designing for VCoP "aliveness" or to "generate enough excitement, relevance, and value to attract and engage members" is what makes CoPs successful over time (Wenger et al., 2002).

CoPs are the "social fabric of a learning organization" (Wenger, 1996). When they successfully evoke aliveness, they expand our collective capacity, integrating "people and structures in order to move toward continuous learning and change" (Yang et al., 2004, p. 34). The learning organization framework outlines seven dimensions CoPs should consider across individual, team, and organizational levels as they design, including continuous learning, inquiry and dialogue, team learning, empowerment, embedded systems, system connection, and strategic leadership (K. E. Watkins & Marsick, 1993, 1996). However, CoPs have also been described as knowledge/learning networks (Hildreth & Kimble, 2004), and it is necessary to extend the conversation in this direction as well. Incorporating knowledge gleaned from research (Schreurs et al., 2019) reveals further implications of three network effects for VCoP design, including preferential attachment, reciprocity, and transitivity. These effects describe how the formation and evolution of connections influence network structure and interactions, potentially allowing for emergence. Preferential attachment, for example, through partnerships, can further reinforce social ties, providing additional advantages for those who are connected. However, (im)balance may be found in the degree of reciprocity present within social ties or the willingness of partners to engage mutually. Through high mutual engagement, groups may also demonstrate transitivity and self-organizing in ways that support network cohesion (Schreurs et al., 2019, p. 2). Yet, whether VCoPs act on the seven dimensions of a learning organization or demonstrate a positive connection to the three network effects can mean the difference between organizational/networked learning and learning organizations/networks.

LIMITATIONS AND FUTURE DIRECTIONS

This review was limited to a search for empirical literature on global health VCoPs over the last five years. Although the search was thorough, only 13 articles fit the search criteria. Additional searches could be conducted over the next few years to incorporate even more recently published literature and expand the number of returns. Moving forward, future research on learning (co)evolution could explore how VCoP evaluations relate to different stages of learning, consider evaluation stages across the totality of VCoP programming design, and explore how best to capture VCoP (long-term) impact attributed to health outcomes and the culture of learning organizations and networks.

CONCLUSION

VCoPs showed structured flexibility in their: (1) (re)development, (2) meeting frequency, (3) (a)synchronous activities, and (4) reflection on current practice. VCoP design and session leadership influenced a continuum/hierarchy of general member engagement before, during, and after synchronous sessions. Synthesis of findings resulted in a new typology of VCoP learning (co)evolution, making it possible to categorize VCoPs into five stages (slightly evolving, somewhat revolving, moderately revolving, highly revolving, and coevolving) across four design domains (network development, general member engagement before/after sessions, general member engagement during sessions, and session leadership). Analysis revealed VCoPs in the categories of slightly evolving (n=3), somewhat revolving (n=1), moderately revolving (n=4), and complexly coevolving (n=4). No VCoPs were found to enter the highly revolving stage as an overall designation; however, five studies were highly revolving for one or more domains. Regardless of the VCoP stage, all VCoPs showed signs of adaptation and recommended future evolution. Based on these findings, practical implications for educators and policymakers include consideration of multiple types of ongoing assessments to better understand evolving contextual needs and the evolution of VCoP designs to promote their long-term sustainability by meeting members' preferences for engagement. Through a focus on partnerships, design, and relationship accountability, global health VCoPs can emerge forth a new rhythm to ever-evolving circumstances amid complexity.

ACKNOWLEDGMENT

REFERENCES

Alary Gauvreau, C., Le Dorze, G., Kairy, D., & Croteau, C. (2019). Evaluation of a community of practice for speech-language pathologists in aphasia rehabilitation: A logic analysis. *BMC Health Services Research*, *19*, Article 530. https://doi.org/10.1186/s12913-019-4338-0

Amaratunga, C. A. (2014). Building community disaster resilience through a virtual community of practice (VCOP). *International Journal of Disaster Resilience in the Built Environment*, *5*(1), 66–78. https://doi.org/10.1108/IJDRBE-05-2012-0012

Arora, S., Thornton, K., Murata, G., Deming, P., Kalishman, S., Dion, D., Parish, B., Burke, T., Pak, W., Dunkelberg, J., Kistin, M., Brown, J., Jenkusky, S., Komaromy, M., & Qualls, C. (2011). Outcomes of treatment for hepatitis C virus infection by primary care providers. *The New England Journal of Medicine*, *364*(23), 2199-2207. https://doi.org/10.1056/NEJMoa1009370

Barnett, S., Jones, S. C., Bennett, S., Iverson, D., & Bonney, A. (2012). General practice training and virtual communities of practice: A review of the literature. *BMC Family Practice*, *13,* Article 87. https://doi.org/10.1186/1471-2296-13-87

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Burt, R. S. (2004). Structural holes and good ideas. *American Journal of Sociology*, *110*(2), 349–399. https://doi.org/10.1086/421787

Carvalho, L., & Goodyear, P. (2014). *The architecture of productive learning networks*. Routledge. https://doi.org/10.4324/9780203591093

Dooley, K. J. (1997). A complex adaptive systems model of organization change. *Nonlinear Dynamics, Psychology, and Life Sciences*, *1*, 69–97. https://doi.org/10.1023/A:1022375910940

Dubé, L., Bourhis, A., & Jacob, R. (2006). Towards a typology of virtual communities of practice. *Interdisciplinary Journal of Information, Knowledge, and Management*, *1*, 69–93. https://doi.org/10.28945/115

Dugan, J. P. (2017). *Leadership theory: Cultivating critical perspectives*. Jossey-Bass.

Erklauer, J. C., Thomas, A. X., Hong, S. J., Appavu, B. L., Carpenter, J. L., Chiriboga-Salazar, N. R., Ferrazzano, P. A., Goldstein, Z., Griffith, J. L., Guilliams, K. P., Kirschen, M. P., Lidsky, K., Lovett, M. E., McLaughlin, B., Munoz Pareja, J. C., Murphy, S., O'Donnell, W., Riviello, J. J., Schober, M. E., … Simon, D. W. (2022). A virtual community of practice: An international educational series in pediatric neurocritical care. *Children*, *9*(7), 1086. https://doi.org/10.3390/children9071086

Fragou, O. (2020). A design framework for building a virtual community of practice. In M. E. Auer. & T. Tsiatsos (Eds.), *The challenges of the digital transformation in education* (pp. 427–441). Springer. https://doi.org/10.1007/978-3-030-11932-4_41

Friberger, M. G., & Falkman, G. (2013). Collaboration processes, outcomes, challenges and enablers of distributed clinical communities of practice. *Behaviour and Information Technology*, *32*(6), 519–531. https://doi.org/10.1080/0144929X.2011.602426

Galheigo, S. M., Braga, C. P., Magalhães, L., & Kinsella, E. A. (2019). An occupational therapy community of practice within pediatric acute care: Fostering professional, social and cultural capital in resource challenged settings. *Brazilian Journal of Occupational Therapy*, *27*(4), 776–791. https://doi.org/10.4322/2526-8910.CTOAO1825

Gould, D. W., Lamb, E., Dearth, S., & Collier, K. (2019). Building state and local public health capacity in syndromic surveillance through an online community of practice. *Public Health Reports, 134*(3), 223–227. https://doi.org/10.1177/0033354919828713

Harris, D. L., Krause, K. C., Parish, D. C., & Smith, M. U. (2007). Academic competencies for medical faculty. *Family Medicine*, *39*(5), 343–350. https://www.stfm.org/familymedicine/vol39issue5/Harris343

Hildreth, P., & Kimble, C. (Eds.). (2004). *Knowledge networks: Innovation through communities of practice*. IGI Global. https://doi.org/10.4018/978-1-59140-200-8

Hunt, R. C., Struminger, B. B., Redd, J. T., Herrmann, J., Jolly, B. T., Arora, S., Armistad, A. J., Dezan, A. M., Bennett, C. A., Krohmer, J. R., & Brown, L. H. (2021). Virtual peer-to-peer learning to enhance and accelerate the health system response to COVID-19: The HHS ASPR Project ECHO COVID-19 Clinical Rounds Initiative. *Annals of Emergency Medicine*, *78*(2), 223–228. https://doi.org/10.1016/j.annemergmed.2021.03.035

Lucero, D., Scott, R., Oré, C. E., & Parker, M. (2020). The development and implementation of Gathering Grounds, a virtual community of practice rooted in Indigenous praxis. *American Indian Culture and Research Journal*, *44*(3), 45–64. https://doi.org/10.17953/aicrj.44.3.lucero_etal

Masroori, Z., Coelho, C. F., Zhao, Q. J., Vyravanathan, S., Du, A. Y., Carlin, L. E., Taenzer, P., Flannery, J., & Furlan, A. D. (2022). Development and pilot testing of an observational tool to assess interprofessional education in virtual communities of practice (VCoP). *Journal of Interprofessional Education & Practice*, *29,* 100539. https://doi.org/10.1016/j.xjep.2022.100539

Meagher-Stewart, D., Solberg, S. M., Warner, G., MacDonald, J. A., McPherson, C., & Seaman, P. (2012). Understanding the role of communities of practice in evidence-informed decision making in public health. *Qualitative Health Research*, *22*(6), 723–739. https://doi.org/10.1177/1049732312438967

Mullan, J., Metusela, C., Guppy, M., Pond, D., Ivers, R., Hoffman, R., Rhee, J., Hespe, C. M., Davis, A., Barnett, S., & Bonney, A. (2022). Development of a COVID-19 virtual community of practice in New South Wales: A qualitative study. *Australian Journal of General Practice*, *51*(4), 263–269. https://doi.org/10.31128/AJGP-03-21-5881

Murad, A., Lederman, R., Bosua, R., Chang, S., & Wark, J. (2016). Design considerations for a virtual community of practice for health practitioners: A learner centred design approach. *Australasian Conference on Information Systems*, Wollongong, NSW, Australia. https://aisel.aisnet.org/acis2016/84?utm_source=aisel.aisnet.org%2Facis2016%2F84&utm_medium=PDF&utm_campaign=PDFCoverPages

Nguyen, D., Ssebunya, R. N., Hirani, K., Mandalakas, A., Benjamin, J., Ligon, B. L., & Thammasitboon, S. (2023). Using starling murmuration as a model for creating a global health community of practice to advance equity in scholarship. *Medical Teacher*, *46*(4), 537–544. https://doi.org/10.1080/0142159X.2023.2260083

Obolensky, M. N. (2014). *Complex adaptive leadership: Embracing paradox and uncertainty*. Gower Publishing. http://ebookcentral.proquest.com/lib/ugalib/detail.action?docID=564122

Romero-Mas, M., Gómez-Zúñiga, B., Cox, A. M., & Ramon-Aribau, A. (2020). Designing virtual communities of practice for informal caregivers of Alzheimer's patients: An integrative review. *Health Informatics Journal*, 26(4), 2976–2991. https://doi.org/10.1177/1460458220950883

Schreurs, B., Cornelissen, F., & De Laat, M. (2019). How do online learning networks emerge? A review study of self-organizing network effects in the field of networked learning. *Education Sciences*, *9*(4), 289. https://doi.org/10.3390/educsci9040289

Shaw, L., Jazayeri, D., Kiegaldie, D., & Morris, M. E. (2022). Implementation of virtual communities of practice in healthcare to improve capability and capacity: A 10-year scoping review. *International Journal of Environmental Research & Public Health*, *19*(13), 7994. https://doi.org/10.3390/ijerph19137994

Sibbald, S. L., Burnet, M. L., Callery, B., & Mitchell, J. I. (2022). Building a virtual community of practice: Experience from the Canadian foundation for healthcare improvement's policy circle. *Health Research Policy & Systems*, *20*, Article 95. https://doi.org/10.1186/s12961-022-00897-0

Silverstein, A., Benson, A., Gates, C., & Nguyen, D. (2022). Global community of practice: A means for capacity and community strengthening for health professionals in low- and middle-income countries. *Journal of Global Health*, *12*, 1–9. https://doi.org/10.7189/jogh.12.04034

Snowden, D. J., & Boone, M. E. (2007). A leader's framework for decision making. *Harvard Business Review*, *85*(11), 69–76. https://hbr.org/2007/11/a-leaders-framework-for-decision-making

Swords, C., Bergman, L., Wilson-Jeffers, R., Randall, D., Morris, L. L., Brenner, M. J., & Arora, A. (2021). Multidisciplinary tracheostomy quality improvement in the COVID-19 pandemic: Building a global learning community. *Annals of Otology, Rhinology and Laryngology*, *130*(3), 262–272. https://doi.org/10.1177/0003489420941542

Watkins, D. R., McDaniel, A., & Erskine, M. A. (2017). Building a faculty-centric virtual community of practice (VCoP) within the post-secondary education environment: A systems approach framework. In J. Mcdonald, & A. Cater-Steel (Eds.), *Communities of practice facilitating social learning in higher education* (pp. 241–260). Springer. https://doi.org/10.1007/978-981-10-2879-3

Watkins, K. E., & Marsick, V. J. (1993). *Sculpting the learning organization: Lessons in the art and science of systemic change*. Jossey-Bass. https://doi.org/10.1002/hrdq.3920060410

Watkins, K. E., & Marsick, V. J. (Eds.). (1996). *In action: Creating the learning organization.* American Society for Training and Development.

Watkins, K. E., Marsick, V. J., Wofford, M. G., & Ellinger, A. D. (2018). The evolving Marsick and Watkins (1990) theory of informal and incidental learning. *New Directions for Adult & Continuing Education*, *2018*(159), 21–36. https://doi.org/10.1002/ace.20285

Watkins, K. E., Sandmann, L. R., Dailey, C. A., Li, B., Yang, S. E., Galen, R. S., & Sadki, R. (2022). Accelerating problem-solving capacities of sub-national public health professionals: An evaluation of a digital immunization training intervention. *BMC Health Services Research*, *22*, Article 736. https://doi.org/10.1186/s12913-022-08138-4

Wenger, E. (1996). Communities of practice: The social fabric of a learning organization. *The Healthcare Forum Journal*, *39*(4), 20–26.

Wenger, E., McDermott, R., & Snyder, W. M. (2002). *Cultivating communities of practice: A guide to managing knowledge.* Harvard Business School. https://hbswk.hbs.edu/archive/cultivating-communities-of-practice-a-guide-to-managing-knowledge-seven-principles-for-cultivating-communities-of-practice

Wenger-Trayner, E., & Wenger-Trayner, B. (2015). *Introduction to communities of practice.* https://www.wenger-trayner.com/introduction-to-communities-of-practice/

Wilson, K., Dennison, C., Struminger, B., Armistad, A., Osuka, H., Montoya, E., Padoveze, M. C., Arora, S., Park, B., & Lessa, F. C. (2021). Building a virtual global knowledge network during the coronavirus disease 2019 pandemic: The infection prevention and control global webinar series. *Clinical Infectious Diseases*, *73*, S98–S105. https://doi.org/10.1093/cid/ciab320

Wolbrink, T. A., Kissoon, N., Mirza, N., & Burns, J. P. (2017). Building a global, online community of practice: The OPENPediatrics World Shared Practices Video Series. *Academic Medicine*, *92*(5), 676–679. https://doi.org/10.1097/ACM.0000000000001467

Yang, B., Watkins, K. E., & Marsick, V. J. (2004). The construct of the learning organization: Dimensions, measurement, and validation. *Human Resource Development Quarterly*, *15*(1), 31–55. https://doi.org/10.1002/hrdq.1086

AUTHOR

Kari Eller is a doctoral candidate in the Learning, Leadership, and Organization Development Program at the University of Georgia. She received a Bachelor of Arts in Spanish Language and Literature from North Carolina State University and a Master of Science in Child, Youth, and Family Studies from the University of Nebraska–Lincoln. As a researcher, she is interested in how adult learning and leadership amid complexity can bring about organizational change that strengthens global health and well-being. An innovative and global connector with 20 years of experience, Kari has served as an educator, social worker, advisor, and international program coordinator. Currently, she supports qualitative analysis as a member of the Insights Team at The Geneva Learning Foundation.