Lessons Learned from Going Global: Infusing Classroom-based Global Collaboration (CBGC) into STEM Preservice Teacher Preparation

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Abstract

There are many affordances of integrating classroom-based global collaboration (CBGC) experiences into the K-12 STEM classroom, yet few opportunities for STEM preservice teachers (PST) to participate in these strategies during their teacher preparation program (TPP). We describe the experiences of 12 STEM PSTs enrolled in a CBGC-enhanced course in a TPP. PSTs participated in one limited communication CBGC (using mathematics content to make origami for a global audience), two sustained engaged CBGCs (with STEM PSTs and in-service graduate students at universities in Belarus and South Korea), and an individual capstone CBGC-infused project-based learning (PBL) project. Participating STEM PSTs reported positive outcomes for themselves as teachers in their 21st century skills development and increased pedagogical content knowledge. Participants also discussed potential benefits for their students in cultural understanding and open-mindedness. Implementation of each of these CBGCs in the STEM PST course, as well as STEM PST instructors' reactions and thoughts, are discussed.

Introduction

In 1963, composers Richard and Robert Sherman wrote lyrics for a Walt Disney amusement ride that debuted at the 1964 World Fair in New York City (Brown, 2014). Influenced by the events surrounding the Cuban Missile Crisis, the song's message is of peace, unity, and brotherhood (Langer, 2012; Richards, 2012). The lyrics to this song have since become familiar world-over:

> It's a world of laughter, a world of tears; It's a world of hope and a world of fears; There's so much that we share, that it's time we're aware; *It's a small world after all.*

Even then, it would have been difficult to predict just how *small* the world would become; never in the history of humanity have these words rung truer than they do today. Largely a result of globalization and perpetual technological advancements, global interactions now take place at breakneck speed. The subsequent benefits and consequences of those interactions impact every facet of society (Collins, 2015).

The results of these increasingly global interactions are particularly relevant in the sphere of American K-12 education. First, schools should be responsive to increasingly diverse populations. Between 2003 and 2014, American K-12 public schools saw an 18% increase in the racial and ethnic diversity within their walls (National Center for Education Statistics [NCES], 2016). Non-white (minority) student enrollment in K-12 public schools is now equal to that of white (majority) students and is projected to surpass the majority by 2025 (NCES, 2016). A growing number of students are foreign-born (or have at least one parent who is), speak a language other than English as their first language, and hold a wide variety of non-Western cultural values and traditions (United States Census Bureau, 2016; Uro & Barrio, 2013). Second, schools must prepare students for the global society in which they will find themselves. In addition to strong content acquisition, schools must provide environments that foster the growth of 21st century skills, including knowledge, skills, and dispositions to navigate and succeed in the era of globalization (i.e. *global competence*) (Soland, Hamilton, & Stecher, 2013; World Savvy, 2018). This poses both unique challenges and opportunities for schools and teachers; not only are they working with culturally and ethnically diverse students each day, but they must, in turn, prepare their students to do the same. Schools, but particularly teachers, wield a considerable amount of influence and responsibility when it comes to preparing students for their futures (Reimers, 2009). Teachers have been shown to have the largest effect on student outcomes within schools, second only to the student (Hattie, 2003). As a result, designing globally-focused school curricula and growing globally-responsive teachers are necessary.

Organizations such as the International Society for Technology in Education (ISTE, 2008), National Science Teachers Association (NSTA, 2009), PBLWorks (PBLWorks, 2012), and Partnership for 21st Century Learning – A Network of Battelle for Kids (P21, 2019) have called for greater global connections in K-12 classrooms, specifically STEM classrooms. Designing and engaging K-12 students in global collaboration experiences, though, requires a teacher proficient in both constructivist-based pedagogy and instructional technology and who has been exposed to globally-focused curriculum, activities, and interactions. To prepare teachers, there is a need to include global education and global collaboration in teacher preparation programs (TPP), along with providing preservice teachers (PSTs) training in innovative instructional methods to support it (Gibson, Rimmington, & Landwehr-Brown, 2008; Markham, 2011; Thomas, 2000).

In this study, we explored the experiences of STEM PSTs' engagement with global education within a single course during their TPP, specifically through *Classroom-Based Global Collaboration (CBGC),* which we define as students directly interacting with other students from around the world in the context of regular classroom instruction, not study abroad experiences. We leveraged global collaboration as an effective instructional pedagogy for promoting academic (content) knowledge and the development of K-12 students' 21st century skill sets, including global competence (Cummins & Sayers, 1997; Kerlin, 2009; Riel, 1994). This paper details implementing CBGC, PST reactions and thoughts on CBGC use in the classroom, instructors' reactions and thoughts, and conclusions with next steps.

Teacher Preparation Programs and Global Education

Some TPPs include coursework that fosters global awareness, including global content, global pedagogy/methodology, and global problems and issues. This form of global education pedagogy is one of the most widely used in PST preparation, generally delivered through courses on diversity that emphasize theory, rather than practice, or through comparative studies (Aydarova & Marquardt, 2016; Walters, Garii, & Walters, 2009). While important, this form of global education can be incorporated devoid of any actual interaction with global peers and these approaches have been met with varied levels of success in affecting change in PSTs' attitudes towards global education, their perceptions of diverse learners in future classrooms, and their ability to move beyond superficial, surface-level explorations (Derman-Sparks, 1995).

Other global education experiences for PSTs include sustained global interactions during study abroad and/or short-term or long-term global field (student teaching) experiences (Zong, 2009). Several studies have reported positive outcomes for PSTs engaging in immersion experiences and full-semester international student teaching placements (Walters, Garii, & Walters, 2009). For example, PSTs from the United States who engaged in international student teaching reported greater appreciation for and awareness of cultural diversity, changes in preconceptions and stereotypes, increased curriculum and pedagogical perspectives, exhibited higher levels of reflective practice, and indicated that experiencing *other* would make them better classroom teachers, particularly with regard to English Language Learners (ELLs) (Clement & Outlaw, 2002; Kambutu & Nganga, 2008; Pence & Macgillivray, 2008). Additional studies have demonstrated positive outcomes in diversifying STEM pedagogy and instructional methodology perspectives (Fang & Gopinathan, 2009), increasing PSTs' confidence in personal global awareness (Cogan & Grossman, 2010), and developing PSTs' 21st century skills (Dede, 2009; P21, 2019).

However, it can be difficult for STEM PSTs to engage in these types of experiences. Certification requirements, lack of university offerings, financial constraints, and overall interest pose challenges (Walters, Garii, & Walters, 2009). This is true for the study site, a well-established STEM TPP that is a high-fidelity replication site of a nationally acclaimed, university-based program located within a large public university in the southwestern United States. The program has an active enrollment of over 400 students and more than 200 graduates in the past decade. The university itself is unique in that it has no college of education; therefore, a majority of the students electing to enroll in the program are recruited directly from STEM departments. Consequently, many PSTs have not previously considered teaching as a career option. Developing new teachers who have both a degree in a STEM field and a content-specific teaching certification is a huge asset, yet, degree requirements, coupled with state certification requirements, make it difficult to include travel abroad opportunities. For these same reasons, the addition of a dedicated global perspectives or diversity course within the program has also been a challenge. These STEM PSTs use the required certification courses to fulfill the electives required for their STEM degree, but it leaves little room for additional education-related courses beyond the minimum required for certification.

Characteristics of Our PSTs

Thirteen STEM PSTs, mostly young undergraduates who were seeking their STEM content degree and teacher certification simultaneously, participated in the course. Among the 13, five were male and eight were female. Ten sought grades 7-12 certification in science and three sought grades 7-12 certification in mathematics. While several PSTs indicated some international/global experience in the form of travel abroad opportunities or interactions with international exchange students in their secondary schooling, none had experience with GBGC activities. Engaging with others from around the globe as a function of their class and coursework was novel.

It should be noted that while 13 PSTs were enrolled, only 12 completed all portions of the course; although still enrolled, one PST simply stopped attending class midway through the semester. Therefore, the findings and conclusions presented reflect this and are discussed in the context of the 12 PSTs who fully completed the semester.

STEM PST Course and CBGC Integration

PSTs need experience using innovative instructional practices if that is to transfer to classroom practice. Recognizing the need to provide the PSTs enrolled in our program with global perspectives and interactions, but unable to address it using the more conventional routes of dedicated course offerings and travel abroad experiences, our program decided to do something different. The final course in our program offered prior to PSTs' semester-long student teaching placement is *project-based learning* (PBL). PBL is a pedagogical approach grounded in providing relevancy to students' lives, engaging students in inquiry-based investigations, facilitating collaborative processes, and using emergent technologies (Krajcik & Czerniak, 2014). Studies have demonstrated that PBL (as an instructional method) supports the development of students' 21st century skills (e.g. collaboration, communication, critical thinking, problem solving, self-directedness, etc.), technology literacy, and global competence, as well as academic content proficiency (Holm, 2011; Larmer & Mergendoller, 2010; Thomas, 2000). We decided that the PBL course provided an ideal framework for integrating CBGC within PST preparation, where students can further engage with STEM content, refine their 21st century skill set, and strengthen their pedagogical know-how by entering into collaborative learning experiences with authentic, global partners. The course used both the P21 *Framework for 21st Century Learning* and the *Teacher Guide: K-12 Global Competence Grade-Level Indicators* (P21, 2019).

By reworking an existing course, we were able to offer STEM PSTs what we have termed CBGC experiences. For this course, *global* referred to any entity beyond the borders of the United States- in essence, international. *Collaboration* was defined as working together with others for the purpose of exchanging ideas, increasing knowledge, completing a project, and/or creating a product. Additionally, this course focused on global collaboration specifically in the context of regular classroom instruction, not study abroad experiences.

To guide our design, we used a *Global Education Continuum* (see Figure 1) to categorize the levels of collaboration for the CBGC activities. Essentially, the higher the level of collaboration along the continuum, the more advanced and sophisticated the interactions and products of those participating become. Although written specifically for science, it has broad applicability to all STEM content areas.

Figure 1 (Click on image to enlarge). Global Education Continuum. Adapted from "21st Century Citizen Science" by J. Nugent, W. Smith, L. Cook, and M. Bell, 2015, *The Science Teacher, 82*(8), p. 35. Copyright 2015 by the National Science Teachers Association.

Global Education Continuum

Global Awareness	Parallel Activity	Shared Data	Limited Communication	Engaged Collaboration	Global Contribution
Least Amount of Collaboration					Greatest Amount of Collaboration
Exposure to other cultures and geographical areas to increase knowledge or perception of a world beyond one's own	Classrooms are separated geographically, yet are simultaneously engaged in the same activity; participating classrooms do not communicate, but are aware of others' participation	Students from a variety of locations sharing data in some way, but without direct communication between classrooms	Students from a variety of locations sharing information via direct asynchronous or synchronous communication	Students from a variety of locations sharing information; involves moderate to significant levels of communication via direct asynchronous or synchronous communication	Result of collaboration that involves giving back or contributing to the world around you

Figure 1. Global Education Continuum. Adapted from "21st Century Citizen Science" by J. Nugent, W. Smith, L. Cook, and M. Bell, 2015, *The Science Teacher, 82*(8), p. 35. Copyright 2015 by the National Science Teachers Association.

We purposefully designed our CBGC experiences to be at the level of limited communication or greater to foster a robust global education experience. The course activities included three CBGC experiences, followed by a culminating capstone project, which are discussed as follows.

Experience 1. The first CBGC was facilitated through *iEARN* (www.iearn.org), a non-profit organization which partners teachers and students from around the world for global education through a variety of projects. Our STEM PSTs participated in a *limited communication project* (Figure 1), where in teams of two or three they completed an instructor-created mathematics PBL unit involving origami and then uploaded their creations to the iEARN *Origami Project* (iEARN, n.d.*a*) for public comment. Students from around the world were able to comment and engage in dialogue with PSTs regarding their origami creations, and vice versa. The purpose of this activity was to introduce STEM PSTs to the PBL lesson format, while simultaneously teaching content and providing them with a CBGC experience.

Experience 2. The second CBGC involved a multi-week discussion exchange with STEM PSTs enrolled at a university in Belarus and was categorized as *sustained engaged collaboration* (Figure 1). During this six-week collaboration, teams of students responded to education-related prompts co-created by the course instructors at both universities. The team members were different than those in Experience 1, but similarly consisted of two or three students. This collaboration was also facilitated through a discussion board within the established KOSKO Future Teachers Project (iEARN, n.d.*b*). Students initiated the project by writing *We Are From* poems (originally adapted from Lyon, 1999) and making introductory videos of themselves to send to their partners (i.e. two-three minutes on what university they attended, major, why they want to become a teacher and what they hoped to learn from the collaboration, posted to YouTube). This activity was followed by a series of discussions over the next several weeks. This included both American and Belarusian STEM PSTs uploading lesson plans or activities they had researched, designed, and/or taught. Then they were asked to compare uploaded documents on topics related to content, pedagogy, instructional design, and roles of teachers and students. Each team provided feedback on their thoughts through discussion on the website. These asynchronous discussion activities were supplemented by two, one-hour long synchronous Skype sessions.

Experience 3. The third CBGC included both STEM PSTs and in-service teacher graduate students enrolled at a university in South Korea. Similar to the Belarusian collaboration, PSTs engaged with their South Korean partners over a six-week time period. The level of collaboration was the same as in Experience 2, *sustained engaged collaboration* (Figure 1). The PST groups used in this collaboration were the same as in the Belarusian collaboration. The South Korean collaboration was facilitated through an instructor-created wiki using *Wikispaces* (https://www.wikispaces.com/), which was selected for its accessibility by both partners in the collaboration. They composed *We Are From* poems, created an introductory video, and responded to education-related prompts co-created by the two course instructors. For example, one prompt was a discussion of TIMSS and PISA data that suggested math and science interest diminished over time, where they were tasked to brainstorm solutions for that issue. Only asynchronous collaboration was available for this partnership.

Capstone PBL project. As a final capstone experience in the course, students were asked individually to design their own STEM PBL unit, where they were to include a CBGC experience that could be used with their future students. They were tasked to draw from their own personal experiences with the course (i.e. CBGC, PBL, and teaching) to develop this lesson. This lesson was designed as a culminating project with applicability to share with future K-12 classroom students and teachers to promote and involve others in CBGC experiences.

STEM PSTs' Thoughts and Perspectives

During the course of the semester, we collected the STEM PSTs' thoughts and perceptions on engaging in CBGC experiences through interviews, surveys, discussion posts, lesson design documents, and observations during Skype sessions. We wanted to understand their perceptions of the GBGC experience for themselves (as teachers) and its (potential) impact for K-12 students. The data collection and outcomes presented here are part of a larger research study on predicting future use of CBGC among STEM PSTs (York, 2017).

Personal Positive Outcomes. PSTs' attitudes towards CBGC were generally positive. The benefits they personally experienced from the collaborations, coupled with the perceived benefits of including CBGCs for their future students, contributed to the favorable responses from almost all participants. Specifically, PSTs' responses indicated two main categories of personal benefit: further 21st century skills development and increased pedagogical knowledge (see Table 1).

Table 1 (Click on image to enlarge)

PSTs' Perceived Personal Benefits of CBGC

Table 1

PSTs' Perceived Personal Benefits of CBGC

Perceived Personal Benefits	Number of PSTs (N=12[a])	% of PSTs
21st century skills development[b]		
Key subjects and 21st century themes: global awareness	11	91.7
Information, media, and technology skills	10	83.3
Life and career skills	8	66.7
Learning and innovation skills	7	58.3
Pedagogical perspectives	9	75.0

Note. [a]While 13 students were enrolled in the course, only 12 completed all portions of the course; although still enrolled, one student stopped attending class midway through the semester. The data presented reflect this and are calculated only to represent the 12 PSTs who fully completed the semester. [b]Perceived personal benefits with regard to 21st century skills were analyzed using the P21 *Framework for 21st Century Learning*.

The most frequently mentioned benefit was the increased *cultural awareness and appreciation* that occurred through the sharing of ideas with global partners. PSTs noted their enjoyment of learning about other cultures and education systems, along with getting to hear, read, and discuss different global perspectives (see Figure 3). In one of their discussion posts to their international partners (pseudonyms are used for reporting), a group mentioned the following:

> Some definite benefits of doing this collaboration have been getting to know other students from across the globe with the same passion for teaching! While we may come from different types of school systems and teach students differently, it has been refreshing to see another point of view and share our lesson plans with you. (Elaine, Thomas, and Brittney)

In keeping with increased global and cultural awareness, one interesting outcome to note for two PSTs was how communicating with global partners provided them with a unique lens for reflecting on how they will support ELLs in their future classrooms. PSTs also noticed strengthening of their *information, media, and technology skills*, particularly in using various technology platforms to support research, communication, and collaboration, along with increased proficiency in both *life and career* and *learning and innovation skills* (although to a slightly lesser extent).

Figure 2 (Click on image to enlarge). Skype session with Belarusian partners.

Figure 2. Skype session with Belarusian partners (own photo).

Using CBGC to learn about different pedagogical approaches to classroom STEM instruction was also a benefit mentioned by a majority of the PSTs. According to one group, the collaboration allowed them to “[learn] new ways to improve our own teaching skills.” (Eric and Cole). Similarly, another team said that “it opens up your mind to other possibilities and lets you see teaching techniques and methods that are different from what we are used to here in the U.S.” (Rachel and Jennifer).

Positives Outcomes for Future Students. As for implementing CBGC activities in their future STEM classrooms, all of the STEM PSTs indicated that they could find relevance in doing so and felt that their future students would benefit in similar ways as they did by engaging in global collaborations. PSTs expressed that having students do this in their classrooms would better prepare them for the ‘real’ world by fostering open-mindedness, reducing cultural stereotypes, increasing empathy, and strengthening communication, collaboration, and technology skills. Many noted that CBGC allows for exposure to more diverse perspectives and ideas than students may normally experience. Anna discussed the benefits of CBGC in interacting with and learning about other cultures. Jennifer said it helps students to “think broad[ly] and not [be] close minded [*sic*],” while Eric expressed that it creates personal connections for students, helping them to “[open] up to new people, new ideas.” Another STEM PST, Leah, thought that cultural stereotypes could be reduced using CBGC, as discussed with her South Korean partner:

> Oftentimes, students romanticize a culture or a country based off of what they see from television or other forms of media….Through global collaborations with these countries, hopefully, wall [*sic*] and barriers about pre-set notions of a culture can be broken down.

PSTs also included the potential for higher levels of student engagement in the classroom. Cole noted that students would be more “engaged by the fact that they are working with people who they’ve never met and are sometimes different than them.”

Lastly, a few STEM PSTs thought that CBGC could be used to facilitate STEM content acquisition in the classroom. Brittney described that it was useful for content-based instruction, because students could “synthesize the content they have been learning in class to share with others in a clear, understandable way.”

Course Instructors’ Thoughts and Perspectives

Positive Outcomes. It is important to note that this was the first attempt for us in the instructor role at organizing and facilitating a CBGC. Any first attempt comes with numerous opportunities for reflection and improvement for subsequent semesters. However, before discussing the challenges that came with being ‘first-timers,’ there were multiple benefits that we as instructors experienced.

As educators, we are always looking for innovative methods to include in our classes, not just for our students, but for our own personal growth in our profession. First, employing an instructional strategy where we had to design and organize global collaborations while still meeting the intended learning outcomes of the course (as required for teacher certification) allowed for immense creativity and ‘outside the box’ thinking on our part. This afforded us valuable insight into the challenges our PSTs would face in their upcoming classrooms and helped us to troubleshoot and identify potential problems and pitfalls before they became a stumbling block for the students.

Second, we gained some wonderful global professional connections. Professional networking comes in a variety of forms, and we found several opportunities for things such as research and sustained interaction through establishing the CBGCs. The opportunity for camaraderie, reflection, and discussion between peers across the world dedicated to developing quality PSTs was a unique and gratifying experience for all parties involved.

Finally, we learned just as much as our students, if not more, about various education systems and STEM pedagogical content teaching from individuals with perspectives and experiences much different than our own. Our perceptions of the world, and often teaching and learning, are frequently one-sided, especially in STEM PST preparation. STEM education in the United States is taught with an overwhelming preference towards Western, imperialistic ideology, which is not always congruent with the experiences and worldviews of others (Meyer & Crawford, 2011); much less attention is given to global trends, perspectives, and methods. Engaging in these experiences opened our eyes to other philosophical and theoretical views regarding STEM teaching and learning that we did not have knowledge of and/or had not previously considered or discussed in our course. Listening to and observing our students interact with students in Belarus and South Korea, we watched as their world expanded. We, too, were reflective learners as we considered what it might look like to walk in these students' shoes or to face the challenges of their instructor.

Learning Opportunities. There were multiple challenges (what we like to call 'learning opportunities') from the instructor perspective when establishing and engaging in CBGC activities with STEM PSTs. However, we found none of these challenges to be a deterrent or a burden to embedding these experiences within our curriculum. The following notes some of the challenges we faced, in hopes that this provides others with tips for successful implementation of CBGC.

To start, we utilized an existing global collaboration network (e.g. iEARN) for the Belarusian partnership and relied on personal connections for the South Korean partnership. Finding international collaborators can appear overwhelming, however, there are numerous resources to assist in this, including organizations and matching websites that specifically cater to individuals interested in global partnerships.

As instructors, we also wanted to provide our PSTs with as much direct communication with their partners as possible. Both asynchronous and synchronous communication strengthen collaborative skills, although a greater sense of community is achieved through synchronous activities (Higley, 2013; Hrantiski, 2008). Synchronous activities provided the biggest challenge for both us as instructors and our PSTs, especially with time zone differences. However, these were an expected challenge that we tackled by using technology with a world time zone meeting planner app to facilitate schedules. Asynchronous communication provides greater opportunities for research, critical thinking, and reflection throughout the collaboration (Higley, 2013; Hrantiski, 2008). While easier to accommodate, it too had its logistical issues. Some partnerships within the CBGCs produced lots of communication and feedback, while others had less. Our student teams often compared notes with each other and were disappointed if their partners were not writing feedback on the wiki or iEARN collaboration space.

Several technology platforms were used for communication throughout the course of the CBGCs. iEARN was easy to use as a platform for lower-level collaboration. Although one instructor was very familiar with the program, it was completely new to the other instructor and PSTs. After a brief class time training session, most students had no issues. Any issues experienced with iEARN were a function of time zone differences and lack student effort, not choice of platform. However, some PSTs expressed confusion and frustration using the instructor-created wiki during the South Korean collaboration. Despite prior experience with other online discussion boards, the organization of the wiki was not intuitive. Selecting user-friendly technology platforms and providing adequate instruction for its use is necessary for facilitating communication between global partners and supporting collaborative activities (Geer, 2000; Klein, 2017). This also requires course instructors to be well-versed in the technology in order to assist students with their technology-related needs (Geer, 2000).

Planning the CBGC between university instructors was particularly difficult, although not insurmountable, and required significant time, effort, and organization. Partnerships are made easier when both instructors have clearly defined learning outcomes and are committed to the partnership, even if the individual goals for each look different. For example, in the partnership with South Korea, our STEM PSTs used the CBGC to explore the idea of incorporating global collaboration into a future PBL unit, while the Masters students in South Korea were interested in learning more about American STEM PST education and practicing their written English skills.

The logistics associated with accommodating busy schedules, three university calendars, and three separate time zones was a formidable challenge. Although Skype sessions may have been preferred, most instructor-to-instructor communication, by necessity, was done through email. Consequently, there were occasional time lags in communication between the instructors, facilitating the need for due date extensions and rescheduling student-to-student Skype experiences in class.

In addition to the logistical challenges of time and content, there were also language barriers, social norms, and cultural differences that had to be addressed. These collaborations were facilitated in English (to meet some of the learning outcomes of our global partners), and although most of our partners in both South Korea and Belarus had a very strong academic English vocabulary, casual conversation was a challenge. We stressed respect and that PSTs should resist making assumptions about our international peers. We also included some coaching for our STEM PSTs in best practices for working with ELL peers, such as eliminating colloquialisms and slang, explaining unfamiliar terms, and speaking slowly and clearly during Skype sessions. Because PSTs were openly discussing education in both countries, the roles of teachers in society, and their personal teaching philosophies, these ‘challenges’ provided rich opportunities to help PSTs reframe their limited ideas of STEM education and to help them learn to focus through a different cultural lens while communicating their ideas with respect and openness.

Conclusions and Next Steps

We continue to stretch ourselves as teacher educators and our TPP to benefit PSTs’ global learning. While most of the challenges of CBGC were associated with logistical and cultural pieces, one area that we as instructors found that we need to enhance is the emphasis on using CBGC in the facilitation of STEM content acquisition. The PBL course primarily focuses on innovative pedagogy, not necessarily STEM content development in PSTs. None of our PSTs expressed leveraging CBGC to deepen their own STEM content knowledge and/or understanding. We found instead that PSTs overwhelmingly spoke of CBGC activities as being additions to the content pieces, rather than functioning as a means to facilitate STEM content delivery and acquisition (this was also somewhat true for their perceptions of future classroom use). This may only serve to reinforce the predominant trend in which incorporating global education elements “remains at best a sidebar to the regular curriculum”

(Boss, 2016, para. 2). For us as course instructors, this means designing future CBGC experiences that explicitly marry content and methods. Emphasizing STEM content facilitation and acquisition through global collaboration is important to establishing relevancy.

We also plan to scaffold small, increasingly interactive CBGCs across the continuum of our STEM PST coursework. Those courses that currently explore the theory of how students learn and how curriculum should be developed could only benefit from the addition of an international perspective. Furthermore, we are exploring ways to incorporate these ideas into courses within the MAT in Science and Mathematics Education graduate program. These courses, populated mostly by in-service teachers seeking either advancement into instructional support roles or content enrichment for their classrooms, would be an ideal seedbed for the ideas and opportunities present in CBGC.

Additionally, we concluded that this experience was rich and rewarding for our STEM PSTs. Their toe-dip into the pool of global learning shifted their ideas of what was possible regarding collaboration with global peers in the everyday STEM classroom. Reaching out to educators abroad and/or developing peer or mentor relationships across national boundaries was modeled for them and was a part of their everyday course experience. It opened their eyes to the fact that they are part of an international group of educators who want the best for themselves and their students. Though they had to navigate different cultures, they gained experience working with international peers who had the same goals in mind. This was particularly important given that the global partners were all future and current STEM teachers. We also believe that these experiences will benefit them in their day-to-day teaching as they step into increasingly diverse classrooms.

Finally, it helped fulfil the fundamental objectives of the TPP's PBL course by expanding our PSTs' tool kit of PBL ideas for technology and authentic audiences. Awareness of 21st century skills and how to scaffold pedagogy that supports the development of these skills in a future classroom was demonstrated and then practiced as students designed their own CBGC STEM lessons. Ultimately, based on the feedback from both instructors and students, we can highly recommend a CBGC on the level of *limited communication* or *sustained engaged collaboration* within TPPs. The challenges in doing so are worth the personal and professional gains made by both instructors and students.

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