Estimating Sample Sizes in a Google Classroom: A Case of Global Collaborative STEM Education

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Abstract
Education is a perpetually evolving field, especially with the rapid advancement of technology and the uprising of the globalization phenomenon, and thus, it can be argued that global education is absolutely necessary. Global collaborative STEM Education (GCSE) is a subset of global education that is rarely discussed in the literature. Specifically, this paper focuses on the teacher mentorship of the GCSE aspect by showcasing a practical example occurring in the backdrop of a mini-project between two classrooms in different parts of the world regarding estimation of sample sizes. Chromebooks—laptops associated with Google that utilizes Google Chrome as its main web browser—were used as a technology tool to access the online application, Google Classroom. This virtual classroom application served as the digital medium for students to post up assignments and engage in communication. Perceptions in participating in this global collaborative STEM project were positive, as participating teachers expressed that it was a pleasant departure from what they normally did in their classroom.

Keywords: global education, global collaborative stem education, teacher mentorship

Education is a perpetually evolving field, especially with the rapid advancement of technology and the uprising of the globalization phenomenon (Crawford & Kirby, 2008). Thus, it can be argued that global education is absolutely necessary. Lindsay and Davis (2013) assert that "global competition for jobs means that today's students must not only be well-educated, creative problem solvers but they must also be equipped to collaborate globally" (p. 3). This begs the question, "How can educators be better prepared to implement global education for their students?" This paper showcases a practical example of teacher mentorship occurring in the backdrop of a *global collaborative STEM education* (GCSE) mini-project between two classrooms in different parts of the world regarding estimation of sample sizes. Particularly, attention will be placed on the teacher mentorship aspect of this project that occurred with one of the teachers. First, a brief review of the literature was conducted regarding theories and concepts that were used to frame the project and this paper. Then, context of the GCSE project and the mentorship experience will be discussed. Finally, the paper concludes with the outcomes and evaluations of the project in the perspective of the mentee involved.

Review of the Literature

This section is divided into two parts: (1) the mentorship process and (2) the global education aspect. First, the theory of *situated learning* is discussed, providing context on how the situative perspective is used as an underlying theme for the mentorship process with the teacher partners from different locations. Then, for the global education piece, the concept of community of inquiry is examined and how the orchestration of its three main constructs—social presence, cognitive presence, and teacher presence—may be applied with the P21 (Partnership for 21st Century Skills) framework on preparing students with the necessary skillset to become successful contributors in a 21st century society.

Teacher Mentorship

This project involved a teacher mentor (henceforth, mentor), familiar and experienced with GCSE, and teachers whose classrooms participated in the project. The mentor and one of the teachers (henceforth, mentee) work in the same school in Pullman, Washington in the United States (US), while the other participating teacher works in an international school in Tokyo, Japan. The extent of the mentor's duties was to oversee the project and provide support and mentorship to the participating teacher in the US. Although participating teachers in this project were experienced, this was their first encounter with GCSE in that they never before had their respective classrooms work collaboratively with another from overseas. Nonetheless, both teachers expressed willingness to participate in this collaborative activity with the understanding that they would be provided help and guidance throughout the project. Thus, in the context of this activity, mentorship refers to the overall learning experience gleaned in the transfer of knowledge and skills from mentor to mentee (Mathur, Gehrke, & Kim, 2012).

Unfortunately, there is a gap in the research regarding mentorship for GCSE, with many studies focusing mainly on mentorship for each STEM discipline separately, general global education, mentorship programs for first-year or novice teachers, or teacher attrition prevention (Chiu, Price, Ovrahim, & Ed, 2015; English, 2017;

Ingersoll & Smith, 2004; Rhodes & Beneicke, 2002; Smith & Ingersoll, 2004). This dearth in the research literature is understandable as GCSE, in general, is an emerging field that needs to be further explored. In line with this inquiry, a framework for this mentorship is proposed using principles and constructs outlined in the theory of situated learning (Brown, Collins, & Duguld, 1988). From the situative perspective, learning is contingent upon the *situation* in which a person learns, as opposed to just *what* or *how* they learn (Peressini, Borko, Romagnano, Knuth, & Willis, 2004). Consequently, teacher learning in the context of implementing a GCSE activity occurs situationally, as interactions between systems such as technology and cooperative classroom exchange may inadvertently affect future learning outcomes. In other words, there is a constant refinement in the mentorship process, as the guidance provided comes from a theoretical perspective, while the practical application may have a completely different result.

The perspective provided by Greeno and colleagues (1998) supports this argument. They assert that situated learning shifts the focus from behavioral and cognitive perspectives to interactions between systems. The teachers participating in this study not only gleaned information from the theoretical perspectives that were provided to them regarding GCSE, but also learned the subtle nuances that came along with undergoing the entire process. For instance, at the conclusion of the GCSE project, the teacher partners from both locations not only learned about different flora from another region of the world, but also subsequently learned how to effectively use the online application, Google Classroom, as a global collaborative tool. In this case, learning occurred in multiple situations—collaboration between mentor and mentee and interaction between teachers themselves with technology acting as an integrated system (Cobb & Bowers, 2014).

Wilson and Myers (2000) provide another perspective for situated learning theory. They argue that a fundamental aspect of learning takes place in communities of authentic practice instead of individual occurrences. In other words, learning involves interactions within social groups. Because the teachers were in two different areas, the delivery mode of mentorship occurred differently between them. Communication with the teacher in the US occurred primarily in a face-to-face setting, while communication with the teacher in Japan communicated via video conference. E-mail messaging was also another form of asynchronous communication and collaboration between all parties involved. In a sense, a mini-community of authentic practice where learning took place was formed, while participating teachers engaged their respective students in the larger community of practice for this GCSE project.

Global Education

As noted earlier, GSCE is an emerging field in the realm of education, but generally speaking, global education is nothing new (Becker, 1982). In recent years, however, many educational researchers have promoted the need for teaching students 21st century skills (AACTE & P21, 2010). The Partnership for 21st Century Skills (P21) created a framework that delineated student outcomes necessary for the 21st century—life and career skills; learning and innovation skills; learning, media, and technology skills; and core subjects and 21st century themes. These outcomes, along with the necessary teacher professional development, pave the way for perpetuating the implementation of global collaborative STEM education in current classrooms.This

particular project was also supported by the underlying themes found in the concept of a *community of inquiry* (CoI). Unfortunately, similar to the theory of situated learning, there is scant research on CoI and its applications in the K-12 educational setting, as most studies focus on levels of higher education (e.g., Garrison & Arbaugh, 2007; Garrison & Kanuka, 2004; Rourke & Kanuka, 2009). However, this paper argues that such a framework may be applied in this particular context, as well. In the concept of CoI established by Garrison, Anderson, and Archer (2000), learning occurs in interactions between students and teacher(s) within the context of digital technologies.

Essentially, there are three core elements or constructs that comprise the CoI—cognitive presence, social presence, and teacher presence, each of which were apparent during this global collaborative project (Garrison et al., 2000). Cognitive presence refers to the ability of participants in the learning environment—in this case, a virtual learning environment—to engage in intellectual experiences via sustained communication. Social presence refers to the ability of the participants to effectively communicate their genuine personalities and humanness within the online setting. And finally, teaching presence refers to the role of the instructor and his or her responsibilities in guiding instruction within the online learning environment (Rourke & Kanuka, 2009). These defined constructs suggest and inform the existence of multiple CoIs within the realm of this GCSE project. Context of the project is provided in more detail in the sections that follow.

Project Context

A seventh-grade middle school science classroom in Pullman, Washington in the US and a private international school classroom in Tokyo, Japan participated in this GCSE project. The mentee who participated in this GCSE project teaches multi-grade level science content. She teaches one section of sixth-grade physical science, two sections of seventh-grade life science, and one section of eighth-grade earth science. One of the seventh-grade classrooms was the participating class for this project. The participating teacher from Japan teaches eighth-grade mathematics.

The US middle school has a population of approximately 650 students and is situated in a community that is fairly well-educated, as it is located in a college town with a local university at the heart of the city. The university draws students, faculty, and other employees from around the globe, and as such, many students in the middle school have parents who are graduate students or university faculty themselves. Meanwhile, the participating classroom in Japan was an eighth-grade middle level classroom in a private international school that comprises students from K-12. Located in an urban area in Tokyo, the international school serves a diverse population of middle to high-class students.

Chromebooks—laptops associated with Google that utilizes Google Chrome as its main web browser—were used as a technology tool to access the online application, Google Classroom. This application was utilized as the virtual classroom that served as the digital medium to post up assignments and engage in communication. All participating teachers and students had Google accounts as part of their respective school networks, which made it convenient to be part of the virtual classroom. Furthermore, every student had access to a Chromebook.

The GCSE project was a week-long lesson which involved students participating in an assignment where they would learn how real-life scientists estimate population sizes of local flora. Students in their respective classrooms modeled how scientists do this by randomly drawing pieces of paper that represented organism locations found in a grid worksheet (see Appendix B for accompanying grid). Then, they would fill out responses in an accompanying worksheet where students would predict population sizes from these small sample sizes (see Appendix A for response worksheet). This worksheet was completed digitally in Google Classroom by each student, and students from each class were paired together with another student from the foreign classroom. Google Classroom was then used a medium to exchange worksheets with respective partners to provide feedback on responses. Additionally, students were also required to conduct research regarding local flora and present it to their foreign counterparts.

Mentorship Experience

Planning of this project between the mentor and mentee occurred one year before the actual execution of the project. Although the initial meeting took place before the execution of the project, meetings between both individuals became more frequent as the timeframe came closer to the actual project date. Both agreed to work on a project that was already a part of the mentee's scope and sequence of the curriculum, so as to not disrupt the flow of her lessons. The teacher from Japan came into the project after a call had been put out by the mentor's colleague who teaches in the same international school in Tokyo. During the mentorship process, the mentee agreed to first present the idea to her teacher partner from Japan before carrying out the project. This sense of autonomy given to the mentee aided in the seamless transitions of the project, as the mentor opted to be more a guide-on-the-side rather than taking a more authoritative stance.

Communication was also integral in the mentorship process before, during, and after the GCSE project. E-mail messaging was used most frequently, but weekly face-to-face meetings prior to project execution were also held. In one of the meetings, a global education continuum identified by Nugent et al. (2015) was presented to the mentee by the mentor, and both agreed that this project would fit into the limited collaboration component of the continuum (see Figure 1). Although there was some form of data sharing and indirect communication between students, there was not any form of direct real-time communication via video conference or chat sessions.

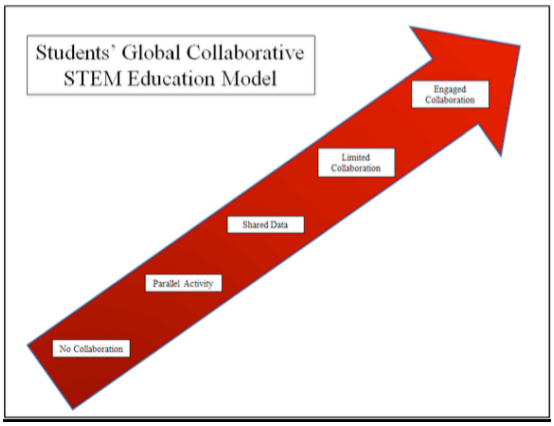

Figure 1. Global Collaborative STEM Education Model

Due to the overwhelming obstacle of different time zones, the mentee decided that doing some form of synchronous communication over video conference would be impractical. With Japan being sixteen hours ahead of Washington, she expressed that the idea of doing a video conference between students would not be efficient, which explains the rationale behind using Google Classroom. During the week of the project, the mentor and mentee met daily to discuss what did or did not work for that particular day. And finally, one more face-to-face meeting was held to discuss and evaluate the overall outcomes of the GCSE project.

Project Outcomes and Evaluation

This GCSE project served two purposes: (1) to provide an opportunity for local students to work collaboratively with foreign students in determining how scientists estimate and predict population sizes of organisms, and (2) to produce global collaborative classrooms by mentoring a local teacher. While students found learning about different sampling techniques to be enjoyable, being able to read and provide feedback on their foreign partners' papers was perhaps the most rewarding aspect of the project. Teachers of both classrooms additionally reported that students found it interesting to learn about the different types of flora from a different part of the world, as well.

Google Classroom made the process of participating in the project more efficient and convenient as everyone was already familiar with the digital classroom interface and how it worked. Though all students have used Google classroom in the past, this was their first experience providing feedback on student work from another country. The mentee commented on how this particular aspect of the project enticed the students to participate in the project because they were looking forward to communicate with foreign students. However, the feature to post on the Google classroom newsfeed had to be disabled to effectively control the magnitude and content of messages that were being posted by the students. Thus, students were only permitted to comment on work submitted as a Google document into the online classroom application. The "edit document" feature was disable for students, as well, to avoid deletion or modifications being made to final work documents.

As a group, respective classrooms also did some research regarding some flora specifically found in their region. Both participating classrooms were able to create PowerPoint presentations of their regional flora and uploaded them onto the Google

classroom platform. Then, teachers were able to showcase these presentations to their respective classes. Initially, this part of the project was intended to be completed individually by all students, but both teachers found that idea to be redundant and unnecessary, especially since only three types of flora were being researched.

All in all, perceptions in participating in this global collaborative STEM project were positive, as both teachers expressed that it was a pleasant departure from what they normally did in their classroom. More notably, the mentee expressed that having the support of a mentor aided in the execution of the project in that she felt supported with her ideas. She also mentioned that learning more about GCSE made her feel more confident in carrying out a similar project for future lessons. It is also interesting to note that even though the teacher from Japan was a math teacher, she mentioned that being able to do a more science-oriented activity motivated her to collaborate with her local science teacher counterparts at her school. Thus, even though the initial intent of this project was to bridge foreign classrooms, efforts were made to collaborate locally, as well.

References

Brown, J. S., Collins, A., & Duguld, P. (1988). *Situated cognition and the culture of learning*. *Educational Researcher* (Vol. 6). https://doi.org/10.3102/0013189X018001032

Becker, J. M. (1982). Goals for global education. *Theory into Practice, 21*(3), 228-233.

Chiu, A., Price, C. A., Ovrahim, E., & Ed, M. (2015). Supporting elementary and middle school STEM education at the whole-school level: A review of the literature. *Museum of Science and Industry Chicago*, 1–21. Retrieved from https://www.msichicago.org/fileadmin/assets/educators/science_leadership_initiative/SLI_Lit_Review.pdf

Cobb, P., & Bowers, J. (2014). Cognitive and situated learning perspectives in theory and practice. *Eduational Researchers*, *28*(2), 4–15. https://doi.org/10.3102/0013189X028002004

Crawford, E. O., & Kirby, M. M. (2008). Fostering students' global awareness: Technology applications in social studies teaching and learning. *Journal of Curriculum and Instruction*, *2*(1), 56–73. https://doi.org/10.3776/joci.2008.v2

English, L. D. (2017). Advancing elementary and middle school STEM education. *International Journal of Science and Mathematics Education*, *15*, S5–S24. https://doi.org/10.1007/s10763-017-9802-x

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, *2*(2/3), 87–105.

Garrison, D. R., & Arbaugh, J. B. (2007). Researching the community of inquiry framework: Review, issues, and future directions. *Internet and Higher Education*. https://doi.org/10.1016/j.iheduc.2007.04.001

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *Internet and Higher Education*. https://doi.org/10.1016/j.iheduc.2004.02.001

Greeno, J. G., & Middle School Mathematics Through Applications Project Group. (1998). The situativity of knowing, learning, and research. *American Psychologist January 1998*, *53*(1), 5–26. https://doi.org/10.1037/0003-066X.53.1.5

Ingersoll, R. M., & Smith, T. M. (2004). Does teacher induction and mentoring matter? *NASSP Bulletin*, *88*(638), 28–40. https://doi.org/10.1177/019263650408863803

Mathur, S. R., Gehrke, R., & Kim, S. H. (2012). Impact of a teacher mentorship program on mentors' and mentees' perceptions of classroom practices and the mentoring experience. *Assessment for Effective Intervention*, *38*(3), 154–162. https://doi.org/10.1177/1534508412457873

Nugent, J., Smith, W., Cook, L., & Bell, M. (2015). 21st-century citizen science. *Science Teacher*, *82*(8), 34-38.

Peressini, D., Borko, H., Romagnano, L., Knuth, E., & Willis, C. (2004). A conceptual framework for learning to teach secondary mathematics: A situative perspective. *Educational Studies in Mathematics*, *56*(1), 67–96.

Rhodes, C., & Beneicke, S. (2002). Coaching, mentoring and peer-networking: Challenges for the management of teacher professional development in schools. *Journal of In-Service Education*, *28*(2), 297–310. Retrieved from http://www.tandfonline.com/doi/pdf/10.1080/13674580200200184

Rourke, L., & Kanuka, H. (2009). Learning in communities of inquiry: A review of the literature. *Journal of Distance Education*, *23*(1), 19–48.

Smith, T. M., & Ingersoll, R. (2004). What are the effects of induction and mentoring on beginning teacher turnover? *American Educational Research Journal*, *41*(3), 681–714. Retrieved from http://repository.upenn.edu/gse_pubs

Wilson, B. G., & Myers, K. M. (2000). Situated cognition in theoretical and practical context. In D. H. Jonassen & S. M. Land (Eds.), *Theoretical foundations of learning environments* (pp. 57–88). Mahwah, NJ: Erlbaum. Retrieved from http://www.rezozero.net/articles/wilson_sitcog.htm

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Appendix A

Estimating Population Size Response Worksheet

Estimating Population Size
Technique 1: Random Sampling

Name: _____
Date: _____ Period: _____

Scientists cannot possibly count every organism in a population. One way to estimate the size of a population is to collect data by taking random samples. In this activity, you will look at how data obtained from random sampling compare with data obtained by an actual count.
The green grid poster represents a meadow measuring 10 m by 5 m. Each grid segment is 1m x 1m. Each sticker represents one organism.

Grid segment	 Idaho Fescue # number	 Dandelion # number	 Snowberry Bush # number
Total # of each species			
Average (divide total by 5)			
Total # of plants in the meadow (multiply average by 50)			

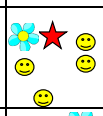
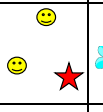
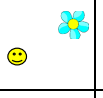
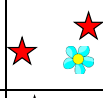
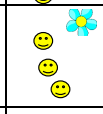
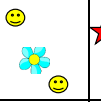
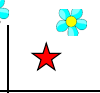
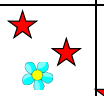
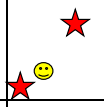
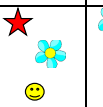
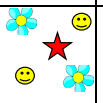
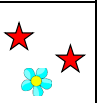
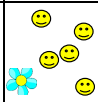
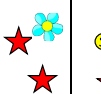
1. A lazy ecologist collects data from the same field, but he stops just on the side of the road and just counts the 5 segments near the road. These 5 segments are located at 1 A-E. When he submits his report, how many dandelions will he estimate are in the field? Suggest a reason why his estimation differs from your estimation.

2. Population Sampling is usually more effective when the population has an even dispersion pattern. Clumped dispersion patterns are the least effective. Explain why this would be the case.

3. Describe how you would use Sampling to determine the population of dandelions in your yard.

Appendix B

Grid Worksheet Modeling Plant Organism Locations

	1	2	3	4	5	6	7	8	9	10
A										
B										
C										
D										
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