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Focus on Inquiry Final Report

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Part I: Focus on Inquiry - Executive Summary

Overview

Many teachers across Alberta are learning to develop instructional design, teaching, and assessment practices that are more closely aligned with contemporary research on how people learn. One of these learning-focused designs is discipline-based inquiry (Friesen & Scott, 2013).

This research was situated to gain an increased understanding of:

- How focused discipline-based inquiry teaching and learning impacts organizational change, teaching practices and student learning;
- How various professional learning strategies impact and translate into changed practices for classroom practice; and
- The impact of professional learning on student learning.

Research Method

For this study, we used a design-based research approach and data were collected through interviews or focus groups, qualitative documentation, classroom observations, online survey and digital artifacts. Ethics for this study was secured through the Conjoint Faculties Research Ethics Board (CFREB) and approved by participating schools and their jurisdiction.

The purpose of this study was to gain an: 1) increased understanding of how strategically focused discipline-based inquiry teaching and learning can impact organizational change, teaching practices and student learning in 36 participating schools; 2) increased understanding of strategies for professional learning; and 3) increased ability to measure impact of professional learning on student learning.

This research serves to provide recommendations to the Ministry in developing structures and supports for career-long learning for educators. Furthermore, the *Focus on Inquiry - Digital Edition* resource on teaching practices and student learning, developed as part of this study, provides a rich repository of digital resources and literary artifacts highlighting the project outcomes.

Results

Results from this study demonstrate early work with teachers and school leaders in building a culture of inquiry through a design-based professional learning community. Findings from this study suggest this approach can deepen an inquiry stance and impact student engagement in learning. However, findings have also surfaced gaps in learning and misunderstandings when enacting inquiry in the classroom and engaging in participatory professional learning. It was evident that eight dimensions of discipline-based inquiry informed task design; assessment and classroom practices and discipline-based inquiry can be supported through creating a network of support and community of learners. Findings suggest teachers and school leaders involved in iterative cycles of inquiry for leadership impact the development of discipline-based inquiry in the school towards improved student engagement and learning.

Findings and Recommendations

Table 1

Research Findings and Recommendations

Research Questions	Findings	Recommendations
1. What professional learning strategies transfer into productive discipline-based inquiry pedagogies at the classroom level?	<p>1.1 Professional learning activities required by teachers and school leaders are centred on building a culture of inquiry.</p> <p>1.2 Our study surfaced a significant misunderstanding in teachers and school leaders when enacting inquiry in the classroom.</p>	<p>Recommendation 1. Findings from this research initiative should serve to inform design-based professional learning and research supporting discipline-based inquiry designs for learning.</p> <p>Recommendation 2. Findings suggest there is need to develop further understanding of design-based professional learning strategies that cultivate a culture of inquiry</p> <p>Recommendation 3. Findings suggest there is a need to develop further design-based professional learning focused on the different practices needed to create rigorous and robust teaching practices.</p> <p>Recommendation 4. Findings suggest there is need to develop clear criteria for principals to assist in leading teacher learning and for teachers to use to help</p>

		guide further growth and learning.
2. What changes to classroom and school practices and structures that are enacted support the development of discipline-based inquiry?	<p>2.1 Dimensions of discipline-based inquiry inform task design, assessment and classroom practices.</p> <p>2.2 Discipline-based Inquiry can be supported through creating a community of learners.</p> <p>2.3 Teachers and school leaders involved in iterative cycles of inquiry for leadership impact the development of discipline-based inquiry in the school.</p>	<p>Recommendation 5. Findings from this research initiative should serve as a resource to support the implementation of the Focus on Inquiry digital resource.</p> <p>Recommendation 6. Findings suggest there is need to continue developing dimensions of discipline-based inquiry to inform tasks design, assessment and classroom practices.</p> <p>Recommendation 7. Findings suggest there is a need to develop best practices demonstrating the use and impact of the Focus on Inquiry digital resource.</p> <p>Recommendation 8. Findings suggest there is a need to develop and disseminate strategies and effective practices in instructional leadership that supports innovative teaching practices leading to engaged student learning.</p>
3. In what ways did teacher professional learning impact student learning?	3.1 A design-based professional learning community can deepen an inquiry stance and impact student engagement in learning.	<p>Recommendation 9. Findings suggest design-based professional learning and research should be considered as an effective means to deepen a focus on inquiry.</p> <p>Recommendation 10. Findings suggest there is a need to develop strategies for design-based professional learning and research measuring impact on student learning.</p> <p>Recommendation 11. Findings suggest there is a need to develop strategies for analysis of collaborative networks (relationships/influences, decisions to adopt discipline-based inquiry, extent of adoption and impact on student</p>

		<p>learning).</p> <p>Recommendation 12. Findings from this research should be shared broadly and serve to inform teachers, school leaders, jurisdictions and the ministry: strategically focused, inquiry-based, teaching and learning can impact organizational change, teaching practices and student learning in schools.</p>
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Participants

Participants in the study were from 36 schools in four school jurisdictions in Alberta:

- Site 1 - One K-8 Rural School, Foothill Schools Division (teachers and school leaders)
- Site 2 - One Geographic Area in an Urban district, Calgary Board of Education (learning leaders from 33 schools meeting in a central location)
- Site 3 - One Charter School, Connect School (formerly Calgary Science School) (teachers)
- Site 4 - One K-8 Rural School with a high FNMI population, Canadian Rockies Public Schools (teachers and school leader)

Participants were purposefully selected for this study based on their participation in professional learning related to discipline-based inquiry. The researchers were all associated with the Werklund School of Education at the University of Calgary and did not have any affiliations with the school jurisdictions or participants in the study. Ethics approval was granted by the University of Calgary Conjoint Faculties Research Ethics Board and letters, consent forms and data collection instruments were all approved.

Data Collection and Analysis

Data were collected over one school year (2014-2015) and involved 140 participants - Site 1 (n=6), Site 2 (n=120), Site 3 (n=12), Site 4 (n=1). Table 2 provides a summary of the data collected.

Table 2
Data Collection

Data Collection Method	Site 1	Site 2	Site 3	Site 4	Total
Professional Learning Sessions (No. participants attending)	6	120	12	10	148
Interviews/Focus Groups (No. of participants)	6	-	-	-	6
Qualitative Documents (No. of participants sharing task designs)	4	33	12	1	50
Classroom Observations	6	-	-	-	6
Online Survey *Section III	6*	-	-	-	6
Overall Total					216

Organization of the Report

This report provides the rationale for using a design based research and professional learning approach to increase understanding and use of discipline-based inquiry and focus on inquiry digital resource in designing tasks for student learning in 36 Alberta schools across four sites. The research method, data collection, analysis, findings and recommendations are included in the report. The discussion for each of the findings is based on an integrated analysis of the various data sources and organized according to the three research questions:

1. What professional learning strategies transfer into productive discipline-based inquiry pedagogies at the classroom level?
2. What changes to classroom and school practices and structures that are enacted to support the development of discipline-based inquiry?
3. In what ways did teacher professional learning impact student learning?

Recommendations for Alberta Education, schools, practitioners and researchers are provided in this report, including recommendations for maximizing usability and sustainability of the focus on inquiry digital resource.

Part II: Focus on Inquiry - Research Report

Project Background

“Inquiry-based learning is a dynamic process of coming to know and understand the world in genuine and authentic ways that take their cue from how knowledge actually lives and works in the world” (Friesen, 2013, p.153). It encompasses the processes of posing questions, problems or issues, gathering information, thinking creatively about possibilities, becoming proficient in providing evidence, making decisions, justifying conclusions, and learning the ways of challenging, building upon and improving knowledge of the topic or field of study. Inquiry and inquiry-based learning are not an instructional method but rather are always intimately linked to a particular topic or field of study and what that field or topic requires of those coming to know it. Opening up such topics or fields for exploration is the opening up of an inquiry space in which students, teachers and experts can then collaboratively work on investigating the rigour and disciplines that shape and guide work in that field. The core characteristics of discipline-based inquiry include authentic problems, questions or issues, work that contributes to building of new knowledge, deep knowledge and understanding, ongoing formative assessment loops, observing and interacting with exemplars and expertise, opportunities to communicate ideas in powerful ways and public presentations and exhibitions (Friesen & Scott, 2013). In *How People Learn: Brain, Mind, Experience and School*, the authors connect research findings on the science of learning to classroom practice:

Many models of curriculum design seem to produce knowledge and skills that are disconnected rather than organized into coherent wholes. The National Research Council (1990, p. 4) notes that “To the Romans, a curriculum was a rutted course that guided the path of two---wheeled chariots.” This rutted path metaphor is an appropriate description of the curriculum for many school subjects:

Vast numbers of learning objectives, each associated with pedagogical strategies, serve as mile posts along the trail mapped by texts from kindergarten to twelfth grade.... Problems are solved not by observing and responding to the natural landscape through which the mathematics curriculum passes, but by mastering time tested routines, conveniently placed along the path (National Research Council, 1990, p. 4).

An alternative to a “rutted path” curriculum is one of “learning the landscape” (Greeno, 1991). In this metaphor, learning is analogous to learning to live in an environment: learning your way around, learning what resources are available, and learning how to use those resources in conducting your activities productively and enjoyably (Greeno, 1991, p. 175). The progressive formalization framework discussed above is consistent with this

metaphor. Knowing where one is in a landscape requires a network of connections that link one's present location to the larger space.

Traditional curricula often fail to help students "learn their way around" a discipline. The curricula include the familiar scope and sequence charts that specify procedural objectives to be mastered by students at each grade: though an individual objective might be reasonable, it is not seen as part of a larger network. (Bransford, Brown & Cocking, 2000, pp.138--139)

Discipline based inquiry as an approach to curriculum design both provides and demands an understanding of how knowledge is organized in the world, how it is acquired, how it forms into coherent and lively relations and precedents, how it understands evidence and methods of working in the world, how it is cared for and passed along to others, how knowledge and its acquisition necessarily links to cultural, linguistic, historical and philosophical roots and ancestries, how it is developed in the contexts of its application and implementation and how its well---being requires engagement and collaboration. Alberta's Ministerial Order on Learning states:

WHEREAS an Engaged Thinker knows how to think critically and creatively and make discoveries through inquiry, reflection, exploration, experimentation and trial and error; is competent in the arts and sciences including languages; uses technology to learn, innovate, collaborate, communicate and discover; has developed a wide range of competencies in many areas, including gathering, analysis and evaluation of information; is familiar with multiple perspectives and disciplines and can identify problems and then find the best solutions; as a team member, integrates ideas from a variety of sources into a coherent whole and communicates these ideas to others; adapts to the many changes in society and the economy with an attitude of optimism and hope for the future; as a lifelong learner, believes there is no limit to what knowledge may be gleaned, what skills may be accumulated, and what may be achieved in cooperation with others; and always keeps growing and learning. (Alberta Education, 2013)

In order to meet the demands of the Ministerial Order on Learning a growing number of teachers in Alberta are adopting a discipline-based inquiry approach to curriculum design. These teachers are also guided by the Ministry of Education's long-term vision for education outlined through Inspiring Education (2010), the Ministerial Order (2013) and a supporting body of research in the Learning Sciences (Bransford et al., 2000; Sawyer, 2006, 2014). Earlier research findings indicate discipline-based inquiry can positively impact student achievement, including standardized examinations (Amosa, Ladwig, Griffiths, & Gore, 2007; Iowa Department of Education, 2011; Ladwig et al., 2007; Newmann, Bryk & Nagaoka, 2001)

and can provide intellectually engaging learning environments (Friesen & Scott, 2013). However, more research is needed to understand how professional learning focused on discipline-based inquiry teaching and learning can impact organizational change, teaching practices and student learning.

Rationale

Teachers and school leaders working with Galileo Educational Network mentors for professional learning are guided by six principles: stewarding the intellect through inquiry-based learning approaches, infusing digital technologies, providing high-quality assessment, honouring collaboration and teamwork, fostering scholarship of teaching and providing practical thought-provoking preparation for teachers (Friesen, 2009). Models of professional learning need to parallel contemporary pedagogies and support school leaders and teachers with designing intellectually engaging tasks, sponsoring collaborative knowledge building and authentic learning experiences. As such, a design-based study exploring professional learning strategies for discipline-based inquiry and the relationship to student learning can inform practitioners, leaders and the broader research community.

Theoretical Framework

In this design-based study, the researchers employed a combination of qualitative and quantitative methods in order to provide a multi-faceted and comprehensive picture of the research objects and task in question. One special focus was on developing new methodological approaches to combining micro and macro level analysis to better understand the reciprocal and co-evolving nature of individual, communal, and organizational transformations. In this sense, the present investigation demonstrates an effort to ‘zoom out’ from individual learning interactions to examine larger social structures that guide and constrain inquiries as well as examine long-standing changes in individual and collective inquiry practices.

Advancing principled practical knowledge or teachers’ “know-how” and “know-why” (Bereiter, 2014) related to discipline-based inquiry can be developed through design-based approaches for professional learning (Friesen & Jacobsen, 2015). In Alberta, practitioners are guided by a common vision through Inspiring Education (2010) and the Ministerial Order for Student Learning (2013). Working alongside researchers and using a design-based research and professional learning approach, teachers can increase understanding of how discipline-based inquiry can impact organizational change, teaching practices and student learning.

Design-based professional learning can be used to improve student outcomes, including achievement, engagement and well-being through an iterative process (Friesen & Jacobsen, 2015). Research also shows the value in researcher-practitioner partnerships to design intellectually engaging, worthwhile tasks with attention to assessment practices rooted in the

Learning Sciences (Sawyer, 2014). As such, a design-based research approach converging theory and practice can be used to study the ways design-based professional learning processes can activate teachers' principled practical knowledge.

In this study, a design-based professional learning and research approach was used consisting of an iterative process of design, enactment, evaluation and redesign. Through this design-based research and professional learning approach, teachers learned to:

- Identify what deep understandings their students must build to make learning advances;
- Collaborate with colleagues, researchers and mentors from the Galileo Educational Network to design worthwhile tasks, activities, and assessments for their students directed towards building these understandings;
- Bring forward evidence of student learning to determine the ways in which their students built deep understanding;
- Discern which instructional practices led to improved student learning and understanding; and
- Assess the impact of these improved or changed teaching practices on student learning. (Friesen & Jacobsen, 2015).

Research Method

A design-based research approach was used; a recognized strength of this research methodology is the combination of quantitative and qualitative data collection and analysis methods within a bounded system.

Dai's (2012) four essential features of design-based research were used to guide the design and align with the aims of the research:

- Authenticity - Improving teaching practices and student learning through professional learning focused on discipline-based inquiry was significant to the research participants and aligned with school improvement goals.
- Complexity - Measuring the impact of professional learning on students learning is complex in schools and influenced by many interactive elements and properties.
- Emergence - The design of the professional learning series with the participants was iterative and continually involved refinement and improvement to gain an increased understanding of strategies for professional learning.
- Formalism - The intent of the design-based research is to understand the affordances and constraints in professional learning focused on discipline-based inquiry teaching and learning and how this can impact organizational change, teaching practices and student learning in 36 schools across four participating school jurisdictions/sites.

There is a need to gain an increased understanding of: (a) how strategically focused teaching and learning within a discipline-based inquiry curriculum design can impact organizational change, teaching practices and student learning in the four participating sites; (b) the ways in which various professional learning strategies impact and translate into changed practices for classroom practice; and (c) how to measure impact of professional learning on student learning.

To fulfill these gaps, this research project focuses on the following objectives:

1. Analyzing to what extent school students are able to participate in discipline-based inquiry processes,
2. Systematically designing and investigating the ways in which classroom teachers transfer learning from the professional learning sessions into practice,
3. Exploring and developing ways to correlate teacher learning with student learning, and
4. Combining micro and macro level analysis to better understand the reciprocal and co-evolving nature of individual, communal, and organizational transformations.

Researchers and participants were involved in an iterative-design based research process involving design, enactment, evaluation and redesign of professional learning focused on discipline-based inquiry guided by the *Focus on Inquiry* (FOI) digital resource over a one year period. The participants in the study were teachers and school leaders from 36 schools across four jurisdictions/sites in Alberta characterized as rural, urban, charter and one with a high aboriginal population. Participation in the study was not a requirement for participating in the discipline-based inquiry professional learning sessions.

The FOI digital resource is a resource that was developed for purposes of this study and to support the Galileo Educational Network mentors and participants with professional learning sessions. Since the book was under development during this study, the participants involved in the professional learning also informed the development of the book. The digital resource is currently organized into six chapters: (1) Building A Culture of Inquiry, (2) Discipline-Based Inquiry: Making it Work, (3) The Importance of Assessment, (4) Teaching and Learning in a Discipline-Based Inquiry Classroom; (5) Creating a Scholarly Practice and (6) Leadership Imperative.

Data Collection and Analysis

Data collection from multiple sources of data over a one-year period involved iterative phases where the researchers and practitioners worked collaboratively to design, enact, evaluate and redesign professional learning focused on discipline-based inquiry. During the iterative phase, data collection approaches included: (i) interviews/focus groups with teachers and school leaders, (ii) qualitative documentation, (iii) classroom observations, (iv) online survey, (v) digital

learning artifacts documenting learning and providing evidence of discipline-based inquiry, and (vi) Focus on Inquiry digital resource development.

(i) Interviews/Focus Groups

Interviews, either individual or a focus group - participants were reminded that anonymity cannot be ensured if choosing to participate in a focus group, as other participants in the focus group would be able to see and hear all participants. The researcher requested that all information shared in the focus group be held in the strictest of confidence. The interviews were audio recorded and the audio recordings were transcribed.

(ii) Qualitative Documentation

Participants provided the researchers with copies of documents from professional learning activities relevant to the scope of this research study. Participants also provided the researchers with copies of planning documents. Researchers documented field notes from school visits, meetings and all professional learning sessions.

(iii) Classroom Observations

Participants provided the researchers with access to their classroom to code classroom interaction using a classroom observation protocol (Jacobsen, Saar & Friesen, 2010). In some cases, multiple observations occurred in the same classrooms with the same teachers. A total of six observations took place in jurisdiction one (n = 2) in a grade one class, (n=2) in a grade three class and (n=2) in combined grade 5 and 6 class.

(iv) Online Survey

There were 24 questions in the survey including three demographic questions, 19 selected - response items gathering data about perceptions of teacher and student practices in the school and two open-text responses about the Focus on Inquiry digital resource. The survey sections and response options are shown in Table 3. (Note: Due to time constraints, only Section III questions were used as part of the present study.)

Table 3
Survey Questions

Survey Section	Number of Items	Response Options
Section I: Demographic Information	Q1 - Position (1)	Options: Teacher, Principal, Assistant or Vice Principal, Other
	Q2 - Role description (1)	Open-text response if OTHER selected in Q1
	Q3 - Grades taught (1)	Open-text response if TEACHER selected in Q1
Section II: Perceptions of teacher and student practices	Q4-Q16 - Perceptions about teachers' understanding and task designs (13)	Scale: Describes 75-100% of the teachers in my department/school = 5; Describes 50-75% of the teachers in my department/school = 4; Describes less than 50% of the teachers in my department/school = 3; Does not describe the teachers in my department/school = 2; I don't have enough evidence to say = 1.
	Q17-Q20 - Perceptions about student engagement (4)	Scale: Describes 75-100% of the students in our school = 5; Describes 50-75% of the students in our school = 4; Describes 50% of the students in our school = 3; Does not describe the students in our school = 2; I don't have enough evidence to say = 1.
	Q21 and Q22- Perceptions about teacher practice and collaboration (2)	Scale: Describes the practice of 75-100% of the teachers in our school = 5; Describes the practices of 50-75% of the teachers in our school = 4; Describes the practice of less than 50% of the teachers in our school = 3; Does not describe the teaching practices in our school = 2; and I don't have enough evidence to say = 1.
Section III: Focus on	Q23 - Describe the ways that	Open-text response

Inquiry digital resource	<p>the Focus on Inquiry web resource has been helpful to you and your understanding of discipline-based inquiry. (1)</p> <p>Q24- Describe the ways that the Focus on Inquiry web resources could be improved or strengthened. (1)</p>	
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(v) Digital Learning artifacts

Participants and researchers collected digital artifacts documenting discipline-based inquiry learning. Artifacts of task designs, assessments, student work demonstrating learning were also collected. Images, videos and narratives were gathered from participants to demonstrate the impact of professional learning focused on discipline-based inquiry.

(vi) Focus on Inquiry digital resource

The new *Focus on Inquiry* digital resource was being implemented while it was created. While large components of the resource are now complete, it is constantly undergoing changes and edits as Galileo Educational Network consultants and mentors work alongside teachers, lead teachers and school leaders to use the resource and inform necessary improvements. This iterative development process also allowed researchers to investigate and identify strategies and effective practices.

Participants were engaged in design-based professional learning guided by the Focus on Inquiry digital resource. Data collected during the study informed the development of the digital resource. The five principles of the Teaching Effectiveness Framework (Friesen, 2009) and the Galileo Educational Network Discipline Based Inquiry Rubric (Galileo Educational Network Association, 2013) were key resources informing task designs and the digital resource.

Findings and Discussion

Research Question 1: What professional learning strategies transfer into productive discipline-based inquiry pedagogies at the classroom level?

Professional learning activities centered on building a culture of inquiry and were tailored to the needs of individuals at each school. Table 4 provides a summary of the participatory professional learning activities organized in each jurisdiction during the one-year study.

Table 4

Professional Learning Activities

Jurisdiction	Learning Activities
Site 1 - One K-8 Rural School	<ul style="list-style-type: none"> ● series of eight planning and design meetings from September - June 2014-15 ● teachers posted designs to a shared online space and researchers provided feedback to inform redesigns ● the researcher observed classrooms (n=6), reviewed digital artifacts, and provided teachers and students with formative feedback to inform next steps ● researchers interviewed teachers and principals and maintained a reflective journal ● participants provided responses to the survey, section III questions
Site 2 - One Geographic Area in an Urban district using a central meeting location, Learning Leaders from 33 schools	<ul style="list-style-type: none"> ● a series of six professional learning sessions were designed for elementary (n=~80) and secondary learning leaders (n=~40) in this area throughout the 2014-15 school year ● a design team comprised researchers, school and district leaders met in advance of each session, reviewed participant input and designed each of the sessions ● researchers provided learning leaders with formative feedback throughout the sessions, from a variety of sources: listening to and interacting with participants as they worked through ideas being presented; participants share their tasks and assessments in an online space (Google docs); conversations with small groups; field notes

	<p>and observations; artifacts of teacher and student learning</p> <ul style="list-style-type: none"> ● exit surveys were administered at the end of each session - using an online form, feedback was gathered at the end of each session combined with other forms of feedback collected to gauge learning needs. This information was used to inform planning for subsequent sessions
Site 3 - One Charter School	<ul style="list-style-type: none"> ● teachers from grades four through nine were invited to participate. Teachers from grades 4, 6 and 9 (n=12) agreed to participate in this study. They posted learning designs to a shared online space and researchers provided feedback to inform redesigns ● researchers visited the site and met with teachers to discuss designs and inform next steps ● researchers spent time in each of the 12 participating teachers' classrooms providing feedback on the instructional practices within the context of the implementation of the curriculum design. ● researchers interviewed teachers and principals and maintained a reflective journal ● teachers shared artifacts of inquiry designs and assessments used to inform teaching and student learning
Site 4 - One K-8 Rural School with a high FNMI population	<ul style="list-style-type: none"> ● a series of five sessions were designed for teachers and administration (n=10) ● one teacher shared artifacts of inquiry designs and assessments used to inform teaching and student learning

The shared learning intentions for the professional learning at all the sites aimed to: build capacity for task design and assessment towards intellectual engagement; sponsor research-informed, evidence-based practices for teaching and learning; develop processes for providing teachers with timely, specific and constructive feedback about teaching and learning; build capacity of teachers and learning leaders to support school administration in sponsoring more effective teaching practices; and strengthen professional learning networks.

All 36 schools in four jurisdictions/sites involved in this study used resources from the FOI digital resource to support their professional learning as well as to inform development/revision of the elements within the digital resource itself. One principal noted the FOI digital resource provides a “great introduction for teachers. Good flow to chapters.

The language used is the perfect balance of academic language at a high level with the research and the everyday language of the classroom teacher.” Participants were involved in a variety of professional learning activities deliberately focussed on designing great tasks. More detail about designing great tasks is provided in the FOI digital resource, Chapter Two. The following excerpt was shared by the Galileo Educational Network mentors and research team to help teachers at Site 3 develop an understanding of designing great tasks:

Create compelling tasks that brings you, the student and the subject matter together in intellectually authentic, meaningful and exciting ways. This requires that you:

- *build tasks that explore and promote the understandings that you identified*
- *integrate technology in a meaningful way into those tasks*
- *tie together the different tasks connecting them to the essential question*
- *scope out a more detailed timeline related to those tasks*

When designing great tasks, the focus must be on what students do, what they create, and what they build. Consider these points from Resnick (1996):

- *Learning is an active process, in which people actively construct knowledge from their experiences in the world. People don't get ideas; they make them....*
- *People construct new knowledge with particular effectiveness when they are engaged in constructing personally meaningful products. They might be constructing sand castles, poems, LEGO machines or computer programs*
- *What's important is that they are actively engaged in creating something that is meaningful to themselves, to the subject discipline or to others around them. Another way of stating this is that the task has to matter: to the world, to the subject discipline, and to the way I live my life.*

In site one, teachers indicated the FOI digital resource was helpful as a theoretical foundation, although some were initially overwhelmed with the depth of the research base supporting inquiry and the robust theoretical structures, assessment rubrics and planning processes presented. Similarly, the site two teachers provided feedback suggesting more support is needed. Sample quotes from site two:

We need more direction to where we can seek resources.

More materials - you have an amazing idea but lack the materials and/or technology to put it into place

Templates for different ways of planning rich tasks would be helpful to be able to present to teachers.

We need the proper guidelines to use our time effectively and maybe instead of just giving us PLC time we need to have more accountability or description of what that time looks like.

With the progression of professional learning and mentoring sessions throughout all the sites, it was evident teachers employed ideas from the FOI digital resource, the Teaching Effectiveness Framework (Friesen, 2009) and the Discipline-Based Inquiry Rubric (Galileo Educational

Network Association, 2013) to guide their task design and assessment planning. Teachers also used the planning guide (Appendix A) as a framework and posted plans to online-shared folders to gather feedback from the research team.

Group and individual discussions with teachers indicated that they were becoming more thoughtful about task design and reflective about their practice. As professional learning sessions and mentoring meetings progressed, teacher comments, classroom observations and particularly analysis of student artifacts affirmed teacher views that their students demonstrated a deeper level of engagement when involved in inquiry tasks. As one teacher noted, “In a word, they are more inquisitive!”

As shown in Figure 1, researchers observed 80-100% of students in site one demonstrating either academic or intellectual engagement in all classes observed (n=6). In two classrooms, 90-100% students demonstrated intellectual engagement during the first, second and final third of the lesson. Three classrooms were observed twice during one school year for a total of six classroom observations. The observations occurred in a grade one class, grade three class and combined grade 5/6 classroom.

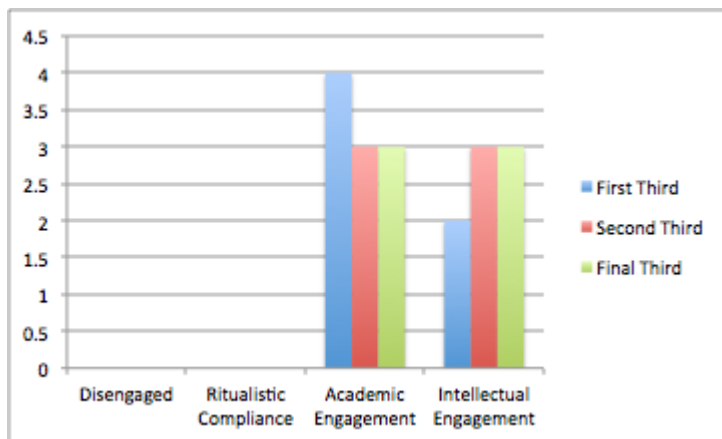


Figure 1. Student Engagement in Classroom Observations (n=6)

Example Classroom Inquiry in grade one-two:

The Earth Rangers, a kids conservation organization and online environmental community in Canada, is dedicated to protecting animals and their habitats. Drawing on students' desire to learn more about hibernating animals and responding to a call to help find a solution for Southern Alberta bats facing threats during the winter months, students began investigating solutions for conserving Alberta's bat population.

Using multiple resources such as books, videos Internet sources and communicating with bat experts, students acquired knowledge to further understand how they might help solve this problem. Students used school iPads to look at different species through images and videos and to gather information about bat species on various web sites. Students also engaged in exploration by interacting with adults with relevant expertise. For example, a bat keeper from the Calgary zoo introduced students to a live Big Brown Bat and discussed different bat species, and explained some of the threats to bats. Students also met with a wildlife biologist with Alberta Conservation Association to learn about the importance of bats, the decline in several bat species, the reason for declining populations and what people can do to help conserve Alberta's bat population. Students investigated bat hibernation, known sites, and characteristics and then explored the concept of constructing bat houses to promote colonies and safe winter hibernation.

This topic is closely associated with grade one and two science about seasonal changes and building things. Students are required to identify and describe examples of animal changes that occur on a seasonal basis, such as changes in location, changes in activity (e.g. recognize that many living things go into a dormant period during the winter and survive) and changes for a hibernating animal, to name a few. Students are also required to select appropriate materials, design and build objects as part of a construction task. In this case, students were challenged to construct a model building or safe hibernation home for bats. Students were required to identify component parts and describe the purpose of each part. In addition, students explored how human activity impacts bats and how bats impact humans. Furthermore, students were able to compare bats to other endangered species and deepen learning and understanding about seasonal and animal changes. This activity required students to reflect the ways of knowing that are central to the discipline of science and engineering.

In preparation for building actual bat houses on June 1st (in conjunction with Earth Day), students built models of a bat house with modelling clay and with each prototype, students incorporated new information into their re-designs and continually questioned what needs to change? Students video recorded and captured images during each building stage in order to document learning and reflect on their progression of learning; students carefully reviewed each prototype and incorporated changes and feedback provided from peers and external experts into each subsequent build. In collaboration with parents, community members and the local junior high, students collaboratively built four bat houses to create a positive impact on the community and to provide safe hibernation habitats for the bats.

As means of outreach to the school community, these young students surveyed (vote/poll) grades three to six students in their school to raise awareness about the threats to endangered species and to inform further research. Students created posters and posted them around the school and community to promote awareness of this important issue. Furthermore, students and parents started a “Save the Bats” fundraising campaign to contribute to bat conservation efforts and support future research. Students were engaged in an authentic exploration and construction activity impacting their school and home community and protecting endangered species.

Teacher engagement was also observed. The grade one-two teacher provided the following reflection early in the process:

I wish you could have been a fly on the wall during the Grade1/2 Science yesterday when had our first real Little Brown Bat lesson! WOW! It was like there were fireworks in the classroom....the excitement may wear off but I will bask in yesterday’s engagement for some time as it was absolutely magical I never could have dreamed that after just one lesson the kids would react this way and with such passion. Grade 1/2s are usually easy to excite but this seemed....deeper than I witnessed before....We have begun and I am so inspired!

Finding 1.1 Professional learning activities required by teachers and school leaders are centred on building a culture of inquiry.

Despite the intentional focus on designing learning and building a culture of inquiry, there is a significant misunderstanding among teachers and school leaders when enacting inquiry curriculum designs within the classroom and engaging in participatory professional learning. During initial professional learning sessions participants expected to gather lesson plans and unit plans. Entering into inquiry curriculum designs was new territory for a number of the participants. It was important to continually revisit learning intentions so all participants shared a common understanding and focus on fostering a repertoire of effective teaching practices through iterative cycles of evidence informed conversations. This was evident even when teachers indicated they had a strong background in and understanding of inquiry curriculum design. We learned that we would need to place additional emphasis into the Focus on Inquiry to assist teachers move from an inquiry curriculum design into enacting the design in ways that create the conditions for learning within day-to-day instruction.

Once participants committed to further their learning and participate in iterative cycles of designing worthwhile tasks and intellectually engaging learning environments, it was evident that most teachers and administrators needed additional support in understanding the

difference between tasks and activities. Tasks refer to the “umbrella” under which many kinds of activities may eventually cluster. In order to complete this task, students will have to engage in a number of activities. Activities are intentionally structured to address concepts and develop skills. A great task ensures that all the activities are meaningful and strongly connected. It is important to not start with a bunch of activities and hope they will somehow add up to something in the end.

Researchers observed challenges and misunderstanding when mentoring teachers while designing tasks. For example, when a teacher presents a fragmented activity, the researcher might respond with feedback through critical questioning. This strategy often prompts a redesign and refinement as well as promotes a deeper understanding of inquiry and the role of the teacher in sponsoring deep disciplinary understanding.

Sample questions:

- What is the overall aim for student learning? What are students expected to learn?
- What do students need to learn and understand in this discipline (i.e. geography, persuasive writing, biology, statistics, etc.)?
- How does this task promote thinking about how the discipline shapes human behaviour or how human behaviour impacts the discipline?
- What knowledge, skills or processes are being developed through this activity?
- What is the value for students in producing this artifact?
- How will assessment information be gathered and used to inform teaching and learning throughout this task?

Designing great tasks is challenging and complex. For example in site one, teachers commented they found inquiry planning to be more complex, less predictable and less structured in comparison to highly scripted and finely scheduled unit planning using a thematic approach. An open-endedness in planning also surfaced during the study. The following excerpt is from one of the researcher’s journals:

They [teachers] are all thinking hard about task designs that will foster student intellectual engagement through legitimate inquiries and working out how to organize these plans in print and in action. Some are using Galileo Educational Network materials, some UBD and some hybrid of planning structures. Some of their drafts have appeared on the Google drive but most are still works in progress. Nonetheless, it appears that all of the teachers are discovering that inquiry planning is not a simple template fit, and more demanding as compared to traditional planning.

In all four sites researchers worked with participants to break down the task into day-by-day connected, coherent activities. Participants were asked complete a planning guide (see appendix) for each lesson designed. The following are examples of task designs under development using the planning guide:

Topic: Flight

This is a generative topic because matters of flight have consumed the imagination ever since 400 BCE when the Chinese learned that a kite could fly in the air. Today,

dreams of solar powered aircraft still consumes people's imagination fueling the possibility of discovering new forms of flight.

We need to think about: How does an Aeronautic Engineer approach such a problem?

Learning Task: To design, build and test a GLIDER that:

- will generate lift, stability and demonstrate structural integrity in a controlled environment (wind tunnel), and
- will be launched to create maximum distance, while controlling take off angle and propulsion.

Understandings Goals of the main Task:

I want students to understand that flight is built upon the principles and properties of air: motions and forces, transfer of energy, and the abilities of technological design as they study some of the basic concepts of flight, including the three axes of flight and the control surfaces that guide the aircraft.

I want students to be able to design, prototype, test, measure, and build How scientist perform dynamic test? (markers, video, etc.) What can we do to aid our observations?

**Learning Activity 1: What process do engineers engage in when solving a problem?
Identifying the stages of design**

I want students to understand that....

When engineers accept a problem to be solved, they are purposeful in their design approach.

Engineers engage in a design process that is intentional, collaborative, and requires flexible and reflective thinking.

Engineering requires creative thinking and problem solving.

I want students to be able to....

Identify key considerations in approaching an engineering problem.

Co-construct the stages involved in an effective design process.

Students	Teacher	Assessment for/as Learning
	-	

Learning Activity 2: DESIGN (3 - 4 days)

- **Ask:** Identify the problem - identify criteria and constraints
- **Imagine:** Brainstorm possible solutions, generate ideas
- **Plan:** Explore possibilities, select outline an approach
- **Presentation** from the expert - Marjan (Bio-mimicry)

		Learning
-	-	

Topic: Historical Roots of Canadian Democracy

What were the roots of Canadian democracy? What political systems helped shape the democratic principles on which we are founded? Is there such a thing as a perfect democracy and if so, have we achieved this ideal in Canada?

Many believe that our democratic history began in 1867 with Confederation. This could not be further from the truth. This inquiry will aid learners in understanding that the roots of Canadian democratic principles can be found in Ancient Athens 2,500 years ago, and in Iroquois story-telling circles established long before the arrival of Europeans. Using simulations, in-depth role-play and the creation and collection of primary resources, students will develop a deep understanding of and appreciation for how the historical Athenian and Iroquoian models of government differed. Looking through the conceptual lens of Patterns and Systems students will conduct a careful investigation into and analysis of the similarities and differences of each system, identifying the patterns of said systems. Students will make connections between these historical models of government and the principles of democracy that shaped the democratic system Canada has today.

Understanding Goals:

Learners will engage in an analysis and critical examination of the Athenian and Iroquois systems of governments from different viewpoints, deepening their understanding and appreciation of the origins of the democratic principles on which Canada's democratic system is founded. The culminating task involves students appraising which aspects of each system they feel had the greatest influence on shaping our current democratic system.

Through this inquiry, students will come to appreciate that Canada is a nation of many people, with democratic roots coming from many histories. Learners will understand that Canadian democracy is an evolutionary process, which has sought inspiration from many historical systems of government. This evolutionary process continues today, raising even deeper questions: What does an ideal democratic system look like? Is the Canadian democratic system perfect or do inequities for some people still exist? What, if any, aspects of the Canadian system could be improved upon?

I want students to ...

- Understand and make sense of how people were governed in Ancient Greece.
- Understand and make sense of how people were governed in The Iroquois Confederacy.
- Understand the power relationships in different societies.
- Understand who holds power and why in Ancient Greece.
- Understand who makes the decisions and why in Ancient Greece.

Understand where the people who hold the power get their authority in Ancient Greece.
 Understand how decisions were made when there were competing viewpoints in Ancient Greece.
 Understand what the citizen's role in the distribution of power was in Ancient Greece.
 Understand who holds power and why in The Iroquois Confederacy.
 Understand who makes the decisions and why in The Iroquois Confederacy.
 Understand where the people who hold the power get their authority in The Iroquois Confederacy.
 Understand how decisions were made when there were competing viewpoints in The Iroquois Confederacy.
 Understand what is the citizen's role in the distribution of power in The Iroquois Confederacy.

I want students to be able to...

- Analyze different systems of democracy
- Identify elements of historical models in the present day system
- Compare and contrast different types of democracy
- Identify advantages and disadvantages of the different models studied

Learning Task: The inquiry begins with a series of simulations that introduce students to historical government systems and how different groups of citizens participated in these systems. Students will develop a preliminary appreciation and understanding of how the Athenian and Iroquoian systems of government functioned and differed. Learners will then participate in small group reflections to discuss and reflect on their experiences and make some basic connections between these historical models and our current system. Students will further reflect on a more personal level, considering how they felt in their specific historical role. Did they have an opportunity to contribute and participate in the democratic process? How did they feel about their role? What connections can they make to Canadian democracy and our democratic principles of equity, equality and fairness?

Learning Activity 1: Historical thinking Intro and KWL- 1 40 minute period

Students	Teacher	Assessment for/as Learning
<p>What will students be doing?</p> <p>Chalk talk or group brainstorm around the question "Why do we learn about history?"</p> <p>Watch a brief intro to the</p>	<p>What will the teacher be doing?</p> <p>Leading the discussion or circling the room while the students engage in the chalk talk</p>	<p>What evidence of learning will be gathered?</p> <p>Chart paper responses from the chalk talk or brainstorm</p> <p>How will it be gathered?</p> <p>Whiteboard or chart paper, student recorded or</p>

<p>history of democracy http://tvo.org/story/civics101-animation-very-very-brief-history-democracy</p> <p>Using padlet or a graphic organizer, students will make 2 posts. In one post or column they will post what they already know about the history of democracy, Ancient Athens and the Iroquois. In the second post or column they will add questions that they would to explore further.</p>	<p>Rotating and questioning as students are completing the posts</p>	<p>teacher scribed</p> <p>How will assessment be used to inform next teaching steps? Identify strengths and misconceptions about why we study history. Identify previous knowledge. Focus the inquiry to deepen understanding.</p> <p>How will assessment be used to help students take their next learning steps? The questions they generate will help focus and the previous knowledge they identify can be used to make connections to as the deepen their understanding.</p>
<p>Learning Activity: Social Role Jigsaw 1-80 min period</p>		
<p>Students</p>	<p>Teacher</p>	<p>Assessment for/as Learning</p>
<p>What will students be doing?</p> <p>Students, in groups of 4, will research the roles of Men, boys, Women, girls, Metics, and Slaves in Ancient Athenian history</p>	<p>What will the teacher be doing?</p> <p>Teacher will be assigning the groups and ensuring students are participating in developing an understanding of such roles</p>	<p>What evidence of learning will be gathered? Roles of different members of society</p> <p>How will it be gathered? Through use of a jigsaw organizer. Charts, tables, webs. Opportunities for student choice in the presentation of information</p>

		<p>How will assessment be used to inform next teaching steps?</p> <p>Students will need to consider the 4 pillars in understanding who has a say in the decision making process in Athens.</p> <p>How will assessment be used to help students take their next learning steps?</p>
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Learning Activity: Ancient Greece Simulation- Direct Democracy- 1 Double Period

Students	Teacher	Assessment for/as Learning
<p>What will students be doing? Participate in the simulation under the teachers guidelines Complete a reflection after the simulations Was your character's opinion reflected in the decision making process? What would have happened if this government was debating the minimum wage? How do you think the people in power could use this government system to their advantage? What other issues might be unfairly represented in this system of government? What are the advantages of</p>	<p>What will the teacher be doing? Set up the intro and explain the simulations Hold a direct democracy simulation with all the students and a classroom make up that is proportional to Ancient Athens with only 10% eligible voters</p>	<p>What evidence of learning will be gathered? Discussion and Reflection after simulation Ancient Athens Check in Direct democracy and representative democracy check in</p> <p>How will it be gathered? Edmodo post</p> <p>How will assessment be used to inform next teaching steps? Checkins are taken from PAT, info can be used to determine if further experiences are required to reinforce content</p>

<p>this system of government?</p>		<p>How will assessment be used to help students take their next learning steps? review of assignments to clarify understanding Feedback and red/yellow/green section on check ins</p>
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Learning Activity: Social Roles of the Iroquois 1-40 minute period

Students	Teacher	Assessment for/as Learning
<p>What will students be doing? Use the textbook and other online sources students will complete a chart that identifies roles of men, women, clan mothers and chiefs</p>	<p>What will the teacher be doing?</p>	<p>What evidence of learning will be gathered? discussion in put and chart completion</p> <p>How will it be gathered?</p> <p>How will assessment be used to inform next teaching steps?</p> <p>How will assessment be used to help students take their next learning steps?</p>

Learning Activity: Consensus Simulation Iroquois Confederacy

Students	Teacher	Assessment for/as learning
<p>What will students be doing? Participate in the simulation under the teacher's guidelines Complete a reflection after the simulations Was your character's opinion reflected in the decision making process?</p>	<p>What will the teacher be doing? Set up the intro and explain the simulations Hold a consensus simulation with all the students and try to get consensus with 50 and then break up into the 5 nations and try to reach a</p>	<p>What evidence of learning will be gathered? Discussion and Reflection after simulation Historical Models Check in</p> <p>How will it be gathered? Edmodo check in questions</p>

<p>What would have happened if this government was debating the minimum wage? How do you think the people in power could use this government system to their advantage?</p> <p>What other issues might be unfairly represented in this system of government?</p> <p>What are the advantages of this system of government?</p>	<p>consensus using the same model the Iroquois used.</p>	<p>How will assessment be used to inform next teaching steps?</p> <p>Checkins are taken from PAT, info can be used to determine if further experiences are required to reinforce content</p> <p>How will assessment be used to help students take their next learning steps?</p> <p>Feedback and red/yellow/green section on check ins</p>
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Learning Activity: Wampum belts and the Great Peace

Students	Teacher	Assessment for/as learning
<p>What will students be doing?</p> <p>Digital Site</p> <p>http://www.nativetech.org/beatwork/wampumgraph/index.html</p>	<p>What will the teacher be doing?</p> <p>Resource about belts with good photos</p> <p>http://www.ganondagan.org/Learning/Wampum</p> <p>http://www3.cgps.org/studentssite/grammar/subpages/Wampum.htm</p>	<p>What evidence of learning will be gathered?</p> <p>How will it be gathered?</p> <p>How will assessment be used to inform next teaching steps?</p> <p>How will assessment be used to help students take their next learning steps?</p>

Learning Activity: What elements are missing in today's democracy that were present in past models?

Culminating Task Ideas:

Visual Art Piece that represents the three “best” elements from each of the democratic systems (Greece, Iroquois, present) What elements would you select to create a perfect system that addresses the key understandings.

Culminating Assessment Ideas:

Present art to the grade 9’s as they did a similar piece

In sites two and four, participants worked alongside researchers to document their inquiry curriculum designs and classroom teacher using video. See examples from these:

- Sled Engineering Grade 2 - <http://galileo.org/sled-engineering/>
- Mix and Flow of Matter Grade 8 - <http://galileo.org/discipline-based-task-design-chemistry/>
- What is Your Top Speed - Grade 9 - <http://galileo.org/top-speed/>
- Becoming Authors - <https://www.youtube.com/watch?v=lv8U7dMIHvk&feature=youtu.be>

Other participant comments also demonstrate the challenge in negotiating personal meaning about great task design:

I’m not sure I’m sold on discipline-based tasks as universally superior. While creating animals and ecosystems may not be realistic, creating realistic environments with your imagination seems like outside the box thinking. Fantasy authors, for example, need that ability to marry creativity and realism to create successful, engaging environments.

One new insight I had today about discipline-based task design was when I looked through the lens of the profession or the discipline I had a more in-depth view of the process. I appreciated taking off my “teacher hat” so I could think about the profession first instead of the teaching of the task. Planning becomes more about process than product!!

It was also observed that teachers started to recognize the iterative and responsive nature of designing tasks:

Two teachers just launched their studies and noted that while their initial planning got the studies underway smoothly, they are now making more strategic revisions and adjustments....Some kids may go deeper than anticipated and/or raise unanticipated questions. Neither of the teachers see such outcomes as negative or irrelevant; rather they are appreciated as indicators of intellectual engagement and student ownership of learning.

Researchers observed seven interrelated characteristics of great tasks that continually inform complex designs: (1) great tasks are hard fun; (2) great tasks are authentic; (3) great tasks reach beyond the classroom; (4) great tasks involve construction; (5) great tasks empower learners;

(6) great tasks are collaborative; and (7) great tasks develop strong habits of mind. Table 5 provides a description of each characteristic, and three illustrative examples highlighting the characteristics and common misunderstandings observed in relation to these characteristics. The first example challenges students to determine the water quality in their community, in the second example students build a colony on Mars and the third example offers an archeology example.

Table 5
Characteristics of Great Tasks

Characteristics of Great Tasks	Description	Example	Misunderstandings
Hard Fun	Great tasks are challenging and multifaceted; require students to use technology to play with ideas and build things; require sustained amounts of uninterrupted time; require students to stretch their thinking	Example 1: Determine Water Quality Example 2: Build a Colony on Mars Example 3: Participate in an Archeology Dig	Fun activities that are challenging can be part of intellectually engaging tasks. However, not all fun activities are worthwhile and contribute to student learning.
Authentic	Great tasks require students to use knowledge in much the same way as real life practitioners and way of working that is true to the thinking of the subject; enable students to build on their own life experiences; create opportunities for students to encounter the real dilemmas, struggles and problems that characterize the subject; permit students to make genuine contributions to the world.	Example 1: Determine the water quality in your local community using three attributes: physical (the path along which the water flows), biological (number and type of organisms) and chemical. Obtain a water quality testing kit to assess the chemical state of your water using hydrological sampling procedures. Create a database or spreadsheet of your findings.	Students (even young students) have the capability to engage in junior versions of activities authentic to the discipline; students have the capability to explore genuine problems that matter with guidance.
Reach Beyond the Classroom	Students communicate what they have learned to	Example 1: Compare results with those of the	Ongoing reflection and documentation

	a variety of audiences through presentation or exhibition. The teacher should not be the sole audience. The students make their learning and thinking public so that others can benefit.	EPA’s current drinking water standards. Contribute your findings to a global database and compare your findings with those from other locations in the world (i.e. GLOBE - www.globe.gov).	of learning by the teacher and students is important in making learning visible, sharing learning broadly and reaching beyond the classroom.
Involve Construction	Students do field work, labs, interviews, studio work, design, construction, etc. as they “build” their final product. Students use a variety of media, methods and resources; use technology at many stages of thinking and analysis, and not just in the final product.	Example 2: Students are challenged to design a colony on Mars and present to a group of scientists from NASA. In order to develop the understandings necessary to do this task, there might be a number of activities designed: using an engaging hook to present and initiate the whole project with the class; research into the physical characteristics of Mars; design and construct a robot device to explore a simulated Martian environment; and correspond with scientists in Antarctica about the problems of living in confined and isolated environments.	All the activities designed need to support a task. The point of the activity is that it should help build the understanding necessary to successfully complete the overarching task.
Empower Learners	Students have a genuine voice (individually and as a team) informing next steps. Students actively participate in defining and assessing learning goals and accomplishments.	Example 3: After securing a permit, mark the dig location into grids. While digging, each group will maintain a field journal to: <ul style="list-style-type: none"> ● measure and record the depth and 	Designing tasks that have next steps entirely predetermined either by the teacher or resources does not

		<p>location of any artifacts found</p> <ul style="list-style-type: none"> ● take a GPS reading of each artifact ● collect and analyze the artifacts, identifying key features 	empower learners to think for themselves and is not responsive to learner needs.
Requires Collaboration	Great tasks are collaborative; require multiple perspectives; require diversity of student abilities, interests and approaches; and require knowledge-building strategies to construct a shared understanding.	<ul style="list-style-type: none"> ● compare observations from field notes to other groups ● begin to put the pieces and clues together to be able to tell the story of what life was like during the oil boom 	Kids might be working on different parts of a task as they do different activities. However, an important part of collaborative work is to pull all the parts together into a bigger whole and often requires scaffolded supports.
Develop Strong Habits of Mind	According to Meier’s (1995), meaningful tasks should promote strong habits of mind: tasks should foster making judgements about the validity and reliability of information (How do we know what we know?); tasks should help students understand the privilege of perspective and viewpoint; tasks should provide a search for connections, patterns and relationships; tasks should require reflection and supposition (What if?); and tasks should matter (Who cares?).	Example 3: Write an archeology report based on your field notes. Using your discoveries from the dig, analyze their location and proximity to other artifacts. What are your predictions as to the purpose of the items found? What do you discover about daily life? How did people live? Have you found evidence as to why people chose to live in this location?	Planning activities in advance and hoping they will add up to something in the end is not an characteristic of designing a great task with attention to developing strong habits of mind and responding to how the kids are learning.

Site two teachers and leaders in the final reflections following six professional learning sessions during the 2014-15 school year identified several needs. The needs included: prioritizing time to collaborate with colleagues; developing communication and leadership skills; making provisions for ongoing support from school administrators; accessing cohesive, school wide, focused, worthwhile and personalized professional learning; and developing a deeper understanding of designing tasks with an inquiry stance. An area for growth opportunity for both teachers and administrators is developing a clearer understanding of what it means to enact inquiry in the classroom and the supports required for effectively fostering a culture of inquiry in school. Table 6 provides a summary of the needs with sample comments from participants, ordered from greatest need according to the frequency of comments coded.

Table 6
Needs for fostering a culture of inquiry

Needs	Sample Comments	Frequency
<p>Prioritizing Time to collaborate with colleagues; Need more practice with and opportunities to analyze evidence of student and teacher learning with colleagues</p>	<p><i>Time - and the time we have for planning and collaborating to be valued.</i></p> <p><i>Provide embedded time within school day to plan/collaborate-so that people will be more comfortable with planning/delivering inquiries, more enthusiastic and willing.</i></p> <p><i>The opportunity to have sessions like this helps to further my practice and also know what other schools in my area are working on. My school has been able to give planning time, PD sessions and 1/2 day sub time to help facilitate this work.</i></p>	80
<p>Communication and leadership skill development; need more opportunities to build collective knowledge about leading teacher learning.</p>	<p><i>I need to learn how to communicate in other ways with adults</i></p> <p><i>I would like to continue to evolve as a champion and leader for this type of work. In order to do this, I will require PD that challenges the way I am doing things now. The fundamentals and skeleton are in place, I want to take it to the next level and change. I need help developing assessment techniques that back up my work, this proof can further champion it legitimacy in our practice.</i></p> <p><i>My favourite session this year was the one in April that looked at the planning process around the discipline of the conservation biologist - this has taken my understanding of</i></p>	46

	<p><i>inquiry and pulled all the pieces together in one venue for planning/thinking/collaborating. Looking at each element with the idea of what the students are doing, what the teacher is doing and what the assessment is at each step of the process - BRILLIANT!</i></p> <p><i>So in the future I will need to continue working with this model to help my staff with their own planning.</i></p>	
<p>Ongoing support and collaboration needed from school administrators; need support to continue building capacity</p>	<p><i>Administration to understand that they may not get 100% buy in but need to continue to move the staff forward so the majority that has bought in can stay engaged and excited instead of them becoming detached waiting for us to sway the naysayers.</i></p> <p><i>To maintain the continued support of the administration who clearly see the value of individual's time and how they build in planning and collaborating sessions into the PD schedule.</i></p> <p><i>Administration needs to use the TEF framework in their approach with the teachers.</i></p> <p><i>Administration may wish to use TEF as a structure the PLCs follow throughout the year.</i></p> <p><i>Administration must recognize the TEF leaders in the school and offer the choice of mentorship to those in need of professional growth in this area.</i></p> <p><i>Many of the demands for 'more time' could be alleviated with thoughtful and clear structures around timetabling, staffing and predictable collaborative time.</i></p>	<p>37</p>
<p>Cohesive school-wide, focused, worthwhile, personalized professional learning; need to strengthen professional learning networks</p>	<p><i>More time to team plan so it is more consistent within across grade, and across the school</i></p> <p><i>Having PLC and inquiry linked together and have the teachers who attend the sessions be resources would be great</i></p> <p><i>A focused, school wide through-line</i></p> <p><i>We have time but not used effectively. Need a clear PD</i></p>	<p>15</p>

	<p><i>focus that reflects student need, established plan to meet this need, effective communication and support from all levels of school, and commitment to follow through.</i></p> <p><i>We need support from admin for time and professional and true PD on inquiry.</i></p> <p><i>Dedicated time to do the preparation (reading, developing tasks, summarizing information for staff, etc.) that is needed to engage in this process effectively.</i></p>	
<p>Develop deeper understanding of designing tasks with an inquiry stance; need more practice with authentic task design and formative assessment.</p>	<p><i>I would really like some more classes on Galileo and how to teach inquiry based learning. I feel I struggle with this and would love feedback and help on how to teach a better inquiry based activity. I am very much a hands on learner and I feel that I need more sessions to feel like I am a little bit of an expert on inquiry based learning and inquiry based activities.</i></p> <p><i>Ability to continue to work with Galileo experts to continue our scholastic growth</i></p> <p><i>I am still working to fully incorporate the literacy needs of our students with our inquiry work in meaningful ways.</i></p> <p><i>I would like to work more with the formative assessment cycle so that I can implement it better thereby creating better learning outcomes for my students.</i></p> <p><i>I'd like recommendations of readings or the like to keep fresh on the work we've done.</i></p>	<p>10</p>

Chapter One in the FOI digital resource is about building a culture of inquiry. The chapter is divided into eight sections: What is Learning? What is Inquiry? What is Discipline Based Inquiry? Why Inquiry? Playing the Whole Game; Changing the Emphasis to Promote Discipline Based Inquiry; Knowledge Building within Discipline Based Inquiry; and Twenty-First Century Students: Engaged, Ethical and Entrepreneurial. In Chapter One, learning is described as an ongoing, active process of inquiry, engagement and participation in the world around us. Our abilities are not fixed, but are continuously developed through learning experiences and active engagement. The goal of learning and instruction lies in adaptive expertise - the ability to apply what is learned in a flexible and creative way, and in different situations. Inquiry is a systematic investigation into a problem, issue, topic or idea that is worth thinking about deeply. Each

discipline (i.e. science, math, history, etc.) has its own particular way of generating knowledge, verifying what counts as quality work, and communicating. As such, discipline-based inquiry situates the inquiry and assessment in the ways of thinking and learning within the discipline and related professions; characteristics include: the study is authentic, students are given opportunities to create product/ culminating work that contributes to the building of knowledge, deep knowledge and understanding is fostered; ongoing assessment, students must observe/interact with outside expertise, and students are given an opportunity to communicate their ideas.

Building a culture of inquiry involves stimulating intellectual engagement, a state in which the learner is so focused, so intensely engaged, that time seems to disappear (a state of intrinsic motivation manifested by intense emotional and intellectual excitement). Students require developmentally appropriate opportunities and challenges; students need to immerse themselves in worthwhile work that reflects a junior version of how professionals in a field engage, create knowledge, assess work and communicate in their discipline. The role of the teacher is to carefully craft the learning experience and worthwhile work with attention to authenticity, academic rigor, assessment, elaborated communication and forms of expression, looking beyond the school, connecting with experts, active exploration and appropriate use of technology. Teachers support students in this process through scaffolding activities, providing frequent opportunities for formative assessment, and using powerful guiding questions to ensure inquiry based tasks lead to deep understanding.

Finding 1.2 Our study surfaced a significant misunderstanding in teachers and school leaders when enacting inquiry in the classroom.

Summary

In this section, findings were discussed related to the first research question exploring what professional learning strategies transfer into productive discipline-based inquiry pedagogies at the classroom level. Findings suggest professional learning activities required by teachers and principals are centred on building a culture of inquiry. However, the findings also surfaced significant misunderstandings when enacting inquiry in the classroom. Chapter One from the FOI digital resource can be used to support building a culture of inquiry.

Research Question 2: What changes to classroom and school practices and structures that are enacted support the development of discipline-based inquiry?

Chapter Two in the FOI digital resource is divided into ten sections: (1) Dimensions of Discipline Based Inquiry; (2) A Design for Inquiry; (3) Developing and Working with a Great Idea; (4) Designing Great Tasks; (5) Working with the Curriculum; (6) The Essential Role of Technology; (7) Centrality of Assessment within Design; (8) Centrality of the Discipline; (9) The Place of the Interdisciplinary; and (10) What Does the Research Say?

In all ten sections in this chapter, it is emphasized that each discipline has its own way of communicating and generating knowledge and verifying what counts as quality work. So, as teachers apprentice learners into these actions and students work in a variety of subject disciplines, they should learn their way around a discipline while engaging in authentic intellectual tasks that create new knowledge. In Chapter Two, the dimensions of discipline-based inquiry are discussed: authenticity, academic rigour, assessment, beyond the school, use of digital technologies, active exploration, connecting with experts and elaborated communication. These eight dimensions describe changes to classroom practices that are enacted to support the development of discipline-based inquiry.

Dimension 1: Authenticity

As described in Chapter Two, an authentic inquiry:

- Emanates from a question, problem or exploration that has meaning to students.
- Is recognizable to an adult at work or in the community as they might actually tackle the question, problem, issue or exploration posed by the inquiry.
- Originates with an issue, problem, question, exploration or topic that provides opportunities to create or produce something that contributes to the world's knowledge.
- Requires a variety of roles or perspectives.

During classroom observations, researchers observed classrooms instructional practices and used the following scales to categorize the instructional practices during the first, second and final third of the classroom time based on intellectual investment, instructional style and authenticity. Intellectual investment was rated on a scale from passive work to flow zone work, characterized as work that is absorbing, creatively energizing, and requiring thought processes that demand analysis, synthesis, conjecture, reasoned judgement, creation and innovation. Instructional style characterizes the teaching style on a five-point scale from completely controlled and directed to the highest level where the teacher is fully present and responsive to the learning as it emerges. Authenticity rates the value of the tasks (personal, social or aesthetic) on a five-point scale ranging from a low of artificial with little relevance or purpose outside of the classroom to a high level of real world and applicable or valuable to a broader context.

Table 7 shows the percentage on a five-point scale for levels of investment, instructional style and authenticity of task/activity as observed by researchers during the classroom observations.

Table 7
Instructional Practices

	Intellectual Investment Passive < > Flow					Instructional Style Controlled < > Responsive					Authenticity Artificial < > Real world				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
First Third	0%	17%	17%	50%	17%	0%	17%	33%	17%	33%	0%	17%	33%	0%	50%
Second Third	0%	0%	33%	17%	50%	0%	0%	0%	33%	67%	0%	0%	33%	17%	50%
Final Third	0%	0%	0%	67%	33%	0%	0%	0%	17%	83%	0%	0%	17%	33%	50%

Observations indicate intellectual investment increased from the first to the final third of the lesson. The highest levels of intellectual engagement were observed during the final third of the lesson as shown in Figure 2.

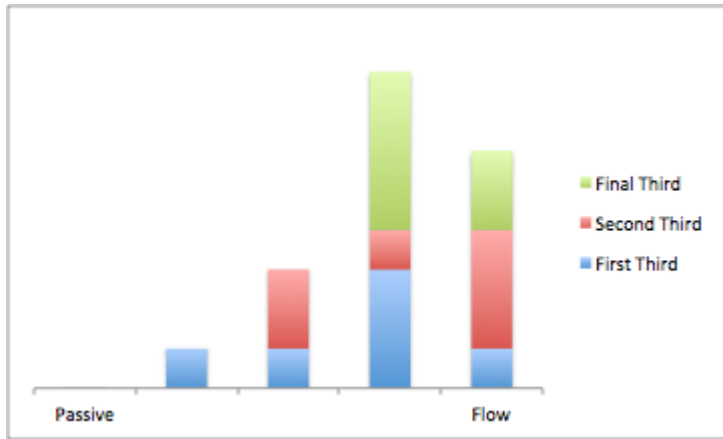


Figure 2. Intellectual Investment Observed (n=6)

Teacher controlled instructional style was observed more often in the first third of the lesson. During the second and final third of the lessons, the teacher's instructional style was more responsive to emerging student needs as shown in Figure 3. Learning how to teach in response to student's learning was challenging for most teachers. In order to develop a responsive pedagogy teachers need to know where the learner needs to go, where they are going, where they are at and what the teacher needs to do to get the student to where they need to go and how to make adjustments along the way.

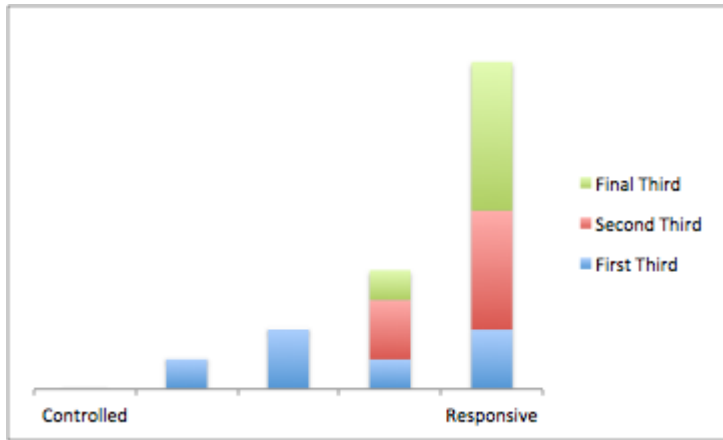


Figure 3. Instructional Style Observed (n=6)

The authenticity of the tasks ranged from artificial to real world with more tasks closer to the real world category particularly during the second and final third of the class as shown in Figure 4.

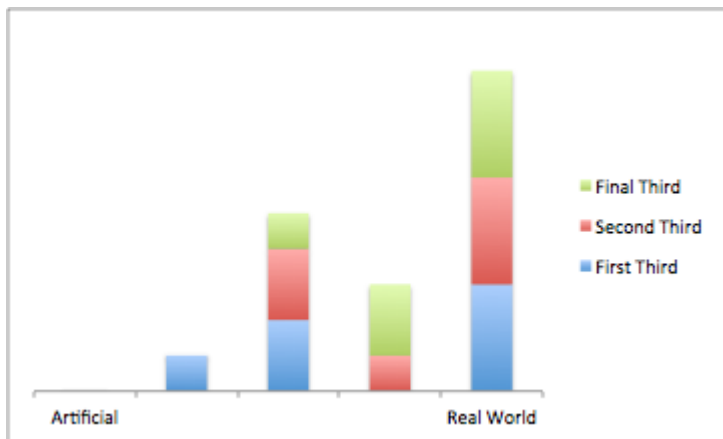


Figure 4. Authenticity Observed (n=6)

The following reflection from a teacher participant illustrates the value in designing an authentic task, leveraging experts in the field and providing students with opportunities to utilize feedback to inform next steps during a building process:

After witnessing the authentic learning that occurred in my classroom through our building project process, I fully believe in and embrace the inquiry-based model in my classroom. Student's excitement of the project and their final reflections solidified that students learn best through active exploration and utilizing an expert to assist in their

understanding. By giving them a base of initial teachings, students then took that knowledge and applied it to their own interpretation of what the building project should look like. By testing their buildings multiple times, they were able to use data they collected from their own building projects and others and improve on their building projects. This was authentic, real world understanding, which I see that they have experienced and applied to their end projects. - Teacher Participant

Dimension 2: Academic Rigour

During classroom observations, the cognitive level of student knowledge work was recorded. Students were observed gathering new information (final third), remembering or reviewing old information as part of knowledge acquisition and performative tasks (high - during first and second third). Understanding and knowledge production tasks - making connections was rated the highest (first, second & final third) followed by examining underlying concepts (first third).

During the classroom observations, researchers characterized the intellectual challenge involved in the student knowledge work by recording frequency of the task and the proportion of students engaged. Using a four-point rating scale, researchers measured the frequency levels: 0=None; 1=Low; 2=Often; and 3=High. Researchers also recorded the proportion of the class engaged in the tasks using a four-point rating scale: 0=None; 1=many or at least $\frac{1}{3}$ of the students in the class but less than $\frac{1}{2}$; 2=most or more than $\frac{1}{2}$ of the students in the class); and 3=almost all but a few students.

Table 8 lists the intellectual challenge observed by researchers for the knowledge acquisition and performative tasks, and ordered from highest to lowest frequency: remembering or reviewing old information, gathering new information, performing routine procedural or decoding tasks and repetition work. The intellectual challenge observed by researchers for understanding and knowledge production tasks, ordered from highest to lowest include: making connections, examining underlying concepts, knowledge manipulation, problem solving, problem posing, idea integration, idea improvement, creating new works or creative work with ideas, knowledge critique, knowledge claim supported by reasons, and knowledge as contestable. Despite the observed academic or intellectual engagement observed in the classrooms, there is an opportunity for growth in developing the nature of the intellectual challenge. The findings from the observations suggests there is a slightly higher frequency of tasks (2.8=high) and higher proportion of the class working (2.6=almost all but a few) with old information in comparison to the frequency in gathering new information (2.3=often) and proportion of the class gathering new information (2.4=most or more than $\frac{1}{2}$) for knowledge acquisition. In relation to understanding and knowledge production tasks, there was a high frequency and proportion of the class: making connections and examining underlying concepts. In contrast, there was a low frequency and at least one third of the class challenged with tasks where knowledge is contestable. As discussed in an earlier section, it is important great tasks develop what Deborah Meier (1995) calls strong "habits of mind" and students understand different viewpoints are an essential component of understanding - knowledge is contestable. Great tasks can help students understand that the privilege of perspective is an essential component of power - and such tasks might help them discover voices and points of view that

have been systematically silenced. In a great task, there should be more than one possible answer, or more than one possible path.

Table 8
Nature of Intellectual Challenge in Tasks

		Frequency	Proportion of Class
Knowledge Acquisition and Performative Tasks	Remembering or reviewing old information	2.8	2.6
	Gathering new information	2.3	2.4
	Performing routine procedural or decoding tasks	0.9	1.1
	Repetition work	0.7	0.7
Understanding and Knowledge Production Tasks	Making connections	2.9	2.9
	Examining underlying concepts	2.7	2.9
	Knowledge manipulation	2.4	2.6
	Problem solving	2.2	2.2
	Problem posing	2.1	2.1
	Idea integration	1.9	1.9
	Idea improvement	1.8	1.9
	Creating new works or creative work with ideas	1.8	1.9
	Knowledge critique	1.6	1.9
	Knowledge claim supported by reasons	1.6	1.6
	Knowledge as contestable	1.3	1.4

Participants also noted, developing tasks with intellectual challenge is an area for further development and growth:

I have started to approach my task design with the TEF in mind first. I am being more mindful of the relevance of the sub-tasks as they relate to the larger task. I am taking more time to unpack student understanding during the different stages of the feedback loops. I would like to explore strategies that would allow students to further develop their critical thinking skills as they work through the different stages in a task. How can I as a teacher further promote critical thinking on learning tasks?

Dimension 3: Assessment

Assessment guides student learning and teachers' instructional planning. Formative assessment is woven into task design and thoughtfully planned involving teachers, students, peer and adults outside of the classroom in the assessment process. Design-based assessment guides planning, teaching and student learning.

Chapter Three in the FOI digital resource provides more detail about the importance of assessment and is divided into four sections: (1) Assessment with discipline-based inquiry; (2) Using feedback to deepen the inquiry; (3) What does the research say? and (4) Assessment methods - evaluating your project and student performance. Assessment information can be used to inform teachers' teaching and used to improve students' learning. Formative assessment practices where students are provided with feedback while the learning is taking place informing their next steps and informing the teacher's next steps is one of the most powerful interventions and influences on improving student learning (Bransford et al., 2000; Darling-Hammond, 2008; Hattie, 2009, 2012; Hattie & Yates, 2014; Heritage, 2010; Wiliam, 2011). This chapter discusses how formative assessment practices need to be embedded in the learning process and are necessary for effective learning.

Drawing on Wiliam's (2011) five key strategies of formative assessment, the research team developed questions using four-point selected response rating. Participants either discussed the five strategies of formative assessment in relation to their task design during professional learning sessions and in some cases (Site 1), individually responded to the questions to self-assess their use of the formative assessment strategies on a daily basis. The responses ranged from a low level 0= not yet part of my practice; level 1=want to learn more; level 2-working on this; to a high level 3=established part of my practice. The responses from the self-assessment (see Figure 5) are not reported as they were used to promote discussion and not for purposes of data collection in this study.

Formative Strategies Self-Assessment

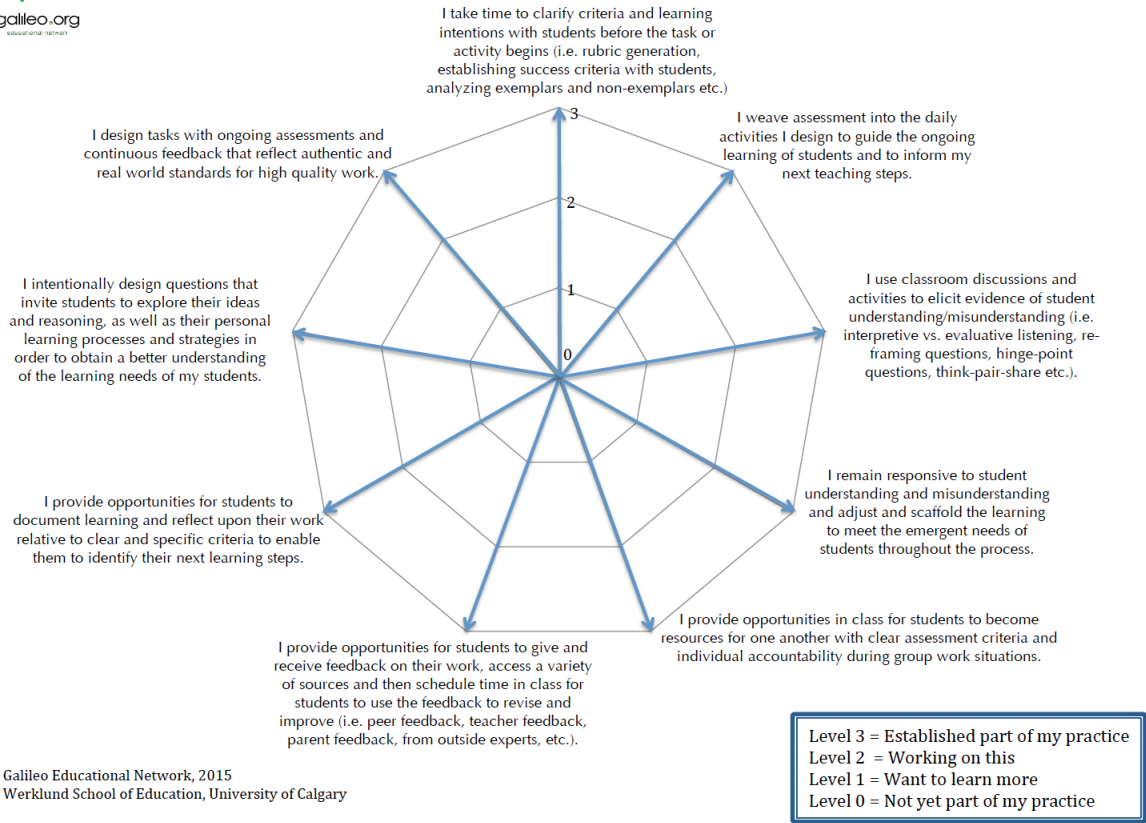


Figure 5. Formative Strategies Self-Assessment

Using Wiliam’s (2011) strategies for formative assessment, the following questions generated by teachers were used to guide analysis and discussion about their learning artifacts. Questioning serves to affirm their designs, clarify design principles, extend their thinking and serves to guide teacher practice (Table 9).

Table 9
Questioning Formative Assessment Strategies

Strategy	Questioning
1. Clarifying Learning Intentions and Criteria for Success	<ul style="list-style-type: none"> Are there ways that assessment criteria could reflect “junior versions” of more authentic real-world standards? How might you involve students in helping to

	<p>establish assessment criteria?</p> <ul style="list-style-type: none"> ● Are there ways that students could use collaboratively generated rubrics and/or assessment criteria to help analyze their own work throughout the process?
<p>2.Engineering Effective Discussions, Activities, and Tasks that Elicit Evidence of Learning</p>	<ul style="list-style-type: none"> ● How might you engineer classroom discussions, activities, and learning tasks to elicit ongoing evidence of students’ growing understanding and competencies? ● How might you involve your students in helping to gather evidence/proof of their learning? What might that look like? ● What different artifacts of student learning might be gathered to help demonstrate what students know, understand and are able to do (or not understand or do yet)?
<p>3.Providing Feedback that Moves Learning Forward</p>	<ul style="list-style-type: none"> ● How might you provide feedback that causes students to think and to help them identify their own next steps? What questions might you ask to get at student thinking? ● How might you be responsive to student understanding or misunderstanding? ● How might you scaffold and adjust learning to meet the emergent needs of students? ● What artifacts might be gathered to show a progression of student learning or demonstrate student learning is moving forward?
<p>4.Activating Learners as Instructional Resources for One Another</p>	<ul style="list-style-type: none"> ● How might students be activated as instructional resources for one another? ● How might students be involved in peer feedback loops and track changes to become resources for one another? ● What type of evidence could be gathered from peer feedback to demonstrate progression of student learning?

<p>5. Activating Learners as Owners of their Own Learning</p>	<ul style="list-style-type: none"> ● How might students be activated as owners of their own learning? ● How might students reflect on their learning to identify next steps or growth? ● What type of questions/responses could be gathered that invite students to explore their ideas and reasoning as well as their personal learning processes and strategies?
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The following example from Site 4 describes a writing challenge intended for young learners and demonstrates how assessment that mirrors the work in the discipline can be meaningfully woven into the task design.



Figure 6. Storyboard

Becoming Authors - <https://www.youtube.com/watch?v=lv8U7dMIHvk&feature=youtu.be>
Foundational skills for writing a fictional story includes analyzing stories and identifying details in the beginning, middle and end of the story; students reviewed the main idea as presented in the introduction, problem, climax, resolution and conclusion of the story. Building on previous knowledge and skills, this task was designed to challenge students to write an imaginative narrative. In this task, students were challenged to think and behave like authors. Using a similar process to what an author would go through, these students were tasked with writing a compelling ending to an unfamiliar story. Students mapped out the characters, setting, problem situation, goal, attempt to solve (encounters, events) and the resolution/ending for their imaginative narrative.

The students watched a video about the beginning of a story (One Man Band) and were then challenged to predict and develop a plausible ending to the story. Using a visual hook that did

not exclude students with diverse reading or comprehension levels was effective in engaging all learners in the class. Students worked with a partner to brainstorm their predictions. Students were also creative and brainstormed ideas that might seem out of the ordinary. Following this, students developed storyboards (see Figure 6) to outline the climax, attempts to solve the problem and resolution for the ending of the story. The students all developed something unique and different. The teacher observed, “they [students] had an opportunity to feel like they were writers but not alone in that process.”

Students worked in heterogeneous ability level groups for this activity to leverage diverse ability levels and idea development made possible when working with a group. In collaboration, students generated ideas, identified story components (genre), mapped the story, prepared an initial draft, edited, refined the draft, edited again and then prepared a final draft version of the story. Assessment was woven throughout the task. The teacher used a small group conferencing strategy to question students about their ideas and provide feedback and suggestions for next steps. The teacher also developed a rubric with the students. The language used in the rubric and criteria used for assessment mirrored the work of an author and the criteria a publisher/reader might use to select a good book. Students engaged in feedback loops through peer review and then published their stories.

Participants provided written feedback following professional learning experiences focused on formative assessment. Sample participant comments related to learning related to the use of formative assessment strategies were positive:

Strategies for making math bull’s-eye rubrics. I find math the most difficult subject to make a concise rubric for.

How good questions [reframed questions] can give us valuable insight into our children’s understanding. Also, how it is important to phrase your question in a way that fosters deeper thinking.

The importance of creating the rubrics and assessments with the students, and the importance of setting that time aside to focus on why and how to build these.

I learned about the 5 key strategies of formative assessment by Dylan William and I will be implementing his strategies into my day-to-day assessment.

Using Google docs in the assessment cycle.

I will continue to focus my growth on activating students as instructional resources for one another. Teaching students to be effective critics of their work and the work of their peers is a challenge.

Feedback should lead to action.

Feedback loops from peers early and often.

However, observations, artifacts and participant comments also demonstrated learning needs in the area of assessment. For example, the following humanities teacher reflects on the differences between formative and summative assessment:

Assessment is where I struggle the most. I often find that I do a bunch of marking, but it doesn't affect the students or they do not consider it. I'm also playing around with giving no grades this year. I find that if I give grade the comments get thrown out of their mind. This year, I've only given grades for two final tasks. We did a PD on not giving grades, just comments to have them focus. Is this the best way to go about it? Is ok to not give them grade and just comments?

Participants also indicated they would like more time to dialogue with colleagues and work through challenges with assessment:

I would like to have more time to talk to teachers from the others school, talk about what their program looks like, advantages and disadvantages. How they assess and why.

Guided by the discipline-based inquiry rubric, participants developed tasks using the eight dimensions. Participant comments, classroom observations and artifacts of task design demonstrate there is a beginning understanding of the eight dimensions of discipline-based inquiry and the value of collaboration and working with colleagues to develop a deeper understanding of the dimensions. However, more development is needed with the eight dimensions. For example, technologies are integral in supporting and amplifying knowledge building activities. We know that merely adding technology to existing structures does not improve learning. Technology does not supplement learning; it can amplify learning. Students using technology purposefully will find the technology provides learning opportunities otherwise not possible. Students can use technology to demonstrate new ways of thinking and doing. It is important students are learning about which technologies are most appropriate to the task or the discipline and for communication. It is also important technology is used in both process and product and closely linked to the ways technology is used authentically in the field to advance knowledge.

Table 10 provides a sample task designed for a junior high mathematics class. The intent of the task was for students to use their understanding of area, surface area and volume of shapes to design and calculate the dimensions of a tailings pond including structural components and environmental impact. All eight dimensions of discipline-based inquiry were considered as part of this design. Although not all eight dimensions were developed to the same extent as demonstrated in the task notes.

Table 10

Sample Task - Tailings Ponds - Area and Volume of Tailing Fluids

Dimension	Task Notes
<p>Authenticity - an inquiry originates with a question, problem, issue or exploration that is significant to the discipline and provides opportunity to create or produce something that contributes to the world's knowledge.</p>	<p>The area and volume of 2-D and 3-D shapes is directly linked to the use of mathematics in determining sizes, shapes of tailings ponds in extractive surface mining operations.</p> <p>The project will build connections beyond the school by helping students to see how surface area, area and volume are related.</p> <p>Showing nets of shapes, building in mine craft (3-D modeling, calculating the amount of each type of building material they need, determining optimum shape based on volume and surface area).</p> <p>Buy in to using formulas to solve the problem. Students will need to incorporate problem solving, prototypes, experimenting, remodeling, reassessing and peer feedback to reach the best solution.</p>
<p>Academic Rigour - students have opportunities to build deep understanding and create or produce high quality products and performance that mirror the disciplines.</p>	<p>Apply knowledge and skills about 2-D and 3-D shapes, determining surface area, and volume to the tailings pond design. Figure out the shapes within the tailings pond and calculate volume and area. Some students chose different shapes like cylinders and calculated the volume and surface area for them. Others can find rectangular or triangular prisms within the tailings pond design.</p>
<p>Assessment - ongoing assessment woven into the design of the study guides students' learning and teachers' instructional planning.</p>	<p>Rubrics were developed by the teacher and students in concert. Small groups came up with wording of the Acceptable and Proficient levels of understanding for their project. Other small groups edited within a shared google document and then critiqued and honed the rubric to make it understandable to all students. As students worked on their project they had to refer to the rubric and decide where they fit in the descriptions. If they were not satisfied they had reached Proficient or Mastery they worked within the group to evaluate what needed to be done to go forward.</p> <p>Before handing in the project they had to self-evaluate using</p>

	the rubric and include it with their project.
Beyond the School - students are encouraged to explore issues or problems with a focus on competencies expected in high performance work organizations, such as teamwork, organizations, problem-solving, communication, decision making and project management.	Town employees helping with the information. Real jobs connected to math topics.
Use of Digital Technologies - students use technology a purposeful manner that demonstrates an appreciation of new ways of thinking and doing.	Minecraft as a modeling framework, visual display of learning, show movement of water. Also, Screencastify was used by one group to describe their work.
Active Exploration - students are engaged in real (authentic) investigations using a variety of media, methods and sources.	Students had to figure out the size in meters the pond would be. They needed to think about what would happen to the liquid in the pond and where it would go if it escaped. They had to consider how to contain it in this event and what space was needed to protect wildlife from the toxic elements. They considered a variety of possibilities for designs.
Connecting with Experts - students are given opportunity to observe and interact with adults with relevant expertise and experience in a variety of situations.	Contacted town engineer. Discussion about the High River flood of 2013 and how the town is rebuilding based on High Water Marks modelled and calculated to determine the volume of water each part of town can hold and the types and sizes of berms that can withstand that volume and flow. River systems, barrier building, calculations and formulas for determining the height and breadth of berms for river systems.
Elaborated Communications - students have opportunities to choose forms of expression appropriate to the task, and	Tasks did not include opportunities to communicate with an audience beyond the classroom. Small group discussions happened as groups came up to similar problems and helped one another navigate calculations and design issues. In large group discussions, the students were able to reference their

communicate what they are learning with a variety of audiences.	work and the examples of ponds they had seen in the news
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Finding 2.1 Dimensions of discipline-based inquiry inform task design, assessment and classroom practices.

Chapter Four in the FOI digital resource focuses on creating a community of learners. Knowing how to learn, being inspired to continue learning and learning together with others is essential in today’s world.

Members of the research team met with teachers from Site 3 to analyze the work that communities of teachers bring forward. Participants analyzed assessment strategies used in their day-to-day practice that sponsor student learning and deepen student understanding. In small groups, teachers identified a discipline concept and shared what evidence is used to determine the depth of student understanding. Table 11 provides sample comments provided by participants demonstrating a variety of assessment strategies and evidence of learning used by teachers across various disciplines.

Table 11
Assessment Strategies and Evidence of Learning Examples

Assessment Strategies	Evidence of Learning
<ul style="list-style-type: none"> ● Informal in-class check-ins with groups/individual students (notes taken on collaborative google doc) with targeted, pre-determined questions ● written and oral (Red, yellow, green, interview, anecdotal), physical demonstration of thoughts and ideas (board) ● One-to-one teacher-student conferencing ● (recalling/reviewing previous learning, linking new concepts to prior concepts, self assessments) ● Checklists ● Rubrics with co-constructed criteria ● Whole class discussions and questioning (popsicle sticks instead of 	<ul style="list-style-type: none"> ● Performance tasks (blog posts, conversations, larger projects, global cafe, debate, showcase, videos, photos, etc.) ● Questioning of one another during round table discussions (asking for evidence) ● Extension questions - can they relate the concept to other, similar situations. ● Inclusion of empirical evidence/proof in student work ● Demonstration of connections to previous knowledge, connections to the real world ● Feedback (peer, parent, teacher) is incorporated into their work; record themselves having a conversation with peers or parents about the

<p>hands up, thumbs up/down, think-pair-share) and verbal response</p> <ul style="list-style-type: none"> ● Feedback Loops: ● Teacher provided formative feedback - comments and rubrics vs. numbers ● Peer feedback (3 before me peer feedback) ● Parent feedback ● Student self-assessments and reflection (self-rating of confidence/comfort in their understanding of a previously learned concept) ● Summative assessments 	<p>concept</p> <ul style="list-style-type: none"> ● Conversation ● Follow up questions in conversation to gauge the depth of their understanding; questions such as “if this...then” or “then what happens...” or “why this and not that” ● Turning the students into teachers- can they explain the concept to someone who doesn’t understand it ● Observations - class participation, confidence ● Self-reflection - can they identify their own strengths and weaknesses in the concept? ● Rubric - characteristics of product/performance compared to a rubric ● Results and ability to communicate understanding on application questions through a “traditional test”
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Teachers were asked: How do you go about designing and then articulating what it is that you require students to be able to understand and do (thinking and action)? Understanding must be built in relationship to key ideas/concepts within the disciplines. Doing also resonates with ways of doing within the disciplines.

Teachers were asked to examine and critically reflect upon a study designed for students. These designs were posted and shared with the research team in a Google Doc. The researchers provided feedback and comments to the participants. Some of the guiding questions included: What are the key understandings/ideas/concepts (ways of knowing, doing and being) that you have articulated in your current study? In what ways does the work of your students show evidence that the key understandings you have identified are becoming visible to you? Reflect upon, what you might need to put in place so that they become more visible? What parts of the Focus on Inquiry resource assist you in undertaking this critical reflection? What else might be needed to support teachers in their professional learning?

Another strategy used by the research team and the Galileo Educational Network mentors was to use teacher-created video clips of practice to connect to theory. A limitation in using classroom video clips is the limited scope and perspective provided by the teacher and students who give permission to share digital artifacts. Despite the limited perspective, these video snapshots of classroom practice and student learning offer a springboard for professional dialogue. Site 2 learning leaders reported using the videos and exemplars to disseminate ideas and sponsor conversations about inquiry-based practices with colleagues at their schools. The

following comments from participants suggest the value in using multi-media clips to support communities of learners:

I would like to see more exemplars like the "Arrival" video.

I also suspect I will pull the video of the Rubik's cube developer at some point as a fun little provocation for conversation :)

I'd like to see more examples like the project we saw towards the end of the period along with all related documentation (rubrics/mini-lessons etc.) I find complete examples of thoughtfully designed work helpful in expanding my ideas of what "intellectual engagement" could mean.

The conversations from my school are continued in this space. I bring back examples of what others are doing for conversation and comparison to our practices and planning. These sessions reinforce confidence in my current practice.

Participants started to see how theory and practice are linked. In Chapter Five of the FOI Digital Resource, "knowledge for practice" is defined as the knowledge teachers require to develop their practice. The following sample comments from participants demonstrate an appreciation by the participants in reviewing literature and guiding documents as part of a scholarly approach to professional learning working in the company of peers and Galileo mentors.

I haven't heard of Ministerial Order before, but know the language. I view this as the focus we maintain for student development and quality task development and will bring this to my team.

Continue conversations with colleagues about formative assessment and do more professional reading about effective tasks within the classroom that lead to deep learning.

I would like to have websites or articles that are research based or a reference sheet for further reading related to the days topics. eg I had never heard of Timperley before and would like to know more

[Provide] ideas for how to incorporate intentional task design into current practice importance of research

[Provide] Articles/books mentioned from session.

Ongoing conversations, helpful articles, practical applications will assist in helping lead this work.

I need to continue to do outside research and learning as this is my first year working with Galileo and the Teacher Effectiveness Framework. My fellow teacher leaders have

been very supportive with this and answering any questions that I have and clarifying any misunderstandings I have.

Consistent with the literature, findings from this study indicate teachers want to have opportunities to learn in the company of their peers, engage in professional dialogue and keep abreast of the theoretical underpinnings for effective practice (Friesen & Lock, 2010; Hattie 2009, 2012; Timperley, 2011; Willms, Friesen, & Milton, 2009). As such, discipline-based inquiry can be supported through creating a community of learners for practicing teachers and pre-service teachers.

Finding 2.2 Discipline-based inquiry can be supported through creating a community of learners.

Chapter Six in the FOI digital resource is divided into two sections - instructional leadership and teacher leadership.

Instructional Leadership

School leaders have an impact on student learning through five key leadership practices: establishing goals and expectations, resourcing strategically, ensuring quality teaching, leading teacher learning and development, and ensuring an orderly and safe environment. School leaders need to undertake cycles of inquiry for further leadership learning. This instructional leadership mindset involves an intense moral purpose focused on promoting deep student learning, professional inquiry, trusting relationships and seeking evidence in action. Leaders are challenged to promote inquiry habits of mind throughout the school. Professional learning focused on cycles of inquiry for both teachers and school leaders can impact the development and growth of discipline-based inquiry in the school. Teachers and leaders become knowledgeable about teaching, learning and the structures needed to further develop an inquiry stance in the school. Positive, respectful relationships are needed for well-functioning schools and for future sustainability and scaling-up innovations.

Sample participant comments related to learning needs in the area of leadership:

Informed, active and learning centred leadership is a critical component to enable teachers to understand inquiry based instructional design, and to build and sustain a robust professional culture that values innovative teaching that enhances student learning.

This is my first opportunity as a LL. My specific responsibilities haven't been identified beyond the job description I read with my HR letter. I have lead and been co-lead of a curriculum department for 5 years so this Galileo experience will continue to inform my leadership responsibilities. I am now a part of the school's admin team so I am taking part in professional readings and learning more about school operations.

[Need] Leadership strategies for how to engage colleagues in the process of developing new tasks effectively.

I like learning more about the leadership part - how to ask questions of ourselves and others in a nonjudgmental way, that causes us to pause and consider the important work that is being done in our schools and to reflect on ways to be sure that it is academically rigorous, intellectually stimulating, challenging and worthwhile.

I would love to learn about leading discussions amongst the leadership team in order to support learning opportunities like this. Many administrative teams have very set interests and goals for their work with staff and I'd like to be able to integrate this into a whole-school focus.

Teacher leadership

“Teachers become leaders when they are resilient, collaborate with others, work through an inquiry stance, and engage in effective professional learning with those principles in mind” (FOI, Chapter Six). In all four sites, teachers and school leaders worked alongside Galileo mentors and researchers to develop an evidence-based practice and leadership through iterative cycles of inquiry. For example, in Site two, participants (n=120) were involved in a series of six professional learning sessions during the study. During the professional learning sessions, participants were invited to share artifacts of student learning with their colleagues to gather feedback and suggestions. In each session participants brought forward artifacts demonstrating evidence of student learning and their own leadership development. Participants worked with small groups to share artifacts and engage in critical and professional dialogue using the artifacts as a source for further learning and improvement.

Participants briefly described the artifacts and its relationship to student growth and learning. Table 12 provides a set of dimensions discussed with participants to foster professional discourse and strengthen learning relationships. Drawing on research related to knowledge-building, student-centered leadership and professional learning, four key dimensions were emphasized when participants shared artifacts with colleagues: (a) scholarship of teaching, (b) knowledge-building discourse, (c) respectful communications, and (d) questioning (Robinson, 2011; Scardamalia & Bereiter, 2006; Stoll, 2010; Timperley, 2011).

Table 12

Fostering Professional Discourse & Learning Relationships

Dimensions	Indicators of Professional Discourse & Learning Relationships
Scholarship of teaching	<ul style="list-style-type: none"> ● Commit to regularly share relevant evidence of learning (artifacts) and engage in learning conversations about improving outcomes for students. ● Treat all artifacts and ideas as improvable. ● Encourage and treat all participants as legitimate contributors to the knowledge advances of the group. ● Take individual ownership and collective responsibility for equal and succinct contributions.
Knowledge-building Discourse	<ul style="list-style-type: none"> ● Provide feedback related to the intention or purpose for sharing artifacts of learning and to allow ideas to evolve into new and more refined forms, improve work and/or to determine next steps. ● Allow participants to express and gain quality feedback, discuss different points of view, and arrive at conclusions. ● Put forward contrasting or different ideas to provoke thinking and deepen knowledge-building discourse.
Respectful Communications	<ul style="list-style-type: none"> ● Balance participation and ensure that all participants have the opportunity to share artifacts, ideas and responses. ● Listen and pause to maintain awareness of others in the group. ● Paraphrase to clarify understanding. ● Embed growth oriented language in responses (i.e. even when in disagreement, debating criteria for effective practice, etc.).
Questioning	<ul style="list-style-type: none"> ● Ask specific questions related to the intention or purpose for sharing artifacts of learning. ● Pose questions to probe for specificity. ● Ask questions in a sincere attempt to gain greater insight into practices that sponsor improved outcomes for students. ● Suspend judgement and frame comments as questions to

	provoke further thinking of entire group.
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The following sample comments demonstrate the value in participating in iterative cycles of inquiry alongside peers and mentors. Many of the participants continued this practice with colleagues at their own schools:

As a team of 4, the other learning leaders and myself have been sharing what we are learning with our colleagues and supporting them with the information we are sharing with them.

I have been sharing the work done in sessions with my partner teacher and colleagues on a casual basis, as well as with my PLC group (cross-graded) which is focused upon building deeper mathematical understanding among our student population.

I enjoyed the sharing between schools. I found this very beneficial!

I enjoyed hearing what others are doing in other school and I always love gathering new ideas to further my teaching or my understanding. So, I think through more sharing or conversation with others and conversations with my school and team members I will continue to learn. I think you are always learning, so all I can do is offer my understanding or experiences and share it with others. That is what I will continue to do to try to move my work and my colleagues work forward.

Through sharing with my colleagues, I picked up some valuable assessment rubric ideas that are relevant and appropriate and I am excited to take these back to my classroom/school and implement/share.

We are sharing and having PD in a model of how we are working here - specifically looking at formative assessment. We are a small school with only about 10 teaching staff and 4 attend Galileo so we share info in PLC and casually at staff meetings and on a daily basis.

Finding 2.3 Teachers and school leaders involved in iterative cycles of inquiry for leadership impact the development of discipline-based inquiry in the school.

Summary

In this section, findings were discussed related to the second research question exploring the changes to classroom and school practices and structures that are enacted to support the development of discipline-based inquiry. Findings suggest changes include a discipline-based

inquiry focus, assessment, teaching and learning in a discipline-based inquiry classroom, and the importance of instructional and teacher leadership. Chapters Two through Six from the FOI digital resource can be used to support building a culture of inquiry and to provide guidance in overcoming the challenges in designing effective classroom and school practices, and structures.

Research Question 3: In what ways did teacher professional learning impact student learning?

Chapter Five - Creating a Scholarly Practice is divided into six sections: (1) Teaching as a scholarship; (2) Beyond Professional Development; (3) Knowledge for, in and of practice; (4) An inquiry stance on practice: how the process of inquiry produces knowledge; (5) Cultivating an evidence-based practice; and (6) Making teaching public.

Professional learning at Site 1, 3 and 4 involved members of the research team and Galileo Educational Network mentors working on-site with teachers and school leaders to develop and inquiry stance on practice. Site 2 involved a larger group of participants and required the research team and mentors to meet with participants at a central location for professional learning sessions. The cycle of inquiry used with participants at all the sites is discussed in Chapter Five and shown in Figure 7.



Figure 7. Cycle of Inquiry begins and ends with the knowledge and skills students need (Timperley, 2011).

The five principles outlined in the Teaching Effectiveness Framework (Friesen, 2009) are also discussed in Chapter Five and were used to guide professional learning: (1) teachers are designers of learning; (2) - work students are asked to undertake is worth their time and attention; (3) - assessment practices improve students learning and guide teaching; (4)- teachers foster a variety of interdependent relationships; and (5) teachers improve their practice in the company of their peers.

Participants valued the support from colleagues at their schools, colleagues attending the professional learning sessions and working alongside mentors from the Galileo Educational Network. Sample comments from participants:

I love planning collaboratively with someone who gets it! Talking helps narrow the focus and ensures the task is authentic and attainable for the students.

The process of creating with colleagues, allows us to see and create worthwhile work for the class, and share ideas.

I think more practice in the presence of other leaders is something that I need going through the task analysis procedure. I need to develop skill in effectively analyzing tasks (case studies) when moving through the Iterative Cycle to be able to effectively comment and ask questions to move practice and thinking forward.

I also think work with task design would also be useful for me. How to create these mindful and engaging tasks to push learning forward with students, so that I can model and support teachers with that at my school.

“Developing a powerful and effective practice is a career-long endeavor, which ideally, teachers build and strengthen in the company of their peers” (FOI Digital Resource, Chapter Five). In a video shared with participants, a teacher reflected on her learning experience as part of a professional learning community. As noted in the FOI digital resource, Chapter Five, “the scholarship of teaching requires that we step back and reflect systematically on the teaching we have done.” The following excerpt is from the video reflection:

My aha moment was rooted in the assessment and task design I use for my students. I always question and struggled with assessment practices as I felt I was not capturing or documenting enough of what they are learning during the day. I thought that although I wasn't trying to create this situation, I as the teacher was the keeper of the “good job” or “you're done now kind of end to task. I always wanted my students to ask themselves if they are finished or what more they can do. With my colleagues at Galileo sessions this year, I've had the chance to design meaningful learning tasks and I focused on involving student voice in developing the criteria for success as well as creating consistent opportunities for feedback. My grade ones are now actually using the term self-assessment and demonstrating on a daily basis that they are capable of giving meaningful feedback to themselves and others. Target rubrics and checklists are second nature to them and I see such a difference in their ownership of their learning and work through continual feedback loops. I have more students than ever coming up with their own ideas on what more they can do. I'm continuously asking questions. Instead of hitting the “I'm done button” that had become so familiar in the past, it opened up a whole new world of possibilities where every child not only knows what it takes to be successful but determines what it takes to be successful and often it's more than I would have asked for.

Reflecting on professional learning experiences was an integral component in all the professional learning sessions throughout the year informing next steps for the research and subsequent sessions. Participants were provided with time to reflect at the end of each session and respond to a few questions using a Google Form. Sample questions used for reflection:

- What new insights have you gained about intellectual engagement?

- What is one thing you learned today about designing worthwhile work that you will take back to your classroom and/or colleagues?
- What is one new insight you had today about collaboratively designing worthwhile tasks?
- What is one new insight you had today about discipline-based task design?
- What's one thing you are doing differently (or have tweaked) since starting these sessions?
- What is one challenge that you are facing as a learning lead or lead teacher in your school setting?
- What else do you need to learn, or be able to do, in regards to leading and modelling effective task design and assessment?

Participants in the large group professional learning sessions as well as those with on-site mentorship and visits from the research team commented on the value of external and scholarly expertise in a learning community. Sample quotes from the participants:

I found that the language is different than I am used to in UBD planning. I read through some of the articles and rubrics....reflecting on my task assessment form and speaking with [Galileo mentor] was very useful in focusing and solidifying how my idea can be developed into a viable unit for grade 7-8 math class. Very valuable work.

Teachers reflected on their practice as they were forced to "think outside their box".... Inquiry promotes collaboration and problem solving among a learning community.

Participants also reflected on the use of technology to support sharing and collaboration in a professional learning community. Sample quotes from the participant feedback forms:

Using Google docs in the assessment cycle.

I used one of the Google doc activities for one of our PD sessions that related to our school development plan. The teachers were intrigued and engaged.

I really loved using the Google drive to collaborate with our team. They helped to narrow down my task

Google Docs might be helpful sharing tool in collaboration when colleagues all plan in different ways and at different times

I like the use of the Google docs to invite feedback from colleagues to further my work.

Having the excel document in Google docs is a great way for a PLC group to work collaboratively and document their ideas instead of having one person doing the note-taking. Seems to be a more effective way to get the speakers' feedback down without having one person interpret and sum up their contributions.

I liked the shared Google doc for our tasks so that I can see and get inspiration from other teachers.

As teachers and school leaders in this study were making learning visible and taking an inquiry stance as part of their professional learning, they started to consider how this could impact student engagement in learning.

I think I am utilizing the methods that I am learning in these sessions in my classroom. Using the target rubrics and creating authentic tasks for my students.

The idea of making learning visible by having students work on the white board in groups and share their understanding with the class.

My biggest concern is making sure all my students benefit. From my experience the "big showcase" projects only benefit the stronger students. They produce amazing show and tell pieces but the task doesn't necessarily engage other/weaker students. I would like to learn how to develop tasks with multiple entry/exits points to meet the learning needs of different students.

I have more in depth learning experiences for my students. Student behaviours have decreased with more intellectually engaging tasks. Students are engaging in self/peer assessments daily. This experience is guiding them into growth mindset individuals, as they are continually trying to improve and move their work and learning forward.

Being able to collaborate with a team to come up with creative ways to teach and assess what is happening in the classroom is helping me to not only continue to improve my own learning and teaching as well as what I know about my own students. It gives me a variety of starting points and a variety of ideas to use in the classroom.

Finding 3.1 A design-based professional learning community can deepen an inquiry stance and impact student engagement in learning.

Summary

In this section, findings were discussed related to the third research question exploring the ways teacher professional learning can impact student learning. Findings suggest creating a scholarly practice with a focus on examining artifacts of student learning in a collaborative and collegial learning environment can inform the next steps for teachers in designing learning tasks and next steps for learners. Adopting an inquiry stance can strengthen pedagogy and leadership capacity through professional learning and thereby positively impact student learning. Inquiry is clearly positioned as an important component of the overall learning culture.

It is hoped that, in the long-term learner-focused teaching, instructional design, and practice can be improved and strengthened. Throughout the duration of the study, participants were continually supported through design-based professional learning and resources in the FOI digital resource. Participation provided an opportunity to work in partnership with researchers, reflect on practice, describe and highlight how instructional design and practice can be improved and strengthened. Participants also informed the development of the FOI digital resource and provided insights about strategies for professional learning and the impact of such practices on student learning. In addition, participation in this design-based research study offered teachers and school leaders an opportunity to help clarify and shape the future of learning and leadership by identifying positive factors contributing to innovative teaching and learning and elements of school leadership that promote professional learning and growth.

Findings from this study suggest strategically focused, inquiry-based, teaching and learning can impact organizational change, teaching practices and student learning in schools. This study serves to increase understanding about discipline-based inquiry teaching and learning and how this can impact organizational change. This study informed the research community and society at large about measuring impact of professional learning on student learning. Findings from this research should be shared broadly and serve to inform teachers, school leaders, jurisdictions and the ministry.

Recommendations

Recommendation 1. Findings from this research initiative should serve to inform design-based professional learning and research supporting discipline-based inquiry designs for learning.

Recommendation 2. Findings suggest there is need to develop further understanding of design-based professional learning strategies that cultivate a culture of inquiry

Recommendation 3. Findings suggest there is a need to develop further design-based professional learning focused on the different practices needed to create rigorous and robust teaching practices.

Recommendation 4. Findings suggest there is need to develop clear criteria for principals to assist in leading teacher learning and for teachers to use to help guide further growth and learning.

Recommendation 5. Findings from this research initiative should serve as a resource to support the implementation of the Focus on Inquiry digital resource.

Recommendation 6. Findings suggest there is need to continue developing dimensions of discipline-based inquiry to inform tasks design, assessment and classroom practices.

Recommendation 7. Findings suggest there is a need to develop best practices demonstrating the use and impact of the Focus on Inquiry digital resource.

Recommendation 8. Findings suggest there is a need to develop and disseminate strategies and effective practices in instructional leadership that supports innovative teaching practices leading to engaged student learning.

Recommendation 9. Findings suggest design-based professional learning and research should be considered as an effective means to deepen a focus on inquiry.

Recommendation 10. Findings suggest there is a need to develop strategies for design-based professional learning and research measuring impact on student learning.

Recommendation 11. Findings suggest there is a need to develop strategies for analysis of collaborative networks (relationships/influences, decisions to adopt discipline-based inquiry, extent of adoption and impact on student learning).

Recommendation 12. Findings from this research should be shared broadly and serve to inform teachers, school leaders, jurisdictions and the ministry: strategically focused, inquiry-based, teaching and learning can impact organizational change, teaching practices and student learning in schools.

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Appendix: Inquiry for Deep Understanding Design Guide

Topic: <i>This is a generative topic because...</i>		
Understanding Goals (2 over the 3 days): <i>I want students to understand that....</i> <i>I want students to be able to....</i>		
Learning Task:		
Learning Activity Day 1:		
Students	Teacher	Assessment for/as Learning
What will students be doing?	What will the teacher be doing?	What evidence of learning will be gathered? How will it be gathered? How will assessment be used to inform next teaching steps? How will assessment be used to help students take their next learning steps?

Learning Activity Day 2:		
Students	Teacher	Assessment for/as Learning
What will students be doing?	What will the teacher be doing?	<p>What evidence of learning will be gathered?</p> <p>How will it be gathered?</p> <p>How will assessment be used to inform next teaching steps?</p> <p>How will assessment be used to help students take their next learning steps?</p>
Learning Activity Day 3:		
Students	Teacher	Assessment for/as Learning
What will students be doing?	What will the teacher be doing?	What evidence of learning will be gathered?

		<p>How will it be gathered?</p> <p>How will assessment be used to inform next teaching steps?</p> <p>How will assessment be used to help students take their next learning steps?</p>
<p>Culminating Task Ideas:</p> <p>Culminating Assessment Ideas:</p>		