International Society of the Learning Sciences

Teacher-Immersion in Research and Evaluation of Computer Supported Collaborative Learning

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Abstract: This paper outlines an effort funded by the US National Science Foundation to produce iterations of research, design, and implementation in the area of project-based virtual collaboration by adolescents who live in different countries. The agency's funding strand, "Research in Service of Practice," emphasizes priority on making progress on the often-elusive connections between research and educational practice. The heavy involvement of teachers in the reported project tracks closely with this priority. The paper summarizes key aspects of the project as prelude to delving into four layers of roles that school teachers have held in it: practitioner, research advisor, research designer, and formal evaluator. It highlights important socio-affective experiences that participating students in the US and peers internationally reported along with recommendations for a new scale-up version of the project that is recently underway.

Introduction

Efforts to articulate and deepen the connections between education research, education innovation, and daily educational practice comprise a sizable literature and a priority in educational policy-making (Broekkamp & van Hout-Wolters, 2007). This paper reports a project called the International Community for Collaborative Content Creation (IC4) (Hamilton et al., 2016) designed to investigate how to operationalize these connections in informal or out-of-school science, technology, engineering, and mathematics (STEM) educational settings. The paper describes IC4's research and practice strand connections. It includes observations and conclusions appearing in the project's official summative evaluation. Three teachers share lead-authorship of this paper; they each served on the team led by two independent consultants that prepared the project's final evaluation. Two actively participated in the underlying research; the third is a newcomer whose initial participation came as a member of the external evaluation team. Recommendations from the research project and its evaluation appear throughout the paper.

Evolution of Teacher Involvement

The invitation by the International Society for the Learning Science's (ISLS) to teachers to lead conference presentations is a strong step towards acknowledging and leveraging the unique niche that teachers occupy in computer supported collaborative learning (CSCL) research and evaluation. Teachers mediate student learning with experience and decision-making at the interface between learning ecosystems (such as classrooms and informal settings) and the learners they serve. They possess vast funds of knowledge and tacit knowledge that interventions or pilot studies require (Elliott et al., 2011). Empowerment evaluation (Fetterman, 1994) and educational design research more generally speak to otherwise inaccessible benefits from the active engagement of field practitioners in settings such as these. In this project, for example, university researchers realized that teachers (and students) often more effectively articulated the project's critical features than they did in proposing its grant funding, and they were thus called on for a sizable fraction of the project's public presentations. Their particular roles first involved serving as club organizers and sponsors. Teachers also participated in monthly planning sessions by which they became more formatively involved in adjusting the research questions and how design adjustments might improve ways to address the questions. IC4 concluded in Fall, 2022, giving way to a scale-up grant by NSF in support of a successor project named Asset-Based Learning Environments (Hamilton et al., 2022). A critical step in the project entailed a formal summative evaluation submitted to NSF, jointly completed by this paper's lead co-authors and two additional external researchers. The evaluation will guide initial iterations of the scale-up version of the project and is a primary source for this paper.

Research Project Description

The original purpose of this research was to explore the construct of "participatory teaching" (Hamilton & Owens, 2018) in the context of enabling adolescents to develop intercultural and global collaboration competence. Competence formation took place as the students jointly formulated STEM projects they carried out through global meetups (Hamilton & Kallunki, 2020). Three factors gave rise in the mid-2010s to this project (Hamilton & Espino,

2020): A) advances in CSCL research; B) the development of communication technologies that enable smooth and inexpensive video interactions across global boundaries; and C) increased attention to the role of culture in collaboration and learning. Combining these factors enabled development of novel, informal STEM learning settings that could be improved through research-shaped design iterations and improvements.

These factors were each in play in IC4's formation. Beginning in 2017, under US National Science Foundation (NSF) support, IC4 ultimately included sixteen sites from ten countries. Adolescents in out-of-school clubs at each site collaborated asynchronously and synchronously to research and create media to teach peers about STEM topics of personal interest. The project sought to answer the question, "How can students from various cultures co-teach and co-learn STEM topics through collaborative content creation?" The most common form of international synchronous communication with peers involved weekly "global meetups" on Zoom, long before the pandemic. The project transitioned to a scale-up model under new NSF support, under the name "Asset-Based Learning Environments" or ABLE, beginning in late 2022 (Hamilton et al., 2022).IC4 and the successor ABLE project employ quantitative ethnography (Shaffer, 2017) to create visual models of how students progress in learning and collaborative capabilities across cultural barriers. Important visual models, using epistemic network analyses, have been published by teacher and researcher teams (ic4.site). These visual models demonstrate important growth patterns whereby cross-national collaboration was associated with development in prosocial constructs, such as willingness to help others. Data collection with this approach takes two forms: it entails year-end interviews and recordings of their direct interactions in their global meetups. In addition to coding these data sets, important research conclusions by teachers emerged from participation in the formal evaluation.

Participant Recruiting and Collaborative Activity Format

Approximately 200 students ranging from age 10 through age 19 participated under the leadership of local teachers and administrators throughout the project. At its outset, IC4 leaders emphasized the joint important of content creation and content communication. In their interviews, IC4 students emphasized that these formats amplified their creative expression in ways not possible in formal classrooms. Though the project formally presented itself as digital or virtual makerspace research, students also completed Arduino and robotics projects they shared or co-produced over video. During the final two years of the project, though, remote learning forced a format shift which led to more PowerPoint or Google Slide presentations as school facilities were not available. The stay-at-home regimens that affected school effectiveness more generally (Engzell et al., 2021) inhibited the range of activities possible for IC4 students.

Communication Between Collaborating Students

CSCL projects of this nature rely on the strong grouping of students (Borges et al., 2017). Student-Student relationships proved important for cultivating trust among group members. In the first years of IC4, groups were assigned by the research team at the grant's host institution, based on student interests. In the last two years of the project, students were given more freedom in choosing their partners. They could watch introductory videos or respond to posts on Slack and then form partners organically. Synchronous communication is not only important for collaboration, but students also reported that it also builds their confidence, communication skills, and sense of their relationship to peers globally. In their interviews, participants recurrently spoke of being shy or introverted when it came to speaking on Zoom meetings initially. After their participation in the global Zoom meetups, they felt that they could speak up more, share their ideas, and their confidence in communicating improved. One student explained, "*Now that I've been talking to people around the world, I know that there are so many other people that are just like me... when talking to each other, we start to realize we have the same interests, same hobbies that we never thought we could find. You're like me and I'm like you."* Students also stated that they liked interviewing people rather than only being interviewed themselves. As data science becomes more prevalent, it would be valuable for students to conduct interviews, collect and analyze data, and then present their findings as part of a project.

To manage poor bandwidth and connectivity, IC4 students could post videos prior to the meetup, to be viewed by the participants while feedback can be given asynchronously on Slack or live at the meetup. There were several videos created by partners from different sites, but an examination of the project records during the evaluation phase suggested a lack of continuity in the final product. These videos may have been more successful if the process of collaborating on a video was modeled more prominently. This broad research recommendation from the evaluation team included a series of specific suggestions for better practices, in alignment with the agency's "Research in Service of Practice" funding strand that supported IC4. IC4 teachers found there were times when students would reach out to the entire IC4 community seeking project partners, but would be met with silence. This raises a potential line of inquiry for ABLE scale-up project: How effective it is when students reach out to other students asking to collaborate with one another. What is the success rate? How often does it happen? Do student connections endure through the

completion of a project? The research team suggests that providing additional opportunities for students to socialize during global meetups may allow them to build relationships that foster a greater commitment to collaboration below.

Students as Teachers

One important component of IC4 came during 2021-2022, IC4's final academic year and when piloting for the ABLE scale-up research was in full swing. A group of students took on a more intense role of peer teachers by leading workshops on Python coding. One student leader stated how the smaller group size of this collaboration made it possible to go more in-depth with the lessons and ensured that all of the students were given the help that they needed. IC4 students who taught or participated in the Python coding theme cited specific cases of how they learned by doing. Teachers express this as a difference between consuming versus creating content, and recommend more vigorous use of peer teaching in IC4 and ABLE's distributed collaboration context. In one interview, this student reflected, IC4 is *"not so much opening my horizons to new technology and new math, but opening my horizons to new cultures and...honing my abilities…While IC4 is … giving [me] that opportunity to learn more math and learn more coding, I really think that it's, for me at least, giving me an opportunity to...teach and...see how my code can...help and impact others and improve their lives and...give them opportunities that they might not have had otherwise*." Self-reflection was also a salient process identified by multiple participants of the beginner group who made observations that were similarly compelling. One member said that through observing how others responded to her online, she became aware that she was speaking too quickly for non-native peers, and shifted to a more deliberate pace that enabled her to attend to whether STEM ideas she was sharing were readily understood by her peers. This example is one of many indicating students were building empathic dispositions through CSCL.

Upon reviewing the transcripts and videos for the project, a common theme emerged of students acting as a teacher within almost every IC4 site. Students discussed that, "teaching yourself to teach others" really allowed individuals to understand the importance of what they were learning. One student shared, *"I really … enjoyed teaching…it made me a better programmer because it made me help, it helped me understand the topic even better."*

Additional Evaluative and Research Findings and Recommendations

The project frequently cites reliance on interest-driven creator theory (Roschelle & Burke, 2019) a framework formally articulated in 2018 by a network of nearly twenty Asian researchers seeking alternatives to high stakes testing in their countries. IC4 students recurrently sought to identify areas of personal interest for collaborative projects, indicating that one thing they would like to take from IC4 to their regular classroom teachers is to provide more opportunities in their classes to choose topics of interest instead of teaching only the material prescribed in their curriculum. IC4 allows students to be intrinsically motivated to see a project from start to end, contributing to a sense that they learn more because they research a topic that interests them at a deeper level and can assist one another in learning the topic.

An important research question for the broader field of distributed learning and collaboration is to find balance between how a suite of realistic challenges are structured and made available to participants. A related direction teachers are pursuing requires finding ways to enrich challenges using culturally relevant questions. Indeed, a common theme we discovered was that when students answered interview questions about learning about other cultures through the projects that others created, respondents did not mention STEM specifics as much as they spoke of getting to know the other students' interests. One student said, "*I …don't think I have any um necessary ideas as to …what it's like to live in Kenya or what it's like to live in Mexico or what it's like to live in the UAE. I really think that I just see that everybody is very talented on the computer*."

Project challenges included short TikTok style videos. Teacher evaluators reviewed interview evidence that this increased or amped participation. They implemented a design in the new ABLE project that uses this format more fully for students to share their respective cultures. This takes the form of short video challenges such as "Show me a place where you learn", "Take me on a tour of your school", or "Take me on a field trip around your area." The researchers suggest that students start developing these types of prompts for one another, incorporating STEM topics, cultural awareness, and personal interests. The students mentioned earlier who specialized in helping other students and teachers learn coding regularly expressed pleasure at the opportunity to teach one another. The design for more opportunities for students to introduce their home and culture into their shared projects is likely to contribute significantly to the data sets that seek to document the synergy between cross-cultural development and learning.

It merits note that the transition from IC4 (2017-2022) to ABLE (2022-2026) includes a shift in research emphasis to individual and group identity formation, an emphasis that subsumed the original IC4 emphasis on participatory teaching. Along with learning about other cultures, more attention on building relationships between students across sites would be beneficial in project efforts to help adolescents develop healthy identities. In response to this observation and as a result of the evaluation, the new ABLE project also features personal identity inventories prior to, during, and after participation.

Students enjoy learning about one another and finding common interests. The evaluation team noted from meetup video recordings that there was an "all business" attitude of presenting information and providing feedback, but in their social context, students would benefit from opportunities to know one another outside of the collaboration projects. The team suggested more systematically or purposefully providing time before or after meetups just for social interactions. The teacher team also suggests defining and employing a construct of ***flourishing*** (Orkibi et al., 2018) to characterize healthful and prosocial identity formation that appears to emerge from both the collaborative projects and the more relaxed interactions. The teacher evaluation team submitted several other recommendations about the project research. One prominent methodological suggestion entails interviews. During some end-of-year interviews, students who had been members for more than one year, referred to earlier experiences from prior years, instead of the current year. This appears to be a methodological deficiency. At the end of global meetups, students are encouraged to reflect on their thoughts from the meetup. These insights are valuable, but because they are reminded at the end of the meeting, students may rush through them just to be finished. The team recommends that instead of waiting until the end of the year to conduct interviews, shorter interviews should take place at the end of each meetup or interview meetups which are scheduled monthly (or regularly) throughout the year. Some of these interviews could be conducted in small groups instead of one on one. This would allow participants to build off of each other's responses, giving deeper insight through collaboration. Personal interviews would then be shorter than the end of the year interviews.

References

Borges, S., Mizoguchi, R., Bittencourt, I. I., & Isotani, S. (2017). Group formation in CSCL: A review of the state of the art. Researcher Links Workshop: Higher Education for All,

Broekkamp, H., & van Hout-Wolters, B. (2007). The gap between educational research and practice: A literature review, symposium, and questionnaire. *Educational research and evaluation*, *13*(3), 203-220.

Elliott, J. G., Stemler, S. E., Sternberg, R. J., Grigorenko, E. L., & Hoffman, N. (2011). The socially skilled teacher and the development of tacit knowledge. *British Educational Research Journal*, *37*(1), 83-103.

Engzell, P., Frey, A., & Verhagen, M. D. (2021). Learning loss due to school closures during the COVID-19 pandemic. *Proceedings of the National Academy of Sciences*, *118*(17), e2022376118.

Fetterman, D. M. (1994). Empowerment evaluation. *Evaluation practice*, *15*(1), 1-15.

Hamilton, E., & Espino, D. (2020). Distributed Collaboration in STEM-Rich Project-Based Learning. https://repository.isls.org//handle/1/6849. In J. Roschelle, editor (Ed.), *Digital Promise Rapid Community Report Series, International Society of the Learning Sciences Repository*: Center for Innovative Research on Cyberlearning.

Hamilton, E., Espino, D., & Culp, K. (2016). Research on an International Network for STEM Media Making and Student-led Participatory Teaching. *National Science Foundation Award DRL-161284 (Advancing Informal STEM Learning (AISL) Program).*

Hamilton, E., Espino, D., Jones, N., & Lee, S. (2022). *Broadening participation, building STEM competencies, and strengthening identity formation through cross-cultural and international collaboration in project-based learning: Asset-Based Learning Environments (ABLE). DRL-2215613* [Grant].

Hamilton, E., & Kallunki, V. (2020). Distributed Collaboration in Project-Based Learning and Its Assessment in Next-Generation Learning Environments. In E. A. Tatnall (Ed.), *Encyclopedia of Education and Information Technologies*. Springer.

Hamilton, E., & Owens, A. M. (2018). Computational thinking and participatory teaching as pathways to personalized learning. In *Digital Technologies and Instructional Design for Personalized Learning* (pp. 212-228). IGI Global.

Orkibi, H., Hamama, L., Gavriel-Fried, B., & Ronen, T. (2018). Pathways to adolescents' flourishing: Linking self-control skills and positivity ratio through social support. *Youth & Society*, *50*(1), 3-25.

Roschelle, J., & Burke, Q. (2019). Commentary on Interest-Driven Creator theory: a US perspective on fostering interest, creativity, and habit in school. *Research and Practice in Technology Enhanced Learning*, *14*(1), 13.

Shaffer, D. W. (2017). *Quantitative ethnography*. Cathcart Press.

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