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RESEARCH

Successful Factors of Virtual Collaborations and Applied Frameworks

Shared Understanding, Building Trust, and Effective Communication

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What Is the Issue?

Due to the COVID-19 pandemic, the past year has offered an unexpected opportunity to experience the benefits of virtual relationships as well their inherent uncertainty and ambiguity (Brown et al., 2004), an unplanned experiment in what can happen when you dramatically decrease the barriers to collaboration but force all collaboration to occur virtually rather than in person. Although 2020 through 2021 may have been a particularly intense time for virtual collaboration, best practices in virtual collaboration approaches and tools are relevant at any time.

Why Is It Important?

The NSF INCLUDES National Network members were already accustomed to collaborating virtually prior to the pandemic, but the last year has accelerated our knowledge of how to make virtual collaborations thrive; the most important factors are shared understanding, trust, and effective communication (Hakanen et al., 2015; Nemiro et al., 2008).

We have experienced the benefits of virtual collaborations—these collaborations can build camaraderie, enhance the breadth and depth of one's social network, increase awareness of scholarly opportunities, and form a sense of camaraderie around the research (Hartman et al., 2019; Schieffer, 2016). While the lack of in-person interactions may limit organic connections, virtual collaborations have opened new doors, providing opportunities for new partnerships and creating value together to advance mutual goals (Goodman, 2020).

Collaboration of all kinds enable researchers, educators, and students to advance research and scientific progress at a greater scale than individual investigations can achieve (Baker, 2015; Pelaez et al., 2018; Smith & Imbrie, 2007). Collaborative learning has been shown to reduce achievement gaps and increase self-confidence in underrepresented groups in STEM (Santeiro et al., 2020) through added peer supports. Collaborations lead to deeper learning when team members value each other's contributions and are motivated to complete the research task together (Hartman et al., 2019; Vuopala et al., 2016). Educators engaged in collaborative efforts express a sense of group belonging developed through building relationships and an increase in professional development and availability of research resources (Hartman et al., 2019; Patton & Parker, 2017).

About This Brief

In this brief, we explore the three critical success factors for virtual collaboration (shared understanding, trust, and effective communication) and how they apply to the NSF INCLUDES National Network. We build upon our prior research brief[1] in which we articulate the features of common network and partnership approaches used by projects throughout the Network by delving into the qualities needed to sustain effective virtual collaborations.

We begin this brief by examining how virtual teams develop a shared understanding of their collaboration style, and then explore how leaders can instill trust in their teams to perform well. Finally, we discuss effective tools for communicating in virtual settings.

[1] NSF INCLUDES Coordination Hub. (2020). Mapping the Common Collaborative Change Models to the NSF INCLUDES Five Elements of Collaborative Infrastructure (Research Brief No. 3).

DEVELOPING A SHARED UNDERSTANDING OF COMMUNITY TYPE

To begin, virtual teams should develop a shared understanding of the type of community they are operating within. Crites et. al (2020) identify four types of community frameworks for effective virtual collaboration: Community of Inquiry (COI), Community of Practice (COP), Professional Learning Community (PLC), and Online Collaborative Learning (OCL).

In Table 1, we describe the unique principles of each community, the definition of each community, and the elements NSF INCLUDES Network members can align with their own collaborative models. Reviewing these frameworks will help Network members develop greater understanding of how teams are structured and what the intended goals are of the collaboration.

TABLE 1. Community Frameworks for Effective Virtual Collaborations (adapted from Crites et. al, 2020)

COMMUNITY FRAMEWORK	DEFINITION	QUALITIES AND CHARACTERISTICS
Community of Inquiry (COI)	Avenues for social critical inquiry, higher order cognitive processing, opportunities to use technology for support and mentorship, and an adaptive context to everyday applications	• Individual engagement necessary to group function • Group learning augmented by social presence and collaboration through building mutual trust and confidence over time • Teacher/moderator support, guidance, and feedback • Deliberate design and structure for high order learning • Practitioner inquiry in a context which is immediately applicable and relevant • Focus on construction of knowledge instead of learning outcomes
Community of Practice (COP)	Groups of people who share a concern or a passion for something they do, and learn how to do it better as they interact regularly	• **Leadership** – establishing leadership roles can motivate members around common goals • **Sponsorship** – protected time and adequate resources are required for individual success • **Shared Objectives** – provide direction on team member responsibilities and encourage active contributions • **Boundary Spanning** – sets parameters and objective benchmarks for the community • **Risk-free Environment** – encouraging open expression and testing of new ideas, while feeling a sense of safety • **Measurements** – to assess the progress of the COP activities

TABLE 1. Community Frameworks for Effective Virtual Collaborations (continued)

COMMUNITY FRAMEWORK	DEFINITION	QUALITIES AND CHARACTERISTICS
Professional Learning Community (PLC)	A community that takes advantage of the working knowledge of teachers by having them collaborate in teams to explore, study, and advise changes to teaching and organizational practices	• A focus on learning needs of students • A culture of collaboration between teachers and between teams of teachers and school administration • Supports for teacher development • Teams of teachers coalesce around with common challenges • Group inquiry processes to find solutions to challenges and document them • Having support (time, space, etc.) for the teams to conduct inquiries • A focus on outcomes after best practice changes
Online Collaborative Learning (OCL)	A model of learning in which students are encouraged and supported to work together to create knowledge	• **Idea Generating** – learners share their divergent views about a topic or problem • **Idea Organizing** – learners clarify, consider, and challenge divergent perspectives; they identify and organize similarities and differences with stronger versus weaker positions • **Intellectual Convergence** – learners create a collaborative product, generate a solution, develop shared understanding, and manage the conflict of disagreement

Of the frameworks presented, the NSF INCLUDES National Network most closely resembles a Community of Practice, as that framework aligns closely with the NSF INCLUDES five design elements of collaborative infrastructure (Table 2).

TABLE 2. Comparison of Community of Practice (COP) and NSF INCLUDES Design Elements of Collaborative Infrastructure

DESIGN ELEMENTS OF COLLABORATIVE INFRASTRUCTURE	COP QUALITIES/THEMES
Shared Vision: Creating a common understanding, agenda, and future in addressing the challenges of broadening participation	**Shared Objectives:** Provide direction on team member responsibilities and encourage active contributions
Partnership: Forming relationships with one another and with new organizations through connections made at PI meetings, NSF INCLUDES-sponsored conferences, and beyond	**Sponsorship:** Protected time and adequate resources are required for individual success
Goals and Metrics: Allowing for robust data that facilitate evidence-based decision making	**Boundary spanning:** Setting parameters and objective benchmarks for the community **Measurements:** Assessing progress of COP activities
Leadership and Communication: Building capacity for leadership and communication among organizations and individuals to create opportunities in STEM education and careers	**Leadership:** Establishing leadership roles can motivate members around common goals
Expansion, Sustainability, and Scale: Collaborative infrastructure leads to increases in partners, connections, and collaborations	**Risk-free environment:** Encouraging open expression and testing of new ideas, while feeling a sense of safety

BUILDING TRUST

In virtual (and in-person) settings, trust is especially important, as collaboration can be effective only if parties enter it with a willingness to open themselves to one another and cooperate in carrying out a task, solving a problem, and learning (Jarvenpaa et al., 1998; Brown et al., 2004). Understanding how trust is built and maintained in virtual relationships is vital for designing virtual teams and developing processes that enable them to function effectively; it is the glue that binds collaborators by fostering faith that all parties contribute responsibly (Brown et al., 2004).

Some studies show that providing opportunities for people to talk about their non-work lives and share vulnerabilities can help build trust (National Research Council, 2015; Zheng et al., 2002). A number of resources exist on how teams build trust and virtual trust-building activities. Teams can become engaged, optimistic, collaborative, ready to try new ideas, and suggest process improvements (Mousavizadeh, 2014).

Establishing work norms and creating opportunities for shared experiences can help build trust in a collaborative team. Yet those launching a virtual collaboration may have difficulty establishing a shared work norm, and individuals joining an existing virtual group may have difficulty learning and adhering to such a norm once it has been established (National Research Council, 2015).

Virtual teams and groups are more likely to succeed if they engage in activities designed to foster shared experience like establishing common vocabularies and work style as explicit goals (National Research Council, 2015; Olson & Olson, 2014). These activities are especially important if members come from different institutions and/or cultural backgrounds. For instance, during kick-off meetings, team members can assess habits and expectations, discuss differences, and agree on ways to resolve differences to increase chances for success (National Research Council, 2015; Duarte & Snyder, 1999).

TOOLS FOR EFFECTIVE COMMUNICATION

Teams have access to an array of technical tools that can foster effective communication. In virtual settings, individuals must make additional efforts to report to others what they are working on, identify issues or challenges to resolve, and discuss the status of the work—using e-mail, videoconferencing, teleconferences, or other electronic media (National Research Council, 2015). Virtual social interactions developed through online technology platforms can lead to trust and knowledge sharing (Hartman et al., 2019; Olaisen & Revang, 2017).

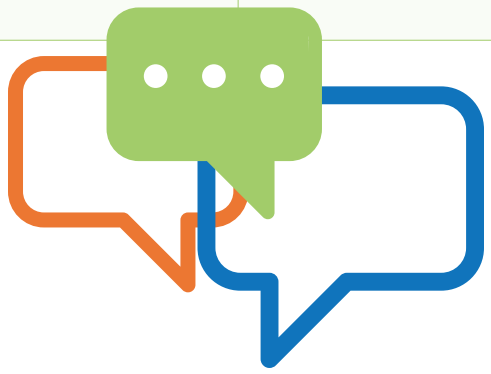
In a recent NSF INCLUDES Coordination Hub-hosted webinar on virtual internship best practices, U.S. Geological Survey Program Analyst Laura Corey emphasized the importance of planning, e.g. ensuring that team members had the appropriate equipment and access, timely and regular communication, opportunities for team-building like icebreakers, and ensuring inclusion for all team members, which includes availability of program mentors.

In Table 3, Olson and Olson (2014) categorize four types of technologies that foster distance work: communication tools, coordination tools, information repositories, and computational infrastructure.

Virtual teams need to assess before, during, and after use of these technologies to determine the proper approach for collaborating effectively. The technology must be easy to use, considering the tasks, infrastructure, culture, and overall work context (National Research Council, 2015). Teams should adapt multiple tools simultaneously based on the workflow, communication needs, and products being developed.

TABLE 3. Technological Classifications for Distance Work (adapted from National Research Council, 2015; Olson and Olson, 2014)

COMMUNICATION TOOLS	COORDINATION TOOLS	INFORMATION REPOSITORIES	COMPUTATIONAL INFRASTRUCTURE
E-mail,texting, and messaging	Shared calendars	Databases and collaboration platforms	System architecture
Voice and videoconferencing	Awareness tools	Shared files	The network
Chat rooms, forums, blogs, and wikis	Meeting support	Lab notebooks (online)	Large-scale computational resources
Virtual worlds	Large visual displays		Human computation
	Workflow and resource scheduling		



KEY TAKEAWAYS

To have successful virtual collaboration, teams must create a shared understanding of their goals and frameworks, instill trust, and have effective communication. The key takeaways include:

Community frameworks. Among the four types of community frameworks identified by Crites et. al. (2020), the NSF INCLUDES National Network is most aligned with the Community of Practice, as it aims to facilitate virtual communication platforms between Network members to share resources and best practices.

Shared practices. Trust is instilled by identifying work norms in the collaboration to develop shared practices, and methods for addressing expectations around interactions, primarily through virtual team-building activities and ice breakers.

Tools to enable collaboration. An array of technical tools enables collaborative teams to decide the most appropriate styles and forums based on workflow, culture, and product development.

Next Steps

We would like to continue a discussion about effective factors of virtual collaboration through online discussion posts at https://www.includesnetwork.org/home. We want to hear about your collaborative approaches and how you are incorporating the five design elements of collaborative infrastructure.

Here are several questions to spark conversation:

- **Which successful factors of virtual communication are most important for you?**
- **Which community frameworks do you ascribe to for your virtual collaboration?**
- **How are you assessing your collaborative team effectiveness?**
- **How can the Coordination Hub provide resources and guidance for instilling a collaborative team culture?**

References

Baker, M. J. (2015). Collaboration in collaborative learning. *Interaction Studies*, *16*(3), 451–473.

Brown, H. G., Poole, M. S., & Rodgers, T. L. (2004). Interpersonal traits, complementarity, and trust in virtual collaboration. *Journal of Management Information Systems*, *20*(4), 115–138.

Gerald E Crites, Andrea Berry, Elissa Hall, Denise Kay, Mohammed K Khalil & Larry Hurtubise (2020) Applying multiple frameworks to establish effective virtual collaborative teams in academia: a review and recommendations, Medical Education Online, 25:1, DOI: 10.1080/10872981.2020.1742968.

Duarte, D., and Snyder, N. (1999). *Mastering Virtual Teams*. San Francisco: Jossey-Bass.

Goodman, E. (2020). The impact of the pandemic on networks: Learning from network managers' experiences. Collective Mind. Available URL: https://collectivemind.medium.com/collective-mind-community-conversations-b03a6258e174

Hakanen, M., Häkkinen, M., & Soudunsaari, A. (2015). Trust in building high-performing teams: Conceptual approach. *Electronic Journal of Business Ethics and Organization Studies*, *20*(2), 43–53.

Hartman, R., Sixsmith, D., Akojie, P., & Banton, C. (2019). Adjunct faculty perceptions of participation in online collaborative research teams. *Higher Learning Research Communications*, *9*(2), 34–47.

Jarvenpaa, S. L., Knoll, K., & Leidner, D. E. (1998). Is anybody out there? Antecedents of trust in global virtual teams. *Journal of Management Information Systems*, *14*(4), 29–64.

Mousavizadeh, V. (2014). *How does a facilitator cultivate trust?* Human Dynamics. Available URL: http://www.humandynamicsblog.com/?p=342

National Research Council (2015). *Enhancing the Effectiveness of Team Science*. Washington, DC: The National Academies Press. https://doi.org/10.17226/19007.

Nemiro, J., Beyerlein, M. M., Bradley, L., & Beyerlein, S. (Eds.). (2008). *The handbook of high-performance virtual teams: A toolkit for collaborating across boundaries*. John Wiley & Sons.

NSF INCLUDES Coordination Hub (2021, January 28). *Virtual internships best practices* [Webinar]. https://www.includesnetwork.org/events/event-description?CalendarEventKey=7dbf0825-6636-4131-a041-79290de1c1db&CommunityKey=5e902dcd-362e-47be-a076-16bc71e2f038&Home=%2fevents%2fevent-description

Olaisen, J., & Revang, O. (2017). Working smarter and greener: Collaborative knowledge sharing in virtual global project teams. *International Journal of Information Management*, *37*(1), 1441–1448.

Olson, J.S., and Olson, G.M. (2014). *Working Together Apart*. San Rafael, CA: Morgan Claypool.

Patton, K., & Parker, M. (2017). Teacher education communities of practice: More than a culture of collaboration. *Teaching and Teacher Education*, *67*, 351–360.

Pelaez, N., Anderson, T. R., Gardner, S. M., Yin, Y., Abraham, J. K., Bartlett, E. L., & Stevens, M. T. (2018). A community-building framework for collaborative research coordination across the education and biology research disciplines. *CBE—Life Sciences Education*, *17*(2), 1-10.

Santeiro, N., Braswell, T., Long, M., Shead, C., Thier, B., Yu, J., Newpher, T., & Ng, M. (2020). *Collaborative learning in STEM positively impacts student outcomes*. [Poster presentation]. Duke University, Bass Connections.

Schieffer, L. (2016). The benefits and barriers of virtual collaboration among online adjuncts. *Journal of Instructional Research*, *5*, 109–125.

Smith K.A., & Imbrie, P.K. 2007. *Teamwork and project management* (3rd ed.). New York, NY: McGraw Hill.

Vuopala, E., Hyvönen, P., & Järvelä, S. (2016). Interaction forms in successful collaborative learning in virtual learning environments. *Active Learning in Higher Education*, *17*(1), 25–38.

Zheng, J.B., Veinott, E., Bos, N., Olson, J.S., and Olson, G.M. (2002). Trust without touch: Jumpstarting long-distance trust with initial social activities. In *CHI 2002 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp.141–146).

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