

PDIG 2019-2020: Policy and Practice: A Professional Learning Community for Math and Science Teachers to Develop High-leverage Pedagogies

1. Project Description

Describe/show to what the degree the project was carried out as planned.

Math and science teachers met for seven of the eight planned meetings. In the first meeting, teachers were introduced to the foundational concepts of Inquiry-Based Learning (IBL) and the principles of high leverage teaching (See Table below). Teachers discussed these pedagogies, focusing on how these strategies could be incorporated into their math and science classrooms.

PLC Handout of Inquiry-Based Learning and Practices of High-Quality Teaching

Characteristics of IBL (Windschitl et al., 2012)	Practices of high-quality teaching (Grossman, 2009)
<ul style="list-style-type: none">• Eliciting students' intuitive ideas about the natural world and adapting instruction to support their development of a deeper understanding of scientific concepts.	<ul style="list-style-type: none">• Use of a driving question to establish an instructional goal.
<ul style="list-style-type: none">• Encouraging students to engage with discourse that centers on scientific concepts.	<ul style="list-style-type: none">• Eliciting students' ideas by pressing and revoicing student thinking
<ul style="list-style-type: none">• Providing students with collaborative, hands-on scientific inquiries where they engage with experimentation	<ul style="list-style-type: none">• Orienting students to each other's ideas
<ul style="list-style-type: none">• Generating opportunities for co-construction of evidence-based explanations based on student observations and data.	<ul style="list-style-type: none">• Positioning students competently
<ul style="list-style-type: none">• Comparing students' explanations and models to accepted scientific phenomenon.	<ul style="list-style-type: none">• Representing and maintaining a record of student thinking by recording key ideas on a board

In the first meeting, two of the experienced teachers who had been part of a previous video club PLC showed their teaching videos. This provided a level of comfort for the teachers who were new to the video club experience. Building on the introduction session, all teachers expressed an interest in pursuing this format for the PLC. In the following two meetings, all teachers presented their videos. Teachers volunteered to present 10-12 minutes of their classroom practices, and the PLC members discussed what they observed. These discussions included constructive feedback on the teaching moments.

In the PDIG application, it was anticipated that teachers would repeat the video club process during the last two PLC sessions. This left the team with three sessions to develop teaching tools that incorporated IBL into lesson plans. The PLC teachers decided to use meetings 4, 5, and 6 to divide into two teams that included both math and science teachers. Each team then developed a math situational problem intended for secondary 4 but could be modified for secondary 3 students. The context of situational problems drew on science concepts in the grade 10 Science and Technology program. Math and science teachers had planned to run a pilot test in their classrooms to determine the extent to which these situational problems engaged and challenged students in the classroom. Unfortunately, this did not happen because of the school closures on March 13th.

What went well

The PLC participants included math and science teachers. Additionally, there were two pre-service teachers and one novice teacher. Three of the participants had worked and studied in a previous PLC. For five of the meetings, we were joined by Dr. Stephen Peters, a math education professor from McGill and a former high school math teacher. This diversity helped make the PLC experience rich, rewarding, and supportive.

One particular benefit was the opportunity for cooperating teachers to see what the student teachers were learning during their math and science methodology courses. As the experienced teachers went through the often hand wringing experience of watching themselves teach, they were able to visualize the difference between how they were teaching and what the pre-service and novice teachers were trying to accomplish. At times, the pre-service and novice teachers brought more experience to the PLC since they had been trained to use IBL. One of the pre-service teachers demonstrated model-based inquiry for the group, which is considered to be the most complex skill that is a part of IBL.

A concern with the video club format of professional development is teacher buy-in. However, this was not a problem. Rather, as teachers reflected on the process, most teachers commented on how valuable it was to see themselves teach – something that few experienced teachers had done since their BEd graduation.

Math teachers expressed a need for new situational problems. Because the PLC included math, chemistry, physics and general science teachers, and McGill science and math methodology professors, it was possible to create two unique situational problems that incorporated math skills that drew on science concepts.

Some of the PLC participants made time to meet online to discuss and develop teaching strategies for adapting and teaching IBL using the school board's online platforms, including zoom and google classroom. Dr. Peters and I facilitated this meeting. Both of us had taught online courses in the past, and Dr. Peters has expertise in digital learning pedagogies.

What was a challenge

Although all teachers were committed to the PLC project, at times it was difficult for all teachers to attend meetings. Teachers went on sick leave or maternity leave. Other teachers joined the PLC.

The team was able to finalize only one of the two situational problems since school was cancelled for the year. One of the situational problems is complete (situational problem 1). However, situational problem 2 needs polishing, and an answer key needs to be developed. After working on these problems, they seem to be more aligned with cross-curricular problems rather than situational problems, where multiple solutions could elicit correct responses.

Meeting Summary

Meeting	Date	Activity
1	October 17	Introduction IBL and practices of high-quality teaching, Video club
2	October 29	Video Club
3	November 27	Video Club
4	January 17	Development of two situational problems, incorporating IBL
5	January 17	Development of two situational problems, incorporating IBL
6	February 26	Development of two situational problems, incorporating IBL
7	May 1	Teaching IBL using online platforms
8	Cancelled	

2. Project Goals and Outcomes

Describe/show to what degree the goals of the approved project were met. Describe or show the gains that the participating teachers achieved through this project.

The goals of the PLC project that were met included:

- Teachers developed a sense of community as they discussed IBL pedagogies.
- Teachers participated in one of two planned video club opportunities. During the video club meetings, teachers discussed and analyzed their teaching, focusing on incorporating IBL into their lesson plans. In the PLC discussions, teachers noted the discourse moves made by novice and pre-service teachers, which provided a valuable conversation prompt to how teaching has evolved. Additionally, the teachers who had participated in a previous PLC that focused on IBL provided valuable insights as to how these practices positively impacted their students. The iterative nature of professional learning was also discussed. One participant referred to the importance of this type of work, given that she worked as a cooperating teacher for pre-service teachers.
- Teachers chose to develop two cross-curricular situational problems that incorporated math and science PoLs. Teachers discussed how to incorporate IBL into the situational problems.

- Teachers had an opportunity to extend their professional network to include teachers from other schools and other teaching disciplines.
- Teachers developed a reflexive stance on their teaching practice. During PLC meetings, teachers discussed decisions that they made in their videos and potential changes to the practices that could benefit their students. They also openly discussed the inherent struggles of shifting their professional practices.
- Teachers that had participated in a 2017-18 PLC demonstrated significant changes in their professional practice, which was noted in the video recorded PLC meetings.

The goals that were not met included as a result of the March 12th shut down:

- Teachers did not have an opportunity to participate in a second video club experience.
- Teachers did not have an opportunity to complete the reflexive journals, but I hope that this will be done by the end of June, or perhaps in an online interview.

An unanticipated outcome arising as a result of the March 12th shut down:

Teachers made time to join the PLC on zoom. Dr. Stephen Peters and I were able to provide a zoom PLC meeting that focused on the challenges of online learning, and possible strategies that include developing IBL lessons online, as shown below:

- Provide active learning opportunities: pose questions, press for understanding
- Delivery diversity: presentations, videos, share screen for problem solving, virtual field trips (E2adventures.com / LesAventuresE2.com), virtual lab investigations
- Make it social and fun: let students create and comment on content.
- Task-based learning: real, relevant learning that can be shared.
- Encourage peer evaluation, editing, review other's work. Reinforces understanding and encourages a culture of sharing.
- Use students' exploring, editing and creative skills.
- Think about what students do in a digital environment and build activities around this (for example TikTok style cellfilms that can be uploaded on google classroom).

4. Reinvestment

Clearly describe how the resources created and/or the learning achieved by the participants can be of benefit to the educational community at large.

The reinvestment of the IBL pedagogies developed in the PLC will continue. The teachers that worked on developing these pedagogies two years ago spoke of the ongoing professional journey that they initiated in the PLC. It is anticipated that the 2019-20 participants will also continue to develop their skills with IBL. As noted in the literature, IB teaching practices can take experienced teachers three years to assimilate and perfect. Therefore, these practices are rare (Windschitl et al., 2012, p. 881).

Developing cross-curricular math science resources will provide teachers with unique resources that seem to be currently in short supply. I will send these resources to the math and science consultants at the SWLSB, and other interested parties.

References

Grossman, P., Hammerness, K., & McDonald, M. (2009). Redefining teaching, re-imagining teacher education. *Teachers and Teaching*, 15(2), 273-289.

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Windschitl, M., Thompson, J., Braaten, M., & Stroupe, D. (2012). Proposing a core set of instructional practices and tools for teachers of science. *Science Education*, 96(5), 878-903.

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