







Focus On Inquiry

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(The contents of this publication do not reflect the views, opinions and/or endorsement of Alberta Education related to methods of teaching. Teachers are expected to use their professional judgement to select the most appropriate methods of teaching that best meet the needs of their students.)

CHAPTER 1

Building a Culture of Inquiry



What is Learning?

Learning is any process that in living organisms leads to permanent capacity change and which is not solely due to biological maturation of ageing (Illeris, 2009).



Learning involves ongoing, active processes of inquiry, engagement and participation in the world around us (Bransford, Brown, & Cocking, 2000). We do it from the moment we're born and it takes place in schools, beyond those walls and throughout our lives. Regardless of ability or background, everyone has the potential to learn. Learning experiences literally shape the brain. So, it's important to know our abilities are not fixed, but continuously developing (Hinton, Fischer, & Glennon, 2012, p. 4). Lifelong learning should be seen as the foundation of an effective school, an active community, and a fulfilled and meaningful life.

Researchers, teachers, policy makers and parents have typically judged the success of learning in terms of how much knowledge a student had acquired. Today, it's understood **the quality of knowledge is just as important as the amount one can possess** (De Corte, 2010; Linn, 2005).

There was also a time when learning was understood as a linear process, a progression through different ages and stages. **Today, researchers and educators view growth, development and learning as a more dynamic system** (Fischer & Heikkinen, 2010, p. 260). It's influenced by neurology, psychology, social and cultural factors. Learning is adaptive – we build new knowledge and skills on the basis of what we already know (De Corte, 2010). Research has also shown the changes that underlie learning in the brain do not occur when learning experiences are not active (Hinton, Fischer, & Glennon, 2012, p. 5). We learn best by acting on, thinking and actually participating in the world.

Learning solely through the direct transfer of information, then, needs to be replaced with a focus on the active construction of knowledge (Fischer & Heikkinen, 2010, p. 253). This involves work that is meaningful, has a necessary depth of study, and assesses students' deep understanding rather than factual memory (Bransford et al., 2000). The task has an authenticity and a sense that what's being accomplished in the classroom is real work that "reflects the living realities of the discipline being taught" (Friesen & Jardine, 2011). When students and teachers pose guiding questions, problems, or tasks that professionals in the field would recognize as important, they can work and learn from experts towards responses and performances of learning that are meaningful, sophisticated, and powerful.



Video: **How can we fit 26 desks in our room** (https://vimeo.com/99935798)

Students must be able to work creatively to generate new ideas, theories, products, and knowledge. **They must gain the competencies required to fully participate in and make meaningful contributions locally, provincially, nationally, and globally – not for someday in the future, but now** (Bransford et al., 2000, p. 5).



Source: www.atbreak.com

Investing time and effort in practicing problem-solving and extending knowledge are among the most important factors influencing the success of learning (Ericsson, Krampe, & Tesch-Römer, 1993). But **achievement is more than a function of ability** (Dweck, 2006). Other drivers of achievement include motivation (the will to learn), metacognition (understanding how to learn) and resilience (the stamina for lifelong learning). An understanding of how these factors develop is useful for all learners (Hinton, 2005).

There are many theories and so-called success stories on how learning should be conducted in the classroom. Some self-proclaimed experts say students can become competent without investing serious time and effort if only the teaching was more fun, more brain-adequate, more computer-based, or if it occurred earlier in life. None of these claims is justified by the results of empirical research (research based on direct observation and experience) (Schneider & Stern, 2010). **What we do know is that knowledge is multi-faceted**. There is knowledge about abstract concepts, about how to efficiently solve routine problems, knowledge about how to master complex and dynamic problem situations, knowledge about learning strategies, knowledge about how to regulate one's own emotions, and so forth. All these factor in contributing to a person's overall competence (De Corte, 2010).



Environment is Everything:

Creating environments that support brain development is a complex task. Experts in the fields of neurology and education agree, however that **a child's physical and mental development should be considered as integrated factors when building an environment suitable for learning** (Hinton, 2005). A powerful learning environment is characterized by a good balance, on one hand, between discovery and personal exploration, and on the other, systematic instruction and guidance. All this needs to take place in a setting that is sensitive to individual differences in abilities, needs and motivations among learners (Schneider & Stern, 2010). Nurturing is crucial to the learning process. Many of the environmental factors conducive to brain functioning are everyday matters – the quality of the social environment and interactions, nutrition, exercise and sleep – which may seem quite obvious, but they are easily overlooked in its impact on education. **By conditioning our minds and bodies correctly, it is possible to take advantage of the brain's potential for plasticity and to facilitate the learning process** (OECD, 2007).



Emotional experiences are built into the architecture of the developing brain. **Emotion and cognition (the brain's ability to process information and apply knowledge), work together to guide the learning process**. The emotions students feel during an experience become silent labels that steer future learning and decision-making (Hinton et al., 2012). What is interesting, is that we can learn to regulate emotional reactions – it's something children and adolescents aren't naturally good at, but with help, **learning to harness negative emotions for more positive thought processes does improve the quality of learning**. Effective emotional regulation strategies include reinterpretation (reframing a situation in a more positive way) and depersonalization (considering a situation objectively, rather than taking it personally) (Fischer & Hinton, 2010).

The human brain is essentially hardwired for social interaction, which allows us to connect to the experiences of others. Positive relationships facilitate learning, and so learning environments should be community-oriented (Fischer & Hinton, 2010). As children and adolescents interact with members of their family and others in their school and community, they internalize many of its beliefs and values. Their **experiences (and therefore, their brains) are carved from the meaning and understandings they gain from their surroundings**. Language, for example, has properties specific to one's culture, which influence young people greatly. It's important then, to be aware of this process and become attuned to one's cultural biases. Gaining this perspective is key to understanding the culture and surroundings of others. This kind of sensitivity is crucial in a world that is increasingly globalized (Fischer & Hinton, 2010).

Everyone learns differently. Genetics and life experience are the main reasons a classroom is made up of students with varying strengths and limitations. This is why a one size fits all approach to learning only results in success for some, with others falling behind and discouragement leading to the lack of motivation to learn.

Facilitating learning by using multiple means of representation, assessment and engagement helps

accommodate students' differing learning pathways (Rose & Meyer, 2002). Understanding these differences – and the science behind the reasons why – is important to recognize if educators are to prepare students for a 21st Century, knowledge-based world.



Cognitive Sciences and Learning:

Educators have long known that new knowledge is built in different ways based on previous learning, and neuroscientists recognize this as a fundamental principle of how the brain learns (OECD, 2007; Schwartz & Fischer, 2003; Tobin & Tippins, 1993). **The brain is also highly adaptive, a property called plasticity** (Singer, 1994; Squire & Kandel, 2008). As we experience different things throughout life, there is creation and strengthening of the brain's neuronal connections and the weakening or elimination of others. Our brains continuously adapt to its environment, with previous experience having a powerful impact on the brain's readiness to learn (Hinton, 2005). Gradually, these experiences sculpt the architecture of the brain.

Learning experiences are translated into electrical and chemical signals that gradually modify connections among neurons in certain areas of the brain. Over time, these changes contribute to the reorganization of brain areas involved in certain types of learning. When a student has a learning experience, neurons are activated and there is a cascading effect in many areas of the brain. Over time, connections that are most active relative to other inputs are strengthened, while relatively less active connections are weakened or eliminated. This is what's referred to as the 'use it or lose it' rule. The more a student learns in a particular area, the more intelligent the brain becomes in that area (Hinton et al., 2012).



Learning: What is Understood Today

Many experts agree the goal of learning and instruction ultimately lies in what is called adaptive expertise (Bransford et al., 2006; Hatano et al., 1986). Adaptive expertise is the ability to apply meaningfully learned knowledge and skills flexibly and creatively in different situations. This concept is the opposite of routine expertise, which is the ability to complete typical school tasks quickly and accurately, but without understanding (De Corte, 2010).

How can teachers build adaptive competence? Several things come into play. Students must gain:

- Knowledge about facts, symbols, concepts and rules of the subject field in question.
- The know-how to problem solve, including the ability to decompose a problem into sub-goals and find a solution through a systematic approach to the task.
- Knowledge about their own cognitive functioning. This means students should be aware of how their attitude and motivation towards learning will affect the outcome. Recognizing a fear of failing at math, for example, or the belief their potential can be developed through learning and effort, are thoughts that need to be recognized for learning to succeed.
- Self-regulatory skills. These include the ability to plan and monitor one's own problem solving, and maintaining attention and motivation to find a solution.
- Positive beliefs about themselves as a learner.

Adaptive competence is important, but it isn't reflected in the traditional form of schooling – where the teacher makes all the decisions relevant to learning strategies, determining goals, and feedback. On the other hand, the ability to self-regulate one's own learning and thinking is an important part of adaptive competence. So, there should be a balance: Structure and guidance needs to be provided by the teacher where and when needed, but there should also be opportunity for self-regulated and self-de-

termined student learning. It should also leave room for what Eisner (2001) calls "expressive outcomes", which are unanticipated results from learning in a variety of situations, such as a forest or a museum (De Corte, 2010).

The main message is this: School learning needs to be more ambitious. It should be active and constructive, cumulative and more self-directed. It should also be more collaborative, and permit individually different processes of meaning construction and knowledge building (De Corte, 2007, 1995).

Reconciling Research and Practice:

For educators, the main message of all this research is the brain is powerfully shaped by experience. This fact is good news because it means that a good educational experience can dramatically improve children and adolescents' brain development. However, it also underscores a great responsibility for society because a bad educational experience can threaten the physical integrity of children and adolescents' brains.

Mind, brain and education research does not support the simplistic notion that each student is either intelligent or not; rather, it points to a more nuanced perspective that recognizes that each student has a complex profile of strengths and limitations (Hinton et al., 2012).

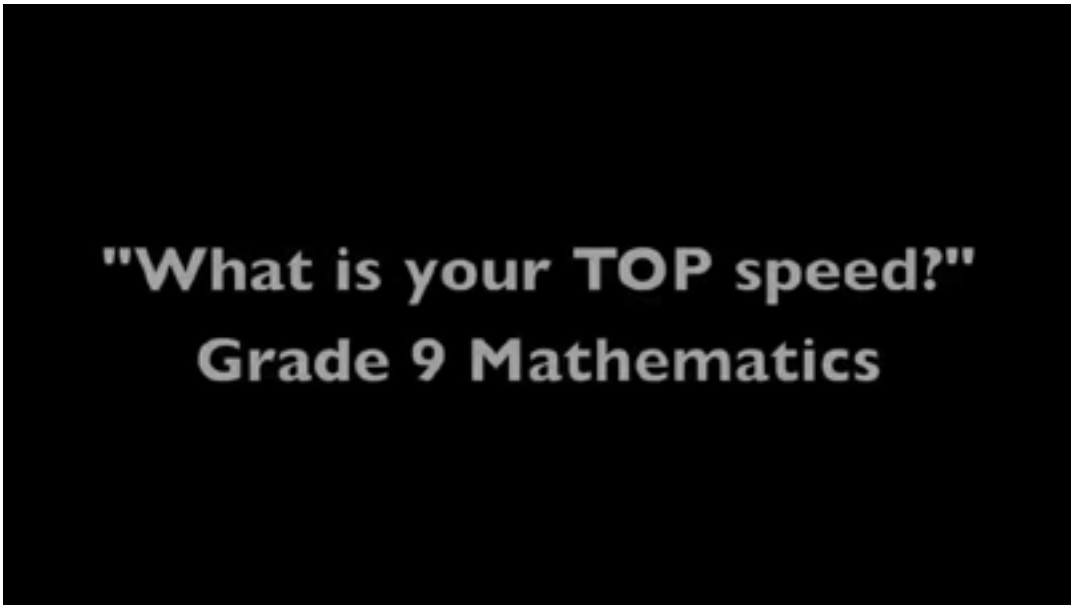
Research on learning in education has undergone tremendous changes over the past two decades. Educators have gained greater insight into teaching methods, guidelines for effective teaching environments and assessment tools. Areas where neurobiology research has clear implications for education include maternal education, daycare program content, and the appropriate timing of social transition periods from home to school, school to university and beyond (Hinton, 2005). Research on mathematics learning, in particular, has yielded better understanding into the knowledge and skills required for problem solving, namely the benefit of learning by understanding strategy, as opposed to drills (Hinton, 2005).

New insights into teaching and learning, however, are still not easily implemented into classroom practice (Depaepe, De Corte, & Verschaffel, 2007); and a great disconnect between research and practice remains the order of the day (Berliner, 2008).

There are several reasons the gap exists: It's a challenge for educators to accurately determine the educational implications of scientific results (Goswami, 2006; Pickering & Howard-Jones, 2007). Without a background understanding of biology and cognitive science, educational policy makers and practitioners are sometimes unable to distinguish solid, credible research from the myths and misunderstandings perpetuated by the media, politicians and commercial interests.

Educators, policy makers and neuroscience researcher bodies should collaborate to identify and define the educational implications of scientific findings. The creation of a system to support this type of collaboration should exist because as the field develops, research in mind, brain and education can play a key

role in designing effective education policies and practices (Hinton, 2005).



Video: **What is your TOP Speed** (https://vimeo.com/135751220)

What is Inquiry?



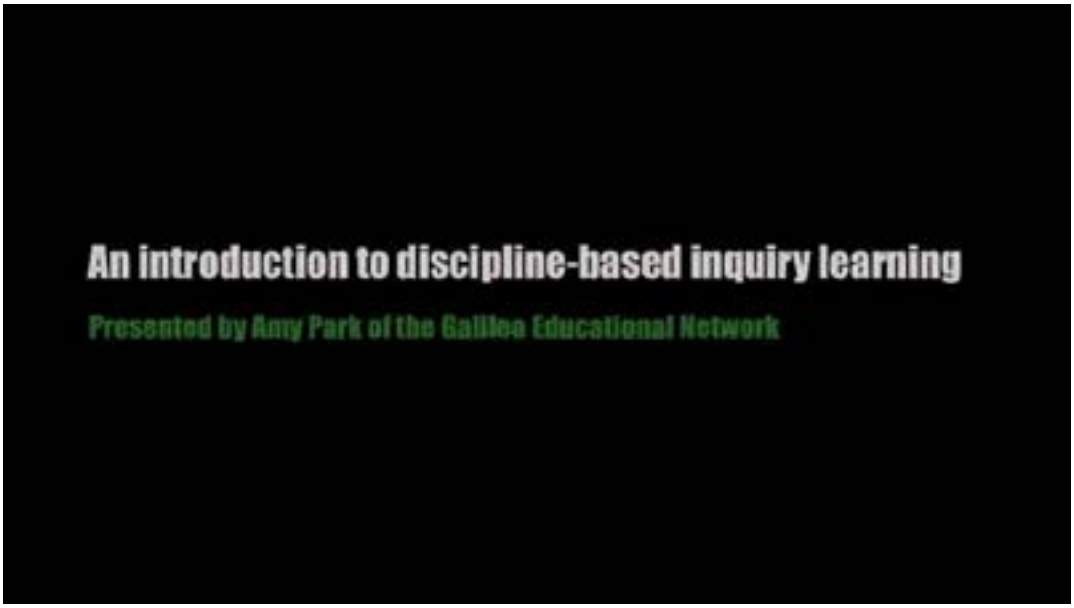
Inquiry is quite simply a systematic investigation into a problem, issue, topic or idea.

Theory and research in the field offer a myriad of conceptual models to inquiry that purport to advance the aims of the curricular shifts taking place.

These approaches, however, rely on differing understandings of what constitutes inquiry and genuine knowledge creation.

To better inform the choice of practices and orientations, we have identified three prominent conceptual models for inquiry:

1. Universal inquiry models
2. Minimally guided inquiry
3. Discipline-based inquiry



Video: **An Introduction to Discipline-based Inquiry Learning** (https://vimeo.com/136846606)

Universal Inquiry Models

The universal inquiry model focuses on process. Inquiry involves a set of steps or processes that can be applied uniformly regardless of discipline or contexts.

- **Examples:** Focus on Inquiry (Alberta Learning, 2004); The TELSTAR model of inquiry (Department of Education, Queensland, 1994); Challenged Based Learning model (Johnson & Adams, 2011)
- **Key assumption:** Students need a highly structured step-by-step framework in order to engage in the kind of self-directed and independent study 'genuine' inquiry requires.

Minimally Guided Inquiry

Minimally guided inquiry is a student and experience-centred model of inquiry. Students might be asked to build a rocket or construct a bridge, but rather than presenting students with essential information on how to do this, they must discover or construct essential information for themselves.

- **Examples:** Discovery Learning (Alfieri, Brooks, Aldrich, & Tenenbaum, 2011); Inquiry Based Teaching (Hattie, 2009, p. 208).
- **Key assumption:** Students most likely to learn concepts if they discover them on their own, rather than being told them. Teacher, acting as 'guide on the side,' should therefore avoid high levels of direct instruction.

Discipline-Based Inquiry

A discipline constitutes a distinctive way of thinking about the world. Distinctive ways of thinking characterize the professions and are modelled by skilled practitioners, those who are responsible for advancing knowledge within a discipline. Discipline-based inquiry ensures students gain mastery of the major schools of thought, including science, mathematics, history, etc. (Gardner, 2006).

As Newmann, Bryk and Nagaoka (2001) found students who engaged in more intellectually rigorous learning immersed within the disciplines, gained in-depth understanding of limited topics, rather than superficial acquaintance with many, and using elaborated forms of communication to learn and to express their conclusions.

Discipline-based inquiry provides students with the opportunity to "play the whole game" (Perkins, 2009) where they experience appropriate versions of the ways knowledge is created, verified, and communicated with a particular discipline.

- **Examples:** Authentic Intellectual Work (Newmann et al., 2001); Galileo Educational Network Rubric for Inquiry Studies (2008); Playing the whole game (Perkins, 2009); High Tech High (Rosenstock, 2011).
- **Key assumption:** Ways inquiry is taken up should emerge from a particular discipline. Students needed learn best when they are brought into the structures and ways of thinking of a particular discipline. Teachers have a large repertoire of pedagogical approaches so that instruction conforms to what is to be learned and the learning needs and strengths of the student. Teachers use a balanced combination of student-centred and direct oriented approaches aligned with disciplinary, curricular and assessment practices. They use diagnostic tools and formative and summative assessments to monitor student's progress and ensure students are acquiring deep understanding and knowledge.


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.
Academic Rigor
Students have opportunities to build deep understanding and create or produce high quality products and performances that mirror the disciplines.
Assessment
Ongoing assessment woven into the design of the study guides students' learning and teachers' instructional planning.
Elaborated Communication
Students have opportunities to choose forms of expression appropriate to the task, and communicate what they are learning with a variety of audiences.
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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, organization, problem solving, communication, decision making and project management.
Connecting with Experts
Students are given opportunity to observe and interact with adults with relevant expertise and experience in a variety of situations.
Active Exploration
Students are engaged in real (authentic) investigations using a variety of media, methods and sources.
Appropriate use of technology
Technology is used in a purposeful manner that demonstrates an appreciation of new ways of thinking and doing.

In a classroom focused on discipline-based inquiry, teachers are activators of learning. They ask probing questions meant to clarify the basic assumptions underpinning a truth claim or the logical consequences of a particular thought and teach students to do the same (Friesen & Scott, 2013).

The spirit of inquiry has a strong historical antecedent in Ancient Greece and the questioning method employed by Socrates when engaging in dialogue with his interlocutors. Starting with the notion that the only thing he knew was he knew nothing, Socrates would engage in a systematic and disciplined questioning process to discover basic truths about the inner workings of the natural world and ethical questions related to such enduring concerns as the nature of justice. By posing such seemingly simple questions as "What is justice?," Socrates showed that many commonly-held assumptions were flawed and even illogical. Socratic inquiry cannot be seen as teaching in any traditional sense involving transmitting knowledge from someone who is more knowledgeable to those who possess less knowledge. The teacher here is not the 'sage on the stage' with the student positioned as a passive receptor of information. However, neither is a teacher engaged in Socratic dialogue a 'guide on the side.' Ross (2003) wrote that "in the Socratic method, the classroom experience is a shared dialogue between teacher and students in which both are responsible for pushing the dialogue forward through questioning" (p. 1). In this understanding of inquiry, both the teacher and the student ask probing questions meant to clarify the basic assumptions underpinning a truth claim or the logical consequences of a particular thought.



Understanding the Socratic tradition helps us recover several elements that seem to be missing in how some people understand inquiry-based learning. The Socratic tradition does not involve giving students free rein over the topic they wish to explore with minimal guidance from the teacher. Rather, the Socratic method creates a space where teacher and student are in dialogue to pursue answers to questions that are worth thinking about deeply. Just as Inspiring Education focuses on ethical citizenship, Socrates did not seek knowledge for its own sake. For Socrates the unexamined life was not worth living. The good life involved seeking knowledge as a means to living more ethically and consciously in the world. Inquiry was

not done sporadically or as a mechanical step-by-step formal method; it was a way of living ethically in the world.

The Middle Ages and the Renaissance. While this spirit of inquiry within the Western tradition may have emerged in Ancient Greece, the term itself can be traced back to the middle of the 13th century through the Latin word inquīrere, which literally means “to seek for.” The spirit of seeking answers to the mysteries of the universe based not on established tradition or superstition but on observation, experimentation, and empirical verification, gained momentum during the early 1500’s in Northern Italy. Key Renaissance figures such as Galileo Galilei and Leonardo da Vinci were emblematic of a quest for knowledge that spread to the rest of Europe in the late 16th century spurred on through the creation of new technologies, eg. microscope, telescope, printing press, etc. This spirit of inquiry and scientific discovery took hold on a wider scale during the European Enlightenment beginning in the 18th century.

In the modern era, these historical threads of inquiry found a home in the work of John Dewey in the early part of the 20th century. As one of the key leaders of the progressive movement in education, Dewey, who had worked as a science teacher, encouraged K–12 teachers to use inquiry as the primary teaching strategy in their science classrooms. Modeled on the scientific method, the particular process of inquiry Dewey (1910) advocated involved “sensing perplexing situations, clarifying the problem, formulating a tentative hypothesis, testing the hypothesis, revising with rigorous tests, and acting on the solution” (Barrow, 2006, p. 266). Dewey was critical of transmission-based pedagogies that emphasized acquiring facts at the expense of fostering modes of thinking and attitudes of the mind related to the ways scientific knowledge is created.

As Dewey’s thinking on education evolved, he broadened the scope of topics and subjects in which to engage students with inquiry. Dewey (1938) encouraged students to formulate problems related to their own experiences and augment their emerging understandings with their personal knowledge. Dewey believed that the teacher should not simply stand in front of the class and transmit information to be passively absorbed by students. Instead, students must be actively involved in the learning process and given a degree of control over what they are learning.



Video: **Over Saturation** (https://vimeo.com/135751921)

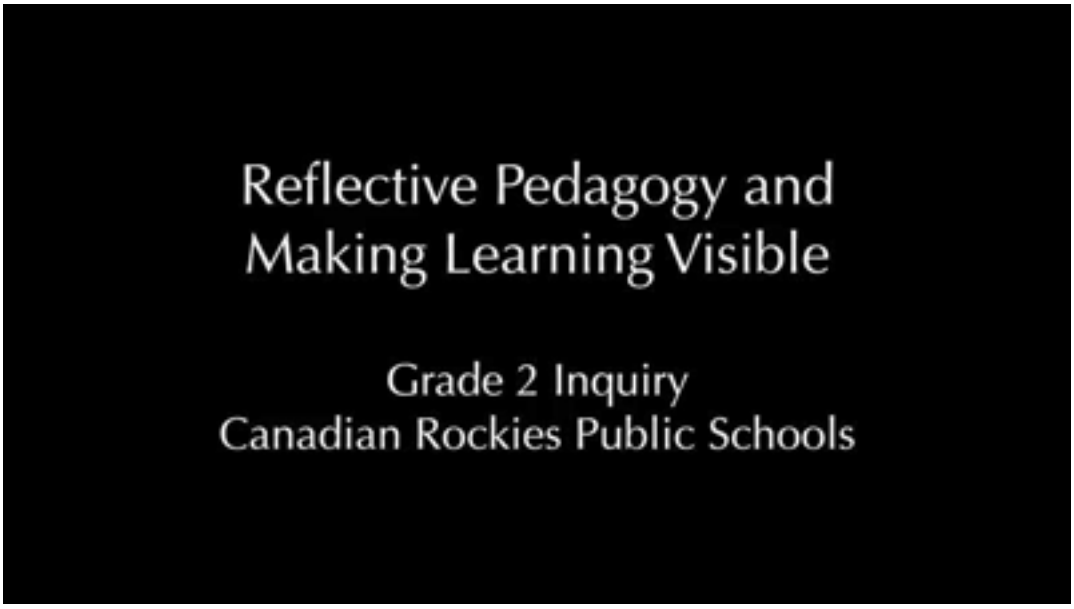
From a curricular perspective, Dewey, like Socrates, believed that active inquiry should be used not only to gain knowledge and particular dispositions, but also to learn how to live. Dewey (1944) felt that the purpose of education was to help students realize their full potential, to strengthen democracy, and to promote the common good. Inspiring Education contains similar language of ethical citizenship; learning not only prepares the young to make their way as individuals in the world, but it also helps them to become advocates for positive social change.

What is Discipline Based Inquiry?



A discipline constitutes a distinctive way of thinking about the world. Distinctive ways of thinking characterize the professions and are modelled by skilled practitioners, those who are responsible for advancing knowledge within a discipline. Discipline-based inquiry ensures students gain mastery of the major schools of thought, including science, mathematics, history, etc. (Gardner, 2006).

As Newmann, Bryk and Nagaoka (2001) found students who engaged in more intellectually rigorous learning immersed within the disciplines, gained in-depth understanding of limited topics, rather than superficial acquaintance with many, and using elaborated forms of communication to learn and to express their conclusions.



Video: **Reflective Pedagogy and Making Learning Visible** (https://vimeo.com/105149831)

Discipline based inquiry is the acknowledgment that students learn best when the subjects are meaningful to them. Student tasks must have "an authenticity, [and a sense] that the work being done in classrooms is 'real work' that reflects the living realities of the discipline being taught" (Friesen & Jardine, 2011). When students and teachers pose guiding questions, problems, or tasks that professionals in the field would recognize as important, they can work and learn from experts towards responses and performances of learning that are meaningful, sophisticated, and powerful. This view of the nature and purpose of learning is supported by a growing body of literature urging educators to design curricula, teaching, and learning experiences where students have the opportunity to "learn their way around a discipline" (Bransford, Brown, & Cocking, 2000, p. 139) by engaging in authentic intellectual tasks and opportunities for genuine knowledge creation (Darling-Hammond, Barron, Pearson, Schoenfeld, Stage, Zimmerman, Cervetti, & Tilson, 2008; Jardine, Clifford, & Friesen, 2008; Organization for Economic Cooperation and Development OECD, 2008; Perkins, 2009; Sawyer, 2006). Educators advocating for this approach argue that each discipline (e.g., science, mathematics, history) has its own particular ways of generating knowledge, verifying what counts as quality work, and communicating. The job of teachers thus becomes to apprentice young people into these practices. But knowledge of the discipline structure does not in itself guide the teacher. For example, expert teachers are sensitive to those aspects of the discipline that are especially hard or easy for new students to master. Teachers need both disciplinary knowledge and pedagogical knowledge and the ways in which these interact together in order to create the conditions for learning to occur.

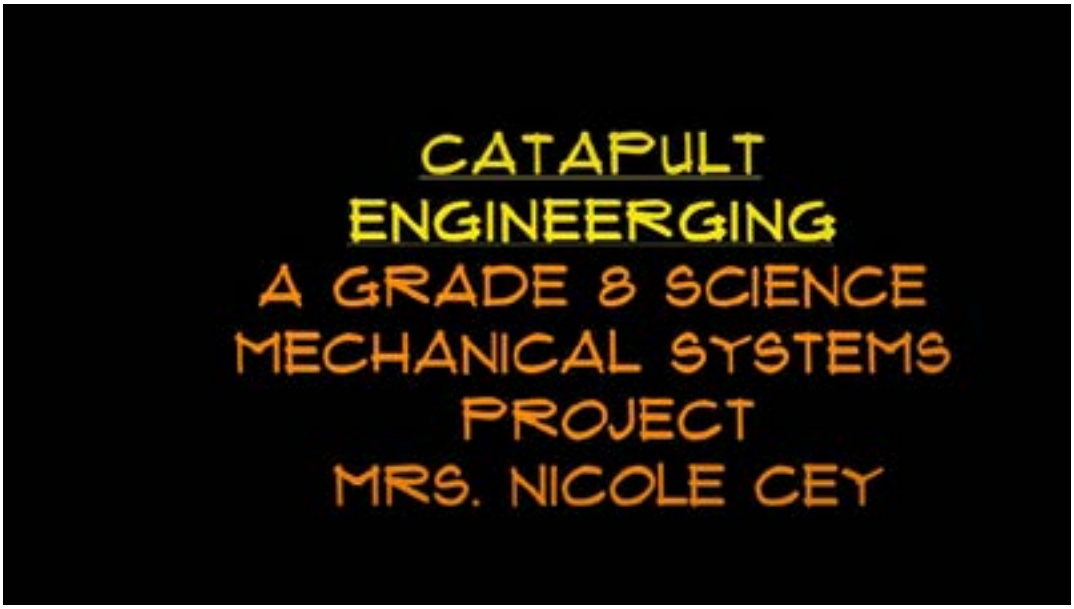


Video: **The Arrival** (https://vimeo.com/99852603)

Findings in the Learning Sciences, including neurology and cognitive science, support an inquiry-based vision for education in the 21st century (Bransford, Brown, & Cocking, 2000; Davis, Sumara, & Luce-Kapler, 2008; Friesen, & Jardine, 2011; Jardine, Clifford, & Friesen, 2008; Organization for Economic Co-operation and Development OECD, 2008; Sawyer, 2006). Deep understanding comes from being immersed in a subject for a long period of time. Superficial coverage of many topics does not help students IMG_3082develop competencies because there is not enough time to learn anything in depth. Schwartz and Fischer (2003), Gardner (2006) and Perkins (2009) identify the need for students to be apprenticed into the ability to think in ways associated with major scholarly disciplines. Curriculum that is 'a mile wide and an inch deep' does not allow learners to see connections among the things they are learning. There must be a "sufficient number of cases of in-depth study to allow students to grasp the defining concepts in specific domains within a discipline" (Bransford et al., 2000, p. 20). This is why this document focuses on **discipline-based inquiry** and not universal inquiry models or minimally guided inquiry.



One of the important missing pieces in many schools is a coherent and simplified way of increasing knowledge of a subject from the lower to upper grades. Students often have difficulty understanding how various activities within a particular subject relate to each other, and how various units of study are related. Students also gain an incomplete and fragmented understanding when the context of what they are learning is divorced from how math, science, and other disciplines live in the world (Perkins, 2009). They are learning about a topic or content, rather than learning how to take part in the process of creating that knowledge.



Video: **Catapult Engineering** (https://vimeo.com/132848474)

"Superficial coverage of all topics in a subject area must be replaced with in-depth coverage of fewer topics that allows key concepts in that discipline to be understood. The goal of coverage need not be abandoned entirely, of course. But there must be a sufficient number of cases of in-depth study to allow students to grasp the defining concepts in specific domains within a discipline. Moreover, in-depth study in a domain often requires that ideas be carried beyond a single school year before students can make the transition from informal to formal ideas. This will require active coordination of the curriculum across school years.

Teachers must come to teaching with the experience of in-depth study of the subject area themselves. Before a teacher can develop powerful pedagogical tools, he or she must be familiar with the progress of inquiry and the terms of discourse in the discipline, as well as understand the relationship between information and the concepts that help organize that information in the discipline. But equally important, the teacher must have a grasp of the growth and development of students' thinking about these concepts. The latter will be essential to developing teaching expertise, but not expertise in the discipline. It may therefore require courses, or course supplements, that are designed specifically for teachers." (Bransford, Brown, & Cocking, 2000, p. 20).

Discipline-based inquiry can be applied to all disciplines, with the aid of a conceptual framework. A study on photosynthesis, for example, has more relevance when set in the larger context of understanding the relationship between the sun, green plants and the role of carbon dioxide and water. Social studies content, such as the effect of industrial development on nature, can add new perspectives. Students can still learn the content of science and social studies, but through a series of well-planned experiences directly involving the learner, they will grasp the larger conceptual context and gain greater understanding while gaining fluency in the ways of working and knowing within that discipline, sometimes referred to as foundational knowledge of the discipline.

When students are actively involved, invested, and given the opportunity to make observations, collect, gather and analyze data, they're using future "need to know" skills they will encounter throughout their schooling and their lives. They learn the content while developing the lifelong habits they need to guide creative thinking and problem solving ("What is inquiry-based learning?", 2004).

Characteristics of Discipline Based Inquiry:

- The study is authentic, in that it emanates from a question, problem, issue or idea that exploration that connects students to the world beyond school in ways that are central to the ways of knowing, doing and being within the relevant disciplines.
- Students are given opportunities to create products or culminating work that contributes to the building of knowledge.
- Assignments and activities foster deep knowledge and understanding.
- Ongoing formative assessment loops are woven into the design of the inquiry study and involve detailed descriptive feedback.

- The study requires students to observe and interact with outside expertise, including professionals in the field.
- Students are given the opportunity to communicate their ideas and insights in powerful ways through myriad media.
- Students' final products are communicated through public presentations and exhibitions (Friesen & Scott, 2013).

Why Inquiry?

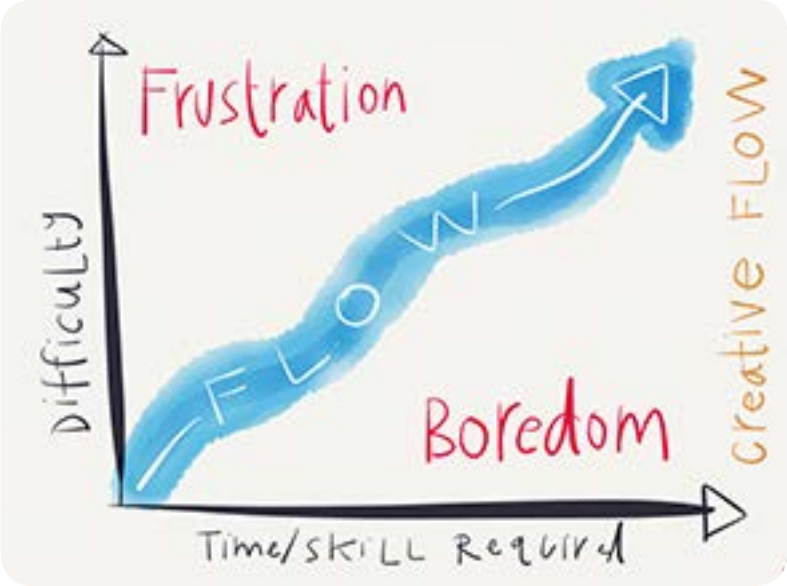


Making observations, asking questions and pursuing investigations – it's how humans have come to understand the world. Research from neurology found that learning experiences modify connections among neurons in certain areas of the brain, which gradually reorganize these areas (Squire & Kandel, 2008). The architecture of a student's brain is shaped by and through learning experiences. The research from the neurosciences also suggests that active engagement is necessary for learning. "Active engagement is a prerequisite for the changes in brain circuitry that are thought to underlie learning. In educational terms, this suggests that passively sitting in a classroom hearing a teacher lecture will not necessarily lead to learning. Conversely, active engagement with educational material within or outside of school will support learning" (Hinton, Fischer, & Glennon, 2012).

The primary purpose of schools is to sponsor learning. We know that people learn best when trying to do things that are challenging and of deep interest to them, reflecting the close interplay of the emotional in cognition and the development of capacity.



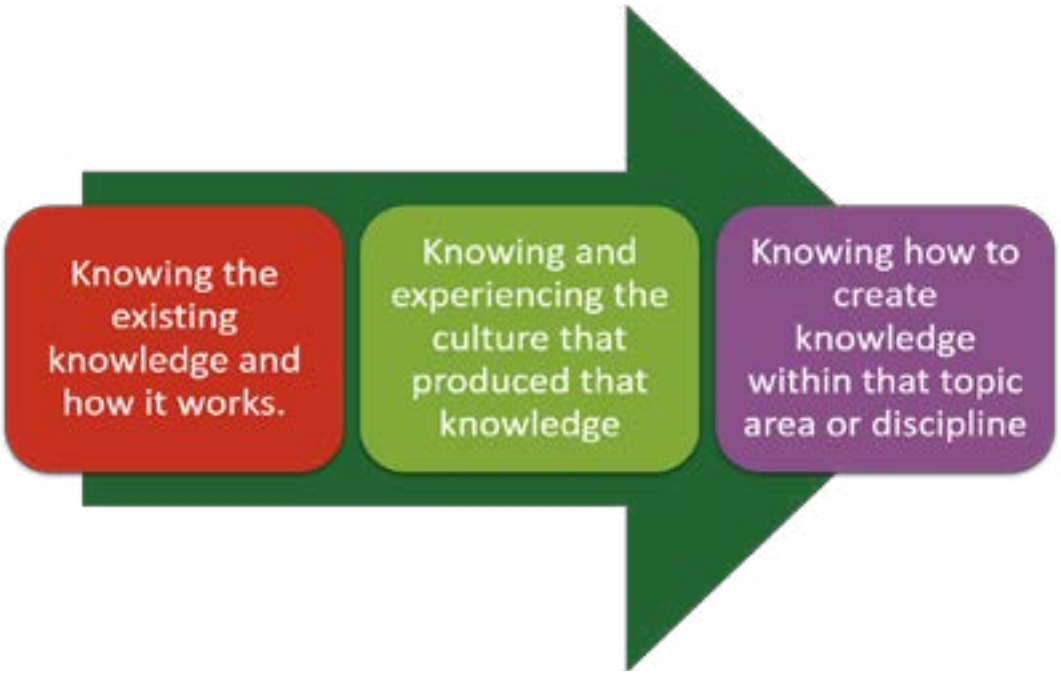
Csikszentmihalyi (1990, in OECD, 2007) calls the 'flow' state, a state of intrinsic motivation manifested by intense emotional and intellectual excitement. Friesen (2007) defines this state as intellectual engagement, the state in which the learner is so focused, so intensely engaged, that time itself seems to disappear. (Friesen, 2010)



Source: http://www.razblint.com/2013/04/flow-graph/

The implications of the findings from this study, when combined with findings from other studies on engagement (National Research Council, 2003), highlight students' need for "worthwhile tasks, some autonomy in how to do them, good feedback, good colleagues to work with, opportunities to learn and improve" (Levin, 2010, p. 77). Knowing how to learn, being inspired to continue learning, and learning together with others are essential in today's world. As a result, in an education system designed on older, different notions of teaching and learning, educators continue to search for ways to redesign schooling so that it sponsors deep, meaningful learning. Merely adding "more interesting courses" or contemporary media to existing structures can be alluring, but our findings suggest a different, more fruitful direction.

Since learning requires students' effort and interest, reforms need to take into account the ways in which the emotional and cognitive aspects of learning work in tandem to create the optimal conditions for deep, engaged learning. Such reforms also require supporting teachers in their designing of flexible, adaptive learning environments that can be manipulated according to the emerging needs of learners and the learning situation. (Willms & Friesen, 2012)



1. **First Level:** Knowing the existing knowledge and how it works.
2. **Second Level:** Knowing the culture that produced that knowledge, eg. the culture of science, mathematics or history. How do mathematicians think? What are the drivers? Ways that knowledge in a particular discipline is created, verified, generalized.
3. **Third Level:** Knowing how to create knowledge. How do you change knowledge? How do you cre-

ate new ideas or knowledge? How do you put forward evidence? How do you work creatively with concepts to create new ideas, new knowledge, new products?

> *The OECD report (2007) explains that at this point the brain begins to make connections and see patterns in the information, which results in a "powerful illumination which comes from understanding" (p. 72). This state of sudden epiphany is described as "the most intense pleasure the brain can experience in a learning context" (ibid., p. 73) and naturally, is an experience that fosters motivation as students experience the pleasure inherent in deep learning. (Friesen, 2010)*

The world is in the midst of incredible advances in our understanding 'of the mind and brain, on the processes of thinking and learning, on the neural processes that occur during thought and learning, and on the development of competence' (Bransford, Brown, & Cocking, 2000). Not that long ago, it was believed that the brain had all of its neurons at birth. The brain was unchanged by life's experiences. We now know that the brain is continually changing in response to experience.



While some may argue inquiry learning takes too much time and it's more efficient to simply give students the information they need to know, this does not lead to true understanding. Students need to engage in real work that reflects the work someone in the field might tackle. This leads to authentic learning and skills that serve students well into the future. They must cope with problems that may not have clear solutions. They will deal with changes and challenges to their understanding.

Schools need to go beyond the accumulation and transmission of information and move toward the generation of useful and applicable knowledge. They should be communities that strive to foster habits of thought and discourse in all students from all backgrounds. They should be places where students

accomplish rich, engaging work – work that inspires, develops insight and stirs the imagination. An Inquiry-based philosophy can accomplish this.

Playing the Whole Game



Sophisticated experiments, public presentations and investigating primary-source documents aren't projects reserved for university students and field experts. When given developmentally appropriate opportunities to actually do the work instead of learning about it, students are engaged. They are using all their senses. They are 'playing the whole game' (Perkins, 2009).

A baseball analogy can be used to explain why students need to immerse themselves in work that's relevant – work that is a junior version of how professionals in a field engage, create knowledge, and communicate in their discipline:

You don't learn to play baseball by a year of batting practice, but in learning math, for instance, students are all too often presented with prescribed problems with only one right solution and no clear indication how they connect with the real world. (Perkins, 2009)

A junior version of baseball may involve fewer innings, a smaller diamond, or teams consisting of whatever neighbourhood kids show up in the park on a given day. Yet this version of the game still conveys the essence of baseball – swinging at and hitting a ball and then making your way around the bases while the opposing team scrambles to put you out. Perkins argues that learning the 'whole game', whether it's playing baseball or learning to play a musical instrument, allows one to experience the big picture while fine-tuning aspects of it over time.

All too often, students find themselves laboring over something not because it is meaningful in the moment, but because it's supposed to be important some time in the future. This 'learning for later' style does not aid in student engagement or the retention of knowledge. When playing the whole game, the

goal is to build learning out of endeavors experienced as immediately meaningful and worthwhile (Perkins, 2009). This teacher of Grade 1 and 2 students designed a study to inquire into the declining brown bat population in their local community. After gathering information about brown bats which included learning about the disease that was affecting the bats during their hibernation, the impact bats have on humans and their role in the ecosystem. In addition to more conventional sources of information, they invited a Chiropterologist and community members into the classroom. The teacher and students decided to design and build bat houses for the brown bats positioning them around their local community. They also decided to create a public awareness campaign.



Video: **Save the Bats** (https://vimeo.com/136864122)

Stated another way, Perkins argues that most students have experienced learning in one of two ways: (Perkins, 2009)

1. "Elementis" Learning the elements of a subject without putting all these pieces together.
2. "Aboutis" Learn about a subject without taking part in the processes that created that knowledge (Perkins, 2009, pp. 3-4).

Typical history instruction involves learning about a particular version of history, with very little critical perspective. The same can be said for science education – students learn someone else's theories, without the opportunity to expand upon and develop their own.

There is some value in these approaches, but the problem lies in overdoing it. Endless learning about something, in the absence of building from and acting on it, only provides a kind of informational backdrop, rather than an empowering and enlightening body of understanding (Perkins, 2009).

The concept of playing the whole game offers a new perspective on what is considered academic rigour,

or the process of imparting more sophisticated information to students.

Playing the whole game is important, but teachers must also make it worth playing in the first place. Engagement and authenticity are keys to learning, so learning tasks and activities must be planned with these in mind. Students want to know about things that have relevance in their lives, so rich, engaging topics make learning worthwhile for students.

Changing the Emphasis to Promote Discipline Based Inquiry



How can schools better reflect what students are facing today and in their future?

By promoting authentic intellectual work that builds knowledge and deep understanding. Authentic intellectual work requires high-level cognitive performance (i.e. rigourous, in-depth understanding instead of superficial acquaintance with memorized bits of knowledge).

The criteria for authentic intellectual work as defined by Newmann (2001) and his research colleagues are:

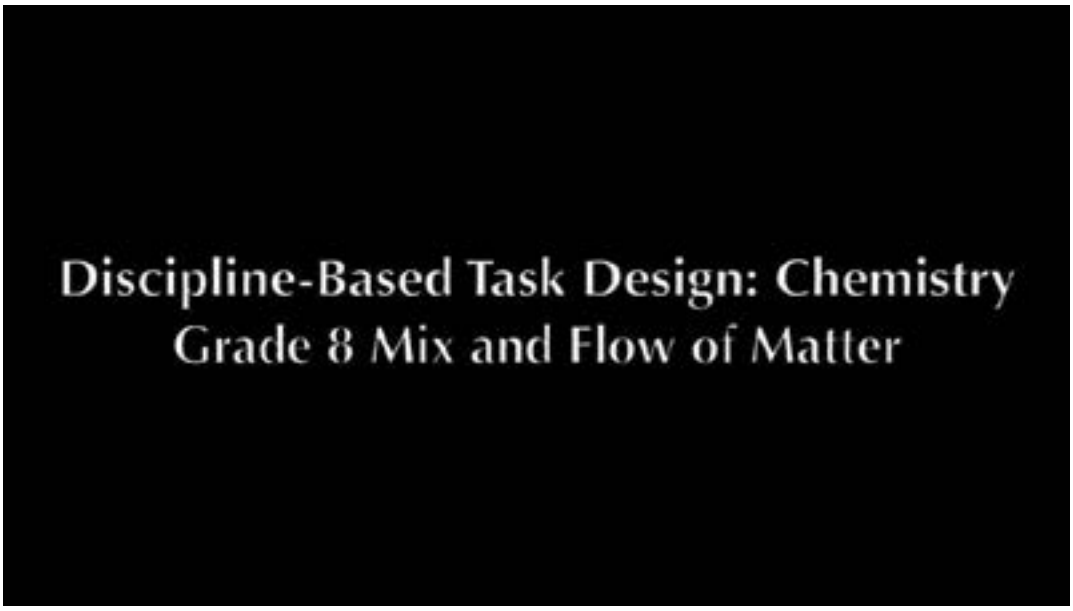
- **Construction of Knowledge:** using or manipulating knowledge as in analysis, interpretation, synthesis, and evaluation, rather than only reproducing knowledge in previously stated forms.
- **Disciplined Inquiry:** gaining in-depth understanding of limited topics, rather than superficial acquaintance with many, and using elaborated forms of communication to learn and to express one's conclusions.
- **Value Beyond School:** the production of discourse, products, and performances that have personal, aesthetic, or social significance beyond demonstration of success to a teacher.

We know workplace demands are no longer limited to isolated skill sets based on occupation. Critical thinking, problem solving, communication and teamwork are essential competencies, no matter the career path. In the classroom, discipline-based inquiry involves a spirit of investigation always linked to a particular topic or field of study. Consequently, inquiry moves away from a purely teacher or student-centered approach to a form of learning that takes its cue from what the field of study requires of

those coming to know it. As they pose guiding questions, problems or tasks that professionals in the field would recognize as important, students and teachers work and learn from experts to develop responses and performances of learning that are meaningful, sophisticated and powerful. (Friesen, 2012).



To support students in this process Darling-Hammond (2008) and Barron et al. (1998) argue that scaffolding activities, giving frequent opportunities for formative assessment, as well as powerful guiding questions ensure inquiry-based projects lead to deep understanding. In general, a scaffolding activity involves tools, strategies and guides to support students in gaining levels of achievement that would not be otherwise possible by actively taking students into the depths of how knowledge is created within the fields of knowledge or disciplines.



Video: **Discipline Based Task Design - Chemistry** (https://vimeo.com/135757445)

So How Do We Get To This Point?

There are several themes to keep in mind as one shifts towards a classroom engaged in discipline-based inquiry:

- **Knowledge building as a community:** Knowledge doesn't merely accumulate; it advances. In any knowledge-building organization, people are honoured for the contributions they make, not for what exists in the mind of each individual. The main value in this? Student-generated theories and models should be judged more by their value as tools enabling further growth, not by conformity to accepted knowledge.
- **Knowledge advancement as idea improvement:** Many people still think of knowledge as advancing towards a final state, which is truth. But progress in many fields, such as technology, science, mathematics, actually opens up new problems to be solved and with it, further opportunities for advancement. Except in a few areas such as disease control, progress is measured in comparison to what has gone before, rather than by distance to a predetermined end-point. In knowledge building, idea improvement is an explicit principle, something that guides the efforts of students and teachers, rather than something that remains implicit in inquiry and learning activities (Scardamalia, 2002).
- **Knowledge of, in contrast to knowledge about:** Knowledge about is the hallmark of traditional educational practice. It is the stuff of textbooks and subject-matter tests. It entails knowledge that can be explicitly stated or demonstrated. Knowledge of, on the other hand, is activated when a need for it is encountered in action. It's a much richer concept than the procedural knowledge of about.
- **Discourse as collaborative problem solving:** Classroom discussions must contribute to idea improvement with the aim of shared understanding; it can't degenerate into a face-off of opinions, and it can't be all form and process. There must be a shared commitment to progressing and expanding the base of accepted fact.
- **Constructive use of authoritative information:** we do not want students to meekly accept authoritative pronouncements. On the other hand, it is impossible to function in society without taking large amounts of information on authority. Judging the quality of information is not a separate problem from the knowledge-building task, it is part of the task. Judgment may involve argument, but it is argument in the service of the overall aim to expand upon and improve ideas (Scardamalia & Bereiter, 2006).

A Word About Inquiry Learning and Academic Rigour:

Rigor is commonly understood as imparting more sophisticated information to students. But in the context of inquiry-based learning, the following definition is offered:

Rigour involves "being in the company of a passionate adult who is rigorously pursuing inquiry in the area of their subject matter and is inviting students along as peers in that discourse." (2011).

-Larry Rosenstock, Chief Executive Officer, High Tech High



Video: **Area III Reflection 2014** (https://vimeo.com/136854232)

Knowledge Building within Discipline Based Inquiry



There's a big difference between merely knowing about something, and gaining a deep understanding of how math, science and other disciplines live in the world (Schwartz & Fischer, 2003). Students need to take part in the process of creating. Building knowledge involves a continual process of extending, sharing and improving upon what is already known (Scardamalia & Bereiter, 2006). Experts in a field of study are always pushing these boundaries, leading to new ideas and inventions that can change lives. This spirit of inquiry can also take place in schools where students are willing and capable to take on the challenges of the outside world. As students develop knowledge-building competencies, they come to see themselves and their work as part of the effort to advance the frontiers of what we know as a society, and indeed contribute in a meaningful way to the body of work within a discipline.

Indeed, there are substantial similarities between deep, authentic learning and the processes by which knowledge advances in the disciplines. Strongly crafted discipline-based inquiry work prepares students to build knowledge and understand the world (Bereiter 2002).



Knowledge is thin or superficial when it does not deal with significant concepts of a topic or discipline – for example, when students have a trivial understanding of important concepts or when they have only a surface acquaintance with their meaning. Superficiality can be due, in part, to instructional strategies that emphasize coverage of large quantities of fragmented information.

Knowledge is deep when it concerns the central ideas of a topic or discipline. For students, knowledge is deep when they make clear distinctions, develop arguments, solve problems, construct explanations, and otherwise work with relatively complex understandings. Depth is produced in part, by covering fewer topics in systemic and connected ways (Newmann & Wehlage, 1993).

Knowledge Building Principles and Indicators (Scardamalia, 2003)

Principle	Standard Best Practice	Knowledge Building Value Added
Community Knowledge, Collective Responsibility	Participants collaborate on the production of a finished product that demonstrates individual or small-group learning	Participants take responsibility for the overall advancement of knowledge in the community.
Constructive Uses of Authoritative Sources	Participants critically evaluate information sources and recognize that even the best are fallible	Participants use authoritative sources, along with other information sources as data for their own knowledge building and idea-improving processes.
Embedded, and Transformative Assessment	Externally defined assessment is taken seriously but does not dominate knowledge work	The community engages in its own internal assessment, which is both more fine-tuned and rigorous than external assessment, and serves to ensure that the community's work will exceed the expectations of external assessors.
Democratizing Knowledge	Everyone's work is recognized and praised; participants help each other find needed information.	All participants are legitimate contributors to the shared goals of the community; all have a sense of ownership of knowledge advances achieved by the group.
Epistemic Agency	Participants demonstrate a personal sense of direction, power, motivation, and responsibility.	Participants mobilize personal strengths to set forth their ideas and to negotiate a fit between personal ideas and ideas of others, using contrasts to spark and sustain knowledge advancement rather than depending on others to chart that course for them.
Idea Diversity	Different ideas or opinions are brainstormed, and then grouped into categories, and finally arguments are carried out to resolve differences.	Different ideas create a dynamic environment in which contrasts, competition, and complementarity of ideas is evident, creating a rich environment for ideas to evolve into new and more refined forms.

Principle	Standard Best Practice	Knowledge Building Value Added
Improvable Ideas	Ideas are accepted or rejected on the basis of logical argument and evidence.	All ideas are treated as improvable; participants aim to mirror the work of great thinkers in gathering and weighing evidence, and ensuring that explanations cohere with all available evidence.
Pervasive Knowledge Building	Special time is set aside for creative work with ideas, usually after the basic work is done; special technologies and supports encourage creative work	Creative work with ideas is integral to all knowledge work.
Real Ideas, Authentic Problems	Project-based learning replaces short-term tasks with more complex, ill-defined tasks.	Real knowledge problems arise from efforts to understand the world; creative work with ideas supports faster and more reliable learning, whereas learning alone seldom leads to knowledge innovation.
Rise Above	Teacher or leader takes responsibility for synthesizing diverse ideas, identifying common ground, and presenting new challenges.	The conditions to which people adapt change as a result of the successes of other people in the environment. Adapting means adapting to a progressive set of conditions that keep raising standards.
Knowledge Building Discourse	Discourse allows participants to express and gain feedback on their ideas, defend different points of view, arrive at conclusions.	Discourse serves to identify shared problems and gaps in understanding and to advance understanding beyond the level of the most knowledgeable individual.
Symmetric Knowledge Advancement	Groups carry out inquiries independently and then publicize their findings for the benefit and response of other groups	Interleaved communities provide successively more demanding contexts for knowledge work, and set into motion inner-outer community dynamics that serve to embed ideas in a broader social context.

Twenty-First Century Students: Engaged, Ethical and Entrepreneurial

Inspiring Education sets out a long-term vision for education in the province as well as a broad policy framework to 2030. It calls for education to be transformed around several key principles. These principles include the three E's of a contemporary education:

Engaged Thinker: who thinks critically and makes discoveries; who uses technology to learn, innovate, communicate, and discover; who works with multiple perspectives and disciplines to identify problems and find the best solutions; who communicates these ideas to others; and who, as a life-long learner, adapts to change with an attitude of optimism and hope for the future.

Ethical Citizen: who builds relationships based on humility, fairness and open-mindedness; who demonstrates respect, empathy and compassion; and who through teamwork, collaboration and communication contributes fully to the community and the world.



Video: **Water** (https://vimeo.com/136846765)

Entrepreneurial Spirit: who creates opportunities and achieves goals through hard work, perseverance and discipline; who strives for excellence and earns success; who explores ideas and challenges the status quo; who is competitive, adaptable and resilient; and who has the confidence to take risks and make bold decisions in the face of adversity.



As education in Alberta is organized around the three E's of a contemporary education, a shift will occur from disseminating information and recalling facts toward developing particular competencies. Teachers will cultivate the natural curiosities of students and plant the seeds of life-long learning. Students will be invited to collaborate in order to create new knowledge while also learning how to "think critically and creatively, and how to make discoveries—through inquiry, reflection, exploration, experimentation, and trial and error" (Alberta Education, 2010, p. 19). This focus on creating knowledge and knowledge-building will require that students engage in deep learning that sponsor deep understanding. Discipline-based inquiry is a form of inquiry that has been found to sponsor deep learning and deep understanding, as well as social, academic and intellectual engagement.

Inspiring Education (2010) and the Ministerial Order on Student Learning(2013) focus on the learner. Critical and distinct elements of student-centered approaches to learning challenge past schooling and education paradigms by starting learning designs with a deep understanding of the knowledge and experiences a student brings with them and an equally deep understanding of how people learn; harnessing the full range of learning experiences at all times of the day, week, and year; and determining progression based on what the student understands and can do based on what is needed to demonstrate competency (know how).



Video: **Nationalism and Canadian Identity** (https://vimeo.com/136847206)

CHAPTER 2

Discipline Based Inquiry: Making It Work

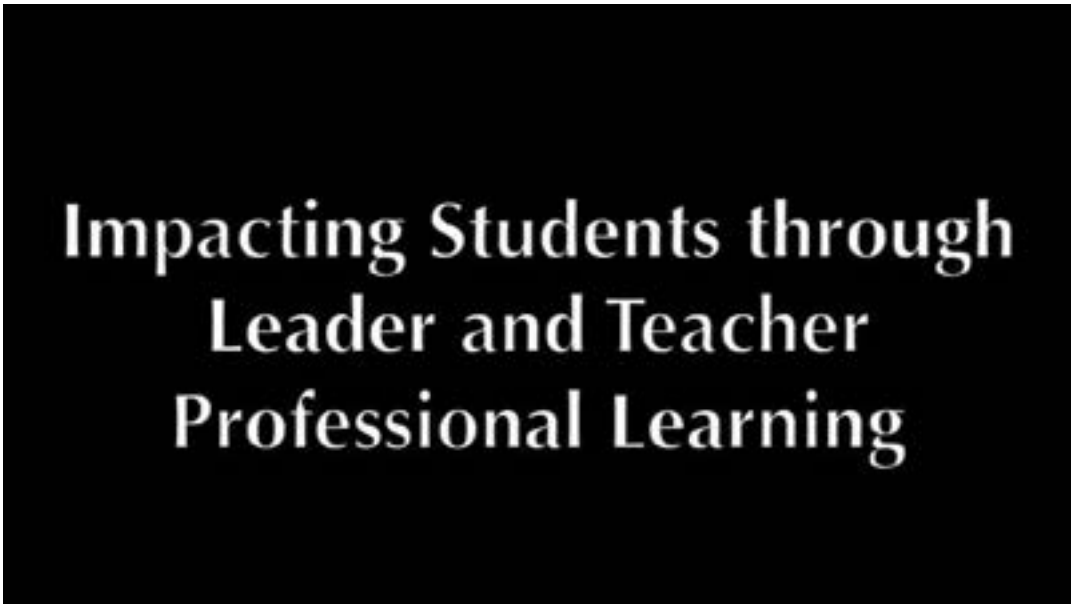


Dimensions of Discipline Based Inquiry



Authenticity

- The inquiry emanates from a question, problem or exploration that has meaning to students.
- The inquiry 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.
- 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.
- The inquiry requires a variety of roles or perspectives.



Video: **Changing Learning Outcomes** (https://vimeo.com/136004810)

Academic Rigour

- Students build knowledge that leads to deep understanding.
- Students are provided with multiple, flexible ways to approach the problem, issue or question using methods of inquiry central to the disciplines that underpin the problem, issue or question.
- Students develop habits of mind that encourage them to ask questions of evidence, and determine viewpoints, patterns and connections.

Assessment

- Assessment guides student learning and teachers' instructional planning.
- On-going assessment is woven into the design of the inquiry study, providing timely descriptive feedback. Assessment takes place both in groups and in self-evaluation.
- Assessment requires students to reflect on their learning using clear criteria they help set. Students use these reflections to set learning goals, establish next steps and develop effective learning strategies.
- Assessment requires the involvement of teachers, peers, adults from outside the classroom and students.

Beyond The School

- The inquiry requires students to address a semi-structured question, issue or problem, relevant to curriculum outcomes, but grounded in the life and work beyond the school.
- The inquiry assists students to become self-regulated. They develop organizational and self-management skills in order to complete the study.
- The inquiry leads students to acquire and use competencies expected in high performance work organizations (eg. team work, problem solving, communications, decision making and project management).



Video: **Cycles of Matter in Living Systems** (https://vimeo.com/136004214)

Use of Digital Technologies

- Students use technology in a purposeful manner that demonstrates new ways of thinking and doing. Technology is essential in accomplishing the task.
- Students are required to determine which technologies are most appropriate to the task. Students conduct research, share information, make decisions, solve problems, create meaning and communicate with various audiences inside and outside the classroom.
- Students and parents have on-going, online access to the study as it develops.
- Students make use of sophisticated applications and technologies for learning.



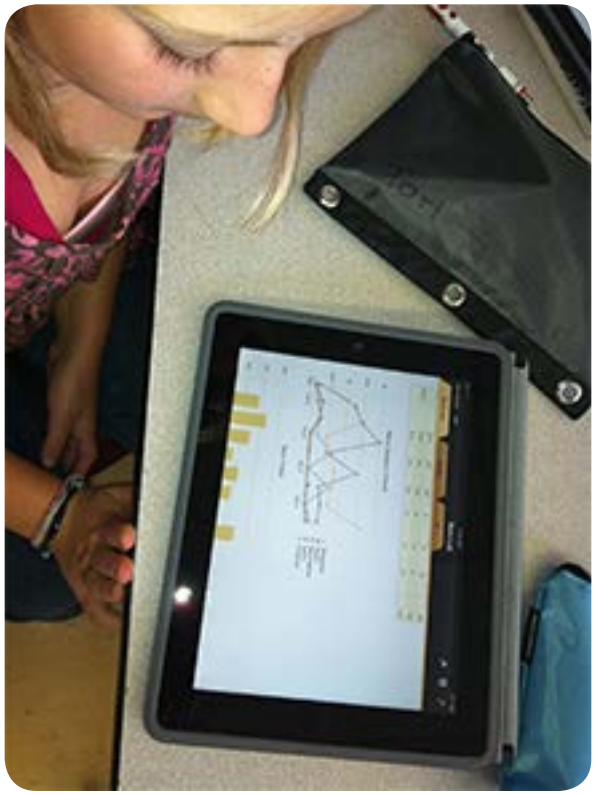
Active Exploration

- Students spend significant amounts of time doing field and design work, labs, interviews, studio work, and construction.
- Students must engage in real, authentic investigations using a variety of media, methods and sources.
- Students communicate what they are learning with a variety of audiences through presentation, exhibition, website, wiki, and blogs.



Connecting With Experts

- Students observe and interact with adults who have relevant expertise and experience in the field of study.
- Students, teachers and outside experts collaborate with one another on the design and assessment of the inquiry work.



Elaborated Communication

- Students have extended opportunities to support, challenge, and respond to each other's ideas as they come to understand relevant concepts. Students have opportunities to negotiate the flow of conversation within small and large group discussions.
- Students have opportunities to choose forms of expression to express their understanding.
- Students communicate what they are learning with a variety of audiences (Galileo Educational Network, n.d.).


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.
Academic Rigor
Students have opportunities to build deep understanding and create or produce high quality products and performances that mirror the disciplines.
Assessment
Ongoing assessment woven into the design of the study guides students' learning and teachers' instructional planning.
Elaborated Communication
Students have opportunities to choose forms of expression appropriate to the task, and communicate what they are learning with a variety of audiences.
Discipline Based Inquiry
galileo.org
educational network
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, organization, problem solving, communication, decision making and project management.
Connecting with Experts
Students are given opportunity to observe and interact with adults with relevant expertise and experience in a variety of situations.
Students are engaged in real (authentic) investigations using a variety of media, methods and sources.
Active Exploration
Appropriate use of technology
Technology is used in a purposeful manner that demonstrates an appreciation of new ways of thinking and doing.

A Design For Inquiry

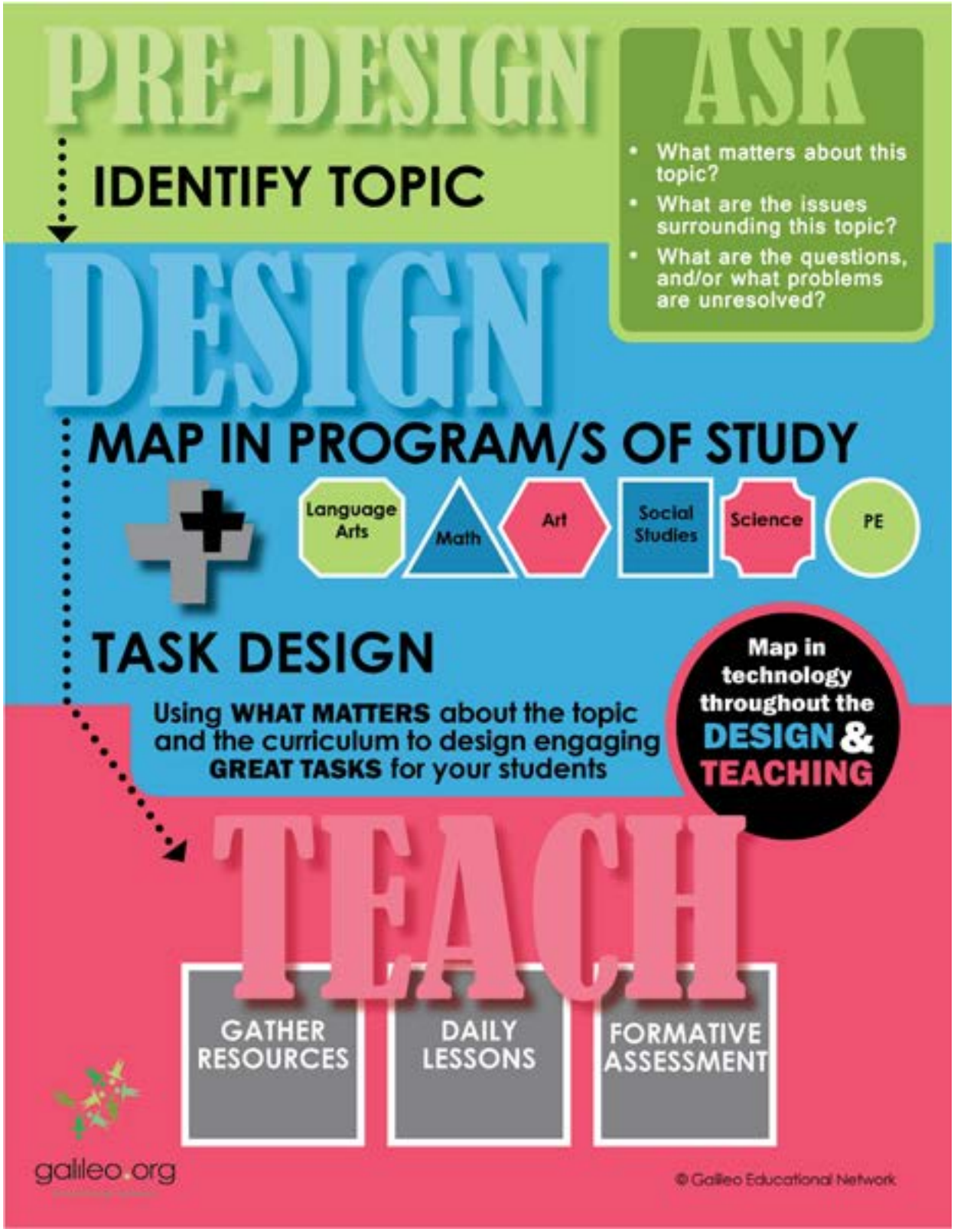


Think of inquiry as a topographical map. It's a living, interrelated place full of its own diversity, history and character (Jardine & Kraemer, n.d.). And then there are students, who bring their own understandings and experiences to the table. It begs the questions: How do you take a class full of differences to a place that can invite them all? How do you teach this?

A good topic for inquiry is open-ended enough to accept different approaches and points of view. It does not need to be broken into developmentally appropriate bits and pieces. In an inquiry, the questions asked and the work accomplished are seen as openings and enrichments towards understanding more about the topic itself. And it's understanding that is relevant in the real world.

Setting the stage: Driving questions and the learning environment

Well-designed inquiries are organized around powerful driving questions that make clear connections between activities and the underlying conceptual knowledge that one might hope to foster (Barron et al., 1998). Questions such as 'what is fair?', 'why don't things fall down, and why don't they fall apart,' are starting points in developing foundational understandings of a topic are interdisciplinary or even transdisciplinary. However, there are equally powerful questions that reside within each of the disciplines. A strong inquiry can be designed in one discipline or multiple disciplines.


PRE-DESIGN
IDENTIFY TOPIC
ASK
What matters about this topic?
What are the issues surrounding this topic?
What are the questions, and/or what problems are unresolved?
DESIGN
MAP IN PROGRAM/S OF STUDY
Language Arts
Math
Art
Social Studies
Science
PE
TASK DESIGN
Using WHAT MATTERS about the topic and the curriculum to design engaging GREAT TASKS for your students
Map in technology throughout the DESIGN & TEACHING
TEACH
GATHER RESOURCES
DAILY LESSONS
FORMATIVE ASSESSMENT
galileo.org
© Galileo Educational Network

But in order for this work to flourish, the classroom environment has to be one that supports inquiry:

- **Teaching and learning environments should replicate the conditions in which real-life researchers and other experts work.** The work at hand dictates what needs to be done, and the standards to which it must be completed. Projects are authentic, worth doing, and fit within the overall direction of learning. Teachers and students work together to lay out project time lines, identify resources, and determine how success will be measured. Age segregation is less important than the interest in, and the ability to contribute to the success.
- **Learning environments are mobile and flexible.** Students and teachers work together face-to-face and online, and with other students and experts from outside the classroom. Digital resources can be easily accessed, and teachers and students can bring their personal digital devices to school and access everything they need.
- **What is learned and how it is learned changes.** Students must have access to robust and academically rigorous content to create new knowledge. They do this by analyzing and synthesizing information, posing problems in ambiguous situations, interpreting content, defending solutions and points of view, and designing, constructing and evaluating their way through a project.



Knowledge building:

We know the importance of building, as opposed to only replicating existing knowledge. When thinking of a classroom project, tasks or activities, ensure they're connected to a problem that is authentic, and can elicit real ideas. The work must also be tied to knowledge building. If it doesn't, classroom tasks become mere exercises and are perceived as such. Remember, at the deepest level, knowledge building can only succeed if you, the teacher, believe students are capable of it.



Video: **Writing Engaging Stories** (https://vimeo.com/136009845)

Essential Questions:

- Arise from people's attempts, throughout human history, to learn more about the world(s) we live in. Essential questions probably intrigued the ancients as much as they puzzle people living today.
- Essential questions are so compelling that people have raised them in many different ways. Essential questions invite perspective to be brought to bear in order to develop deep understanding. For example, the question "What is light?" has scientific, mathematical, aesthetic, literary and spiritual dimensions.
- Attempts to answer essential questions allow people to explore the connection between their personal, individual, unique experience of the world and its exterior, objective, held-in-common dimensions. In exploring essential questions together, people are able to find expression for their own strongest gifts and interests at the same time that they are able to establish a sense of community with others.
- Essential questions allow us to explore what knowledge is, how it came to be, and how it has changed through human history.

- An essential question is always poised at the boundary of the known and the unknown. While permitting fruitful exploration of what others before us have learned and discovered, attempts to answer an essential question open up mysteries that successively reveal themselves the more we come to "know".
- An essential question reaches beyond itself. It is embedded in ideals of freedom, strength and possibility that permit people to come-to-know without becoming trapped in constructs that are oppressive or no longer useful. Essential questions arise from an implicit commitment to human efficacy: to a belief that individuals can make a difference, that knowledge can both be acquired and changed.
- An essential question engages the imagination in significant ways. People can know only a limited amount about the world through direct experience. We are most intrigued, puzzled and enchanted by experience that comes to us imaginatively. Without imagination, we could not ask the questions that drive science forward. We would have no art, no stories, no mathematics, no philosophy. Moreover, it is questions that spark the imagination that permit young and old to journey together into unknown realms. Imagination knows no bounds, no restrictions; nor do the questions we pose when we cultivate our powers of imagination. An essential question that arises from imaginative engagement is an important way to bring teacher, student and subject matter together in ways that enrich all three (Clifford & Friesen, n.d.).

Exemplar: Don't Close the Beach!

Ms. McIntyre's students are studying infectious diseases. To get them interested, she showed a video depicting a beautiful beach. It ended with a shot of a sign reading, "Area Closed: Contaminated." It sparked a discussion amongst the students. They shared their own experiences with suspicious water quality, and talked about how pollution bothered them. Ms. McIntyre led the class in brainstorming possible solutions. Some of the suggestions revolved around raising public awareness and reducing contaminants. A driving question emerged, and it focused on a specific area: How can we reduce the number of days the local beach is closed because of poor water quality?

A good driving question captures the heart of the project in clear, compelling language. It's an open-ended question, but also gives students a sense of purpose and challenge. As the inquiry progressed, students encountered more questions about diseases, bacteria, and sources of water contamination. In an inquiry, students follow a trail that begins with their own questions, leads to a search for resources and the discovery of answers, and often, results in even more questions. Ideas are tested and conclusions are drawn. With real inquiry, comes innovation – the teacher does not ask students to reproduce existing knowledge. They are actively creating it.

Once the students' interests were piqued, Ms. McIntyre explained the project's requirements. It included an individually written paper, an oral presentation of students' work accompanied by media technology, and a product of the students' choice, which would be created in teams. It could be a media kit, a public service announcement, web page, brochure, letters to the government and other officials, among other

products.

This element of inquiry-based learning is key. The project is more meaningful to students when they have a choice over what they do.

Once Ms. McIntyre's students decided on how they were going to address their driving question, they realized collaboration was central to the project. Students formed teams of three or four and began planning what tasks they would do and how they would work together. Now and then, members in each team would review how well they were doing, using rubrics they had developed earlier with their teacher's guidance. To boost collaboration skills, Ms. McIntyre used role-playing and team-building activities. She showed students how to use time and task organizers. They practiced oral presentation skills and learned to produce videos and podcasts. As they wrote in their journals, students reflected on their thinking and problem-solving, which they knew they needed to explain in their oral presentation.

The inquiry should present opportunities to build 21st century skills such as collaboration, communication, critical thinking and the use of technology. Formalizing a process for feedback and revision during a project makes learning meaningful because it emphasizes that creating high-quality products and performances is part of the endeavor. Students need to learn most people's first attempts don't result in perfection and that revision is a frequent feature of real-world work.

An exhibition night at the local community center was planned. The student teams presented their analyses of water contamination issues and proposals for addressing the problem. Those invited included parents, peers, and representatives from the community and local government. As a result of the students' work, several government agencies came through with funding for water monitoring at the local beaches.

**This project is based on a real-life inquiry carried out by students at High Tech High in San Diego, California. (Larmer & Mergendoller, 2010)

Developing and Working with a Great Idea



Now that we've determined which learning conditions are ripe for starting an inquiry, it's time to sit down and design your own topic of investigation. It needs to be something that cuts across subjects, and creates an opening for multiple perspectives. This is where the essential questions come in; they should help kick start your inquiry. Once you have found a topic, ask yourself the following questions; these will help you refine the inquiry as you move to planning tasks and activities:

In one or two words, what is the topic?

A good inquiry has clear boundaries from the start. In a study of complex issues, it's easy to get side-tracked with a huge range of possible resources, ideas or tasks. If you draw clear edges from the start, you are less likely to get lost later on.

Questions and misconceptions:

- **If a study is framed as a question, there must be a right answer.** Traditional teaching and assessment practices are focused on finding the right answer – but research has shown when teachers see answers as the primary or even sole source of learning, lessons end once students have given these answers. Students become conditioned to guess what the teacher wants, and even when they get an answer right, they are not sure why. (Langer, 2001)

- **If a study is framed as a question, any answer will do.** When deeper learning of essential concepts is the goal, students should learn more about the inquiry topic – not simply express opinions about it. Students should read with understanding, interpret findings, critique sources and argue points of view persuasively. As they work in a variety of subject disciplines, they should learn more about how each subject gives a particular window on the world with increasing depth and understanding.
- **If you define a topic for students, it's not student-centered teaching.** It's time to discard the debate on teacher centered vs. student centered teaching and look at it from a different perspective. A good topic puts the subject at the center and invites students, teachers and the world itself in.



Consider your students:

Will they find the problem or issue intriguing? Is there a wide enough scope that they will be able to find many ways into the question, and bring their own ideas and experiences to the table? Is the question basic enough that every student can become engaged? Is it challenging enough that even the brightest minds in the world still struggle to understand? It's also important to note your own reflections on the topic. What do you find interesting? Collect newspaper, magazine and other postings that relate to your topic. Search online for what experts in your chosen topic are doing currently.

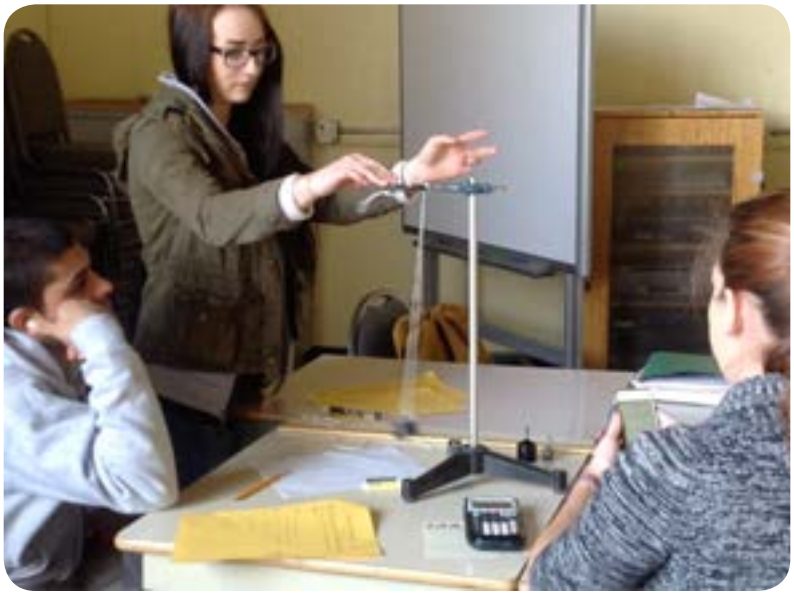
What subject disciplines will this topic cover?

Think about how much time you want to devote to the study. If you have a month, you will make different choices than if you want to take the whole term. Think about your priorities. Which subject(s) do you want to emphasize? What is your own level of knowledge in these areas? Which curriculum concepts do you need to address? Will you be teaching by yourself or will you be teaming with someone? Don't

worry whether your topic is a 'Grade 3 question' or a 'Grade 12 project'. Young children, for example, are intrigued by bears – as are outdoor enthusiasts and some of the world's best scientists and artists.

Topic Search Tips:

- Look for what experts in the topic are doing. What are the puzzles, unresolved issues, emerging ideas and neat findings that current research is uncovering? How are these new discoveries unseating what we thought was true about the topic? What did YOU find out in your research that took you by surprise? You don't need to be looking through the filter of finding teaching ideas – just keep building a sense of what the experts are saying and are excited about.
- There are many sites containing lesson plans and teacher-generated units of study. These tend to be a mixed bag in terms of quality. Don't assume that because a project is online that it is intriguing and worthwhile for your students.
- Check out what other teachers have done with your topic, and the links and resources they found.
- io (intelligence online) contains ideas and tools to help teachers plan and execute inquiry-based projects, which can be linked to the curriculum. It contains inquiry ideas, resources, and links to discussions with other teachers and other classrooms. Rubrics to help assess student work are provided, and teachers can easily create project websites that keep parents and students updated. A websites is especially valuable because parents can become engaged in the inquiry as well. By using a website as part of an introduction to the inquiry, students have a place to start, building on the initial resources you provide on the site.
- Be sure to direct your students to books, magazines, film as well as online resources. Fill the classroom with materials and ideas as you talk, debate, share and add to the collection. Find ways to make it easy for students to share great sites, materials and ideas with you and their classmates. When it comes to planning an inquiry, gathering information for your topic from a wide variety of sources is vital. Go to the library. Talk to someone in the field. Is your topic hot in the media right now?
- The effective use of technology should be evident throughout the inquiry; from preparation and planning, to presentation.



Why is This Topic Worth Studying?

By the time you have decided whether the topic you chose is engaging for students and has strong curriculum ties, you are well on your way to being able to articulate the reasons for your inquiry. You should have a strong sense of how this topic connects to the world outside your classroom walls. A good topic is intriguing to people today–and throughout the ages, too.

If you can tell students what is intriguing, puzzling or genuinely unresolved in the area you are opening up, chances are they will also become interested in the adventure you are charting for them. As you lay out the story behind the question, they will probably have questions and puzzles of their own to add to the mix.

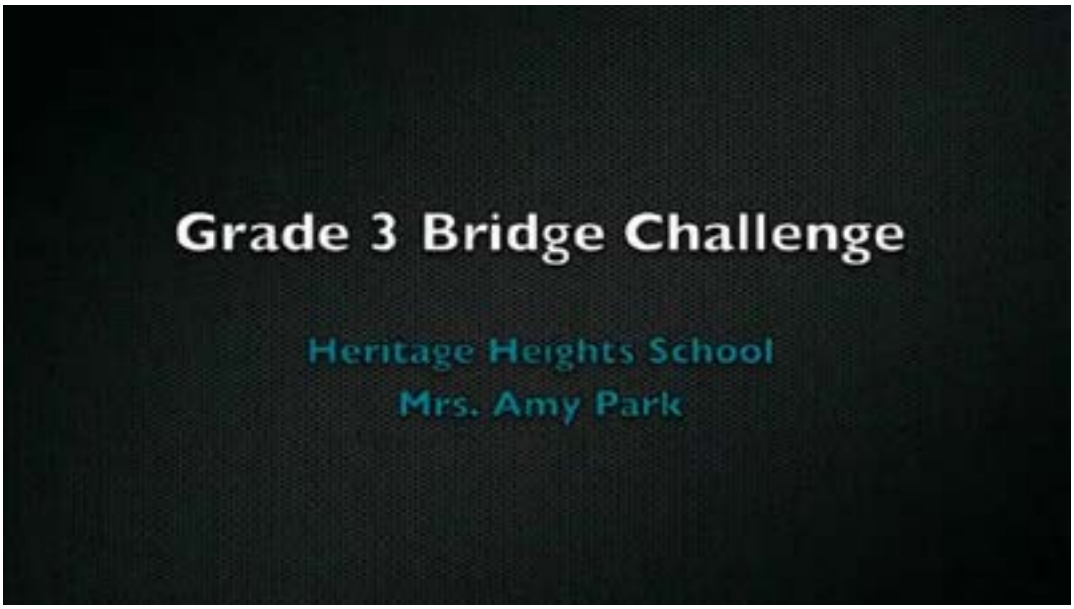
What do you want your students to really understand when they have finished this study?

Consider these three questions:

1. **What should they care about or fall in love with?** If you can identify some of the most compelling problems, puzzles or dilemmas, chances are good students will follow you into the inquiry. If you have no real idea why the topic is interesting or engaging, your students will feel the same.
2. **If they forgot all but one thing you taught them about this topic, what would you want that one thing to be?** A good study takes on questions of enduring value; questions that lie at the heart of a discipline, or that have endured throughout history as worthy of human thought and exploration. Those questions remain compelling today.

3. **If students don't understand *this* about the topic, they don't really understand anything.** Identify what ***this*** is: Sometimes, big ideas and essential questions are very broad. But that shouldn't blind us to the fact they're also very deep. A question that goes to the heart of a key concept will help students develop understandings that will make all subsequent learning meaningful.

Consider this example from a Grade 6 standardized exam in Social Studies. In a multiple choice question, students were asked to identify the main responsibilities of citizens of a democracy. The correct response was to obey the laws and pay taxes. Now, any dictator would be pleased with this answer–but if students think this is what democracy means, they clearly understand nothing worth knowing about this most important form of government. What should they know instead? That is really important to establish right from the outset.



Video: **Bridge Building** (https://vimeo.com/98454596)

What role can I see for technology?

Technology can do far more than letting you do old things in new ways. Consider instead the powerful tools you have at your disposal. How do spreadsheets encourage students to speculate about numbers in powerful ways? How do databases help students discern patterns and relationships that might otherwise remain hidden? How do simulations and micro worlds encourage complex, meaningful games of 'what if?' There already exists a big digital divide between the ways in which youth learn and play with technology outside school and the ways in which they are permitted to learn in schools. By using technology effectively in the classroom, you are bridging this gap.



Students must be brought into the inquiry right from the beginning. Let them know what's up. What weird, interesting, puzzling and intriguing things are you finding as you look for resources? Why should they be excited? Talk to them. Share some of your own background work in collecting resources and find out what excites or appeals to them the most. Start shaping your planning according to their reactions. Then you will be sure you're building an inquiry they will love. Why is this important? Because people learn best when trying to do things that are challenging and of deep interest to them – activities that reflect a close interplay of emotion and cognition in the development of capacity. This is also called intellectual engagement (Willms, Friesen & Milton, 2009). It's an absorbing, creatively energized focus resulting in deep personal commitment to exploration, investigation, problem-solving and inquiry over a sustained period of time (Jacobsen, Lock & Friesen, 2013).

Getting hooked on a topic: Student engagement

There's value in connecting your topic to students' experiences. Hook your students by asking the following questions:

What's weird about the topic?

Your goal is to build on your students' natural curiosity. Life Sciences lends itself wonderfully to weird topics. New technologies let us see creatures that are stranger than fiction, living in hostile environments. What lives at the extreme edges of the planet? What happens when one living thing leaves an ecosystem? What gross or intriguing defense mechanisms let living things adapt to their environment?

Are there life and death issues involved?

Talk to your students and uncover the human side of the story. Who has suffered defending the idea you are studying? What makes a hero, villain or underdog? Find people who have challenged huge odds or overcome insurmountable obstacles. How are elements of today's lifestyle harming us?

What challenges our sense of justice or fair play? Questioning what's right and wrong.

Present questions that force students to take a stand. Important thinking skills are developed as students go beyond the facts to research and defend their point of view. Questions of what's right and wrong help students decide how society determines the difference, while helping articulate their own vision and values. Look for the following within the topic you have chosen:

- Contradictory reports about the same event
- Historical injustices
- Current debates raging in the media
- Reports that challenge cultural assumptions.

Is there more here than meets the eye?

Issues may seem simple on the surface, but once you start digging, all sorts of possibilities emerge. Questions such as 'how can we help the poor?' and 'how do we stop bullying?', may seem simplistic, but they also prompt huge differences of opinion and opportunities to grapple with various solutions.

What is secret, hidden or puzzling?

Too often, school subjects are presented as cut and dried matters of facts and figures to be memorized. There are many things in the world, however, the experts are still uncovering, and new answers are emerging every day. These are areas where students can be easily engaged. Consider the following:

- What is space really like? Recent space probes have overturned many things we thought we knew about our solar system.
- Why can we predict some environmental phenomena but tornadoes and earthquakes still surprise us?

Great Inquiries:

- **Are built on authentic topics.** The topic is based on a real-world question, issue, problem or idea – and it's personally meaningful to students. A good gauge of authenticity is whether adults in the world outside school are also working on the topic. The topic should be one that allows students to contribute to a body of knowledge and make a difference in the real world.
- **Are academically challenging.** Great projects require complex thinking. Instead of breaking think-

ing down into small steps, students explore how ideas and phenomena are related. Students are encouraged to use the same tools, techniques and processes as those who do the work in the real world.

- **Use real world skills.** Great projects deliberately challenge students with questions, issues and ideas that are semi-structured or ambiguous – just the way they appear in real life. Students learn to discern what's important, decide on an effective way to follow up with their questions and have confidence in their problem-solving abilities. They use critical thinking and teamwork skills, and learn to make decisions, communicate and manage their work.
- **Use technology at every phase.** Great projects seamlessly integrate technology into every stage of the work. It can be involved in every aspect of the process – from research and design to active construction and to the communication of meaning. Students don't need to know how to use technology in advance. Instead, they learn to use specific technologies when they need them, in the context of their work.
- **Let students actively explore their world.** Students can be active designers and creators of experiences through which they learn vital skills and develop strong understandings. They collaborate with each other and with adults who have strong expertise in the areas the students are coming to master. They communicate their findings to audiences outside the classroom. The classroom resembles a studio or lab, where students are on the move, designing experiments, conducting field studies, interviewing elders, or debating contrasting points of view.
- **Provide rich assessment opportunities.** Assessment is about designing activities that build understanding. It's also about figuring out what students actually know, what they don't, and how to determine the next steps in learning. Assessment occurs both on a day to day basis, when students set goals, reflect on their own progress and make plans for improvement. There's also assessment as the project comes to an end, when the final product is ready for exhibition, promotion or display. Teachers, peers and even outside experts can provide detailed feedback on the strength and weaknesses of the work.

Creating the Invitation:

An essential part of good teaching is to cultivate an attitude of wonder – both for your own professional practice and for your students. When you focus your topic and identify key understandings, you can open up your own sense of excitement and commitment to the inquiry. The invitation to your topic can be:

- **A written statement that appears on your class website.** Introducing the topic online makes the entire study available for everyone to see – the importance of the topic in the world, its mysteries and its questions. Working at school or at home, students and their parents can read what you have prepared for them and discover in the links and other elements you've created places of personal interest and opportunities to explore.
- **Through direct instruction.** Offer the invitation by bringing in a speaker, reading a story, or ask questions you know will spark students' interest. Lay out the territory for them and listen to their responses. They will tell you what they find most interesting. Encourage them to bring resources from home and to ask questions based on their own experience. They will issue challenges, specu-

late and demand some more time to explore one thing over another. And so, while you have drawn clear and interesting boundaries that shape the whole inquiry, students will begin to find their own paths and voices right from the start. Take note that your level of interest, excitement and knowledge opens up the world for your students. What you offer and how you do it will shape your students' engagement throughout the whole inquiry.

Is it fair? A topic that engages:

Instead of getting her students to do a traditional report on bears, Katie Jordan ignited a classroom debate by presenting a news story about a hunter who was attacked and killed by a bear. The bear was subsequently hunted down and killed by local officials. Katie posed the question, "Is that fair?"

Students debated and explored the effects of urban sprawl on wildlife, and who has more rights, humans or bears? How can bears and humans co-exist? In the end, Katie's students took away more than just a few facts about bears; they took away opinions that will last a lifetime.

When thinking of an inquiry topic, ask yourself:

- **Is there more here than meets the eye?** Issues might seem very simple on the surface, but once you start digging in, all sorts of possibilities begin to emerge. A challenging project can hook you and your students deeper and deeper into the topic. Remember, even if a topic seems simple, it can also prompt differences of opinion – and an opportunity to grapple with even more solutions.
- **What is secret, hidden or puzzling?** Too often, school subjects are presented as cut and dried matters of facts and figures to be memorized. It's exciting, then to learn there are many things in the world experts are still uncovering. New answers are emerging every day, and students can be on the leading edge of knowledge, even as it is being created.

Designing Great Tasks



Once students are hooked by your invitation to a great topic, it's time to focus on what they can build and create. The tasks you design will be worth their full attention – and be open-ended enough that every student can find a way of making the work their own. This cannot be accomplished if tasks are reduced to mere assignments (write a report, complete this quiz).

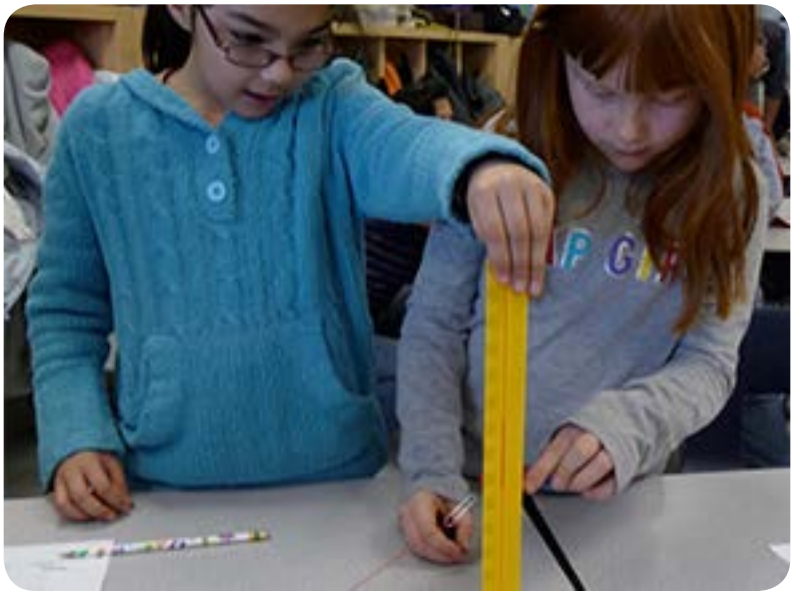
Great Tasks:

In a classroom focused on building knowledge, keep the following in mind:

- **The task should be recognizable to someone who has expertise in the field.** The point of access you create in the task doesn't 'dumb down' the subject or discipline. Great tasks create opportunities to encounter the real dilemmas, struggles and problems that characterize the subject.
- **In a great task, students are designers and builders who confront and try to resolve big issues or essential questions.** They don't just think about concepts; they dig in and make something that requires them to encounter and understand fundamental issues of the subject.
- **A strong task is one that allows students to have a genuine voice in what the next steps will be.** In a weak task, the next steps are predetermined either by teachers (workbooks), or by a computer program (computer assisted instruction). In a great task the discoveries each student makes individually and as part of a team actually determine what they have to do next.
- **Great tasks develop strong habits of mind** that promote questions of evidence (asking how we know what we know), searching for connections and patterns, supposition, and finally, determining why the topic of study matters.
- **Through technology, great tasks permit learners to explore** complex and changing relationships

between variables, bring multiple perspectives to bear, and publish their work to contribute to the knowledge of the world.

- **A good task is hard fun:** Enjoyable to tackle, and meaningful. It's easy to assume a task should be easy enough for students to complete without struggle along the way. In a good task, encountering difficulties is part of the learning – they mark genuine encounters with the heart of the subject. The point is not to avoid those places, but to guide students as they proceed. Their struggles will give a strong idea of where teaching needs to come, just in time for it to be meaningful and useful.



Think of your task as an umbrella…

This lets you think of the smaller activities, or sub-tasks that cluster underneath. In an inquiry, each activity must build the necessary understanding to accomplish the task. For example, a task for senior high English students might be to create their own documentaries. Rather than simply letting them loose with a video camera, you can create sub-tasks that will, for example, build their understanding of what documentary filmmakers are up to these days. Other ideas include developing interview skills, and learning storyboarding, editing and camera techniques.

Don't collect a bunch of activities in hopes they will add up to something meaningful – remember, in learning environments in which inquiry flourishes, sub-tasks and activities are always intentional and strategic in relation to the task and overall topic they support. Be strategic about your activities:

- Identify what students need to do so they can fully explore fundamental concepts.
- Use technology at any stage of the inquiry, in a wide range of activities. This allows you and your students to think about the task in new ways.
- Develop ways of debriefing activities individually, and with the whole class. This helps identify any frustrations and difficulties, and turns them into learning events.

You can build the background knowledge to activities in the following ways:

- When you talked to your students about the topic, what questions did they have? What did they want to know more about? What misconceptions did they have about the topic? The answers can guide your decision about where to start.
- On the basis of your own experience with students and this topic, where are they most likely to encounter difficulties? What activities would help solve these problems really quickly?
- What resources do you have at your disposal? Are there local speakers, field trips (including virtual field trips), Internet sites, stories, or videos?

Is it a good task?

If students are writing a book review, would this be a good task?

Yes: You'd be right – but only if the book review went somewhere other than to your briefcase for marking. People write reviews to tell others what's good, and what deserves rotten tomatoes. If nobody reads a book review except the teacher, then it isn't a real review; it's mainly a writing assignment.

Maybe: You're right – it all depends on the reason you're asking student to write reviews. If nobody reads a book review except the teacher, then it isn't a real book review, it's merely a writing assignment.

No: Book reviews are a classic assignment – and it's tempting to dismiss them as an old, worn-out idea. Rethink this in a way that promotes the principles of inquiry.

If students are solving a probability problem in mathematics, would this be a good task?

Yes: The rights tasks can immerse students in both theoretical and very practical applications of probability. For example, children as young as six, working with engineers from the oil and gas industry, can plan the development of offshore facilities using the same mathematical thinking. This is a great task because students can enter the fields of probability and statistics, simulation, mathematical processes, numerical computation and visualization at a very basic level – or explore them in great depth.

Maybe: You can assign lots of homework questions about probability without actually moving into the space where students have to design, solve and defend their thinking. And you can miss the opportunity for real learning if you think that you have to "cover" probability before you can let students play around with the idea. Remember, the task itself opens up the whole area of probability. It's not an extension activity you might get around to if you have enough time. It actually forms the basis of your teaching.

No: Are you concerned that probability sounds too much like math homework and not enough like an

inquiry? A common misconception about inquiry based teaching and learning is that you have to give students big, abstract questions about the meaning of life, or you are not doing an inquiry. Students can enter the fields of probability and statistics, simulation, mathematical processes, numerical computation and visualization at a very basic level – or explore them in great depth.

If students are making a film, is that a good task?

Yes: Films are a classic example of a performance-based task. If the film bombs, the audience lets you know! And if you have done a great job, the audience is enchanted. When the task is effectively tied to an inquiry, even the youngest filmmakers can work to have their films shown at local IMAX theatres. One group even had their film accepted to the 2005 New York International Film and Video Festival.

Maybe: There's no magic bullet when it comes to making sure a task with real potential doesn't turn back into a lack luster assignment. If you decide in advance that everyone will make a film; that students will do the work entirely outside class time; or that the only people who get to see the finished product are other people in the class, your students will soon get the message: this isn't a task the teacher takes really seriously. When the task is effectively tied to an inquiry, even the youngest filmmakers can work to have their films shown at local IMAX theatres. One group even had their film accepted to the 2005 New York International Film and Video Festival.

No: It's certainly possible to treat the task of film making in a weak way. If you just turn students loose with a camera and check back with them three weeks later to see what they came up with, that's almost certainly a recipe for disaster. Film making demands a wide range of skills and technical expertise. If you build in opportunities for students to acquire the knowledge they need in order to be truly creative with the medium—then the task is really great. The magic isn't in the film making itself. It's in how you use the task as a vehicle for real learning.

Working with Programs of Study

Programs of Study issued by the province, often referred to as the curriculum, state what is to be learned in terms of student outcomes; however, the depth of knowledge and what students gain is up to the teacher.

Teachers can experience a huge amount of pressure to cover all the outcomes in a Program of Studies. Sometimes, the content is out-of-date. Sometimes the outcomes are not written in increasing levels of complexity, i.e., more difficult to master disciplinary concepts are interlaced with more simplistic concepts or even facts. Teachers may need to spend time reorganizing a Program of Studies to ensure it maps well onto the inquiry study and that concepts that are central to the discipline are addressed in depth. There is great potential for teachers to be innovators and agents of change. Teachers can become leaders who collaborate to change system constraints that are less than ideal (Darling-Hammond & Bransford, 2005).

On the other hand, when educators see their job as simply covering a Program of Studies, student understanding is not front and center. Superficial coverage of many topics does not help students develop key competencies such as critical thinking, cooperation, and the ability to solve problems, create opportunities and manage information. When curriculum is 'a mile wide and an inch deep', it does not allow learners to see connections among the things they are learning. Deep understanding comes from being immersed in a subject for a long period of time. And during this time, as our understanding of a topic increases, the topic gets better and better, richer and richer, more and more constituted by hidden histories and ancestries and voices that had been forgotten or ignored (Jardine, n.d.).

Is there time for inquiry?

Inquiry is not something piled on top of student's regular work. When designing an inquiry ensure students have a range of opportunities to acquire and demonstrate understanding. . When teachers hold a strong command of the various Programs of Study they find they can design learning and address key concepts and required outcomes without having to create specific lessons and activities for each one. Don't forget, the freedom that teachers have to adapt their instruction and assessment to the unique needs of their current students is an essential cornerstone for success (Beairsto, 2012).

Sometimes teachers worry that designing an inquiry means they need to ignore the Programs of Study. Nothing could be further from the truth. In order to work with a Program of Studies in powerful ways, they have to know it inside out.

A well-designed inquiry study should map directly to the outcomes teachers are required to address. This provides teachers with the confidence to address what is required by the Program of Studies and also what is required by the discipline or disciplines that guide the inquiry.

How to do it:

There are four places in the design process where you work directly with the Program of Studies:

- Take time to write down the general, or high-level learner expectations or outcomes your topic will address. This will act as a roadmap. They are the fundamental concepts on which everything else will hang.
- Make sure you are selective about what this inquiry will focus on. It's easy to get overwhelmed with large numbers of small outcomes. You don't have to cover every possible curriculum outcome with every project you design. Chances are good that if you pay closest attention to the major outcomes, you will address smaller curriculum details even more effectively as you go along.
- Structure tasks and activities that develop the fundamental understandings. This is the place where you will also pay close attention to the more specific outcomes. Do your tasks and activities build those specific competencies as well?
- Find ways of assessing whether students have learned what you identified as fundamental.

The Essential Role of Technology



Building technology into activities that help build students' understanding all the way through the inquiry is much more effective than using it only in the final presentation of student work.

Technology can immerse students in complex environments in which they must build, not just reproduce knowledge.

Learning how to use technology effectively means teachers need to think carefully about the topic of the inquiry and the disciplines it requires, the questions or the issues that students should investigate in depth, and the ways technology will allow students to think about new ideas in new ways.

Teachers and students can work with ideas, explore what they know, challenge their own thinking, and design and create things that work – all while making efforts to improve their thinking. Technology makes it easier for them to do work this way both as individuals and in collaboration, near and far.

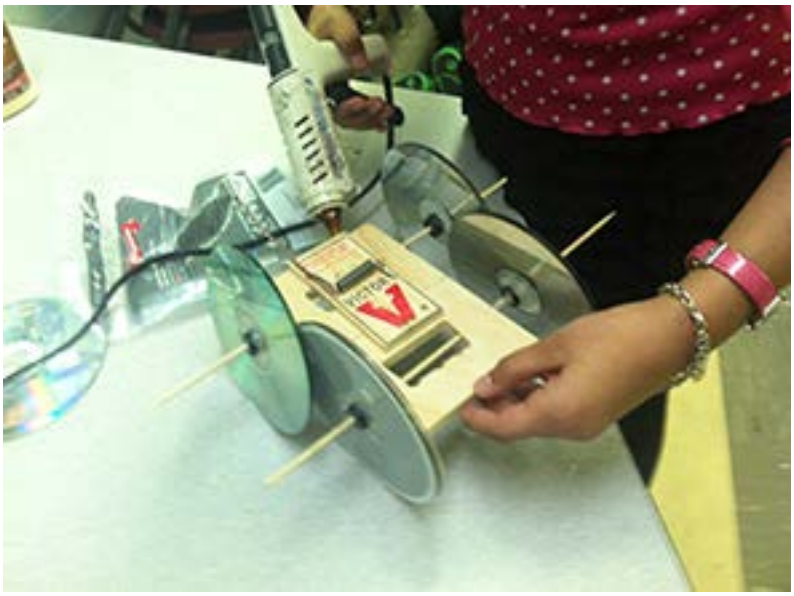
> *What would schools look like if we stopped thinking of computers as tools that let us do old things in new ways? What if we started thinking of them as imagination machines "which start with the ideas we put into them and take them farther than we ever could have taken them on our own?"*
> *–W. Daniel Hillis.*

Ultimately, the power of technology should be harnessed to support innovation and build knowledge. Teachers need to engage students to use these new technologies as designers, creators and builders of knowledge (Alberta Education, 2010). Using technology appropriately helps learners think differently

and gain deeper understanding – but only when the topic of study focuses on knowledge-building and elaborative communication versus individual memorization and recall (Jacobsen, 2010).

Effective use of Technology:

As technology is integrated into the classroom, "it is about engaging students with questions they can explore, rather than only answers we want them to absorb." (Beairsto, 2011)



The effective use of technology permits students to broaden and deepen their approach to any topic by:

- Finding and organizing what is already known about the topic;
- Accessing, using, critiquing and communicating information from a variety of sources and in a variety of ways;
- Seeking, negotiating and creating alternative viewpoints;
- Critically assessing information as they build their understanding;
- Posing and testing solutions, making inferences and modeling thinking; and
- Creating, presenting and defending their own understandings in original ways.

The effective use of technology permits students to raise and solve problems fundamental to worthwhile investigations by:

- Being in touch with world-class expertise and up-to-the-minute developments in their area of study;
- Unsettling prejudices, taken-for-granted notions or simplistic answers through exploring a wide range of perspectives on a single issue;
- Using a variety of powerful thinking tools such as spreadsheets, databases, programming, mi-

croworlds, multimedia authoring, graphics design, modeling software, conceptual mapping, simulations and music composition software.

The effective use of technology permits students to conduct and manage complex inquiries and communicate their growing understandings in meaningful ways by:

- Facilitating the organization and synthesis of information from more than one source;
- Facilitating on-going revisions and rethinking;
- Creating knowledge building communities for rich collaboration;
- Providing project management tools such as calendars, spreadsheets, databases, digital whiteboards and concept mapping tools; and
- Permitting file sharing and a wide variety of synchronous and asynchronous working environments.

Technology and Inquiry:

Technology can play legitimate roles at any stage of an inquiry, not just in the final presentation. It can be a vital component of:

- Searching for valid information;
- Posing worthwhile questions;
- Collaborating with others;
- Organizing ideas and people;
- Testing and modeling emerging understandings;
- Communicating understanding through images, sound and movement as well as text; and creating wide and authentic audiences for student work.

> *"Computers are not rescuing the school from a weak curriculum, any more than putting pianos in every classroom would rescue a flawed music program. Wonderful learning can occur without computers or even paper. But once the teacher and children are enfranchised as explorers, computers, like pianos, can serve as powerful amplifiers, extending the reach and depth of the learners.– Alan Kay, American computer scientist*



Learning for today isn't only about using technology – students must be engaged with questions they can actually explore, rather than only answers we want them to absorb.

Do you see what I see? Cameras as an entry to inquiry:

A dung cam is an interesting thing. Scientists have learned much about elephant behaviour by strategically placing small cameras as the pachyderms go about their daily lives. Learning about this technology is not only an effective hook, it serves as an inquiry into topics of:

- Animals and intelligence
- Struggles to balance the needs of humans and wildlife.
- Humans' fascination with elephants – our reverence and abuse
- Local impacts of globalization
- Global interdependence and responsibilities.

The ability to actually see inside a patient is one of medicine and technology's greatest achievements. But new imaging techniques – and medical advancements in general – present new questions and demand new literacies. It serves as an excellent inquiry into how the body functions, and how new technologies may be changing that.

Centrality of the Discipline

In the past, it was thought students could not work within a discipline until they had learned all the facts, definitions, and procedures about the field. Only once they reached the university level might they have opportunities to engage in historical inquiry, mathematical thinking, or genuine scientific exploration. Today, learning the way around a discipline is no longer for the few who move on in their studies; it is also open to the young.



In an inquiry-based classroom, teachers must design teaching and learning experiences where students have the chance to learn their way around a discipline, engaging in authentic, intellectual tasks that create new knowledge, while mastering key concepts and ideas central to the discipline or field of study. Each discipline, whether it's science, mathematics or history, offers its own ways of communicating and generating knowledge and verifying what counts as quality work. The job of educators, then, is to apprentice young people into these actions.

Students should also read with understanding, interpret findings, critique sources and argue points of view persuasively. As they work in a variety of subject disciplines, they should learn more about how each subject gives a particular window on the world with increasing depth and understanding.

Perhaps most central of all to learning in the contemporary world is the ability to communicate. No matter the topic of inquiry, the problem of the task, communication remains the only way of learning new ideas, reflecting on others', and working with others to build knowledge (Morreale & Pearson, 2008).

The Place of the Interdisciplinary



Interdisciplinary studies involve combining disciplines or subjects together in new ways in order to answer a question or solve a problem that cannot be satisfactorily addressed using the approaches or methods of only one discipline or subject. It's about more than mixing and matching topics; it's about problem solving.

The world today demands a well-rounded individual who can pose questions and solve problems across the disciplines. To be a world expert on the growth of cities, for example, it would be best to know something about history, geography, engineering, politics and health. This illustrates an important reality – to study some things in proper depth, you need to combine existing subjects in interdisciplinary ways. The concept is nothing new – over the course of history, disciplines change frequently. Some come and go, depending on the issues of the day, and others are unrecognizable from 100, or even 30 years ago ("More about interdisciplinarity", n.d.). Some current examples of interdisciplinary studies at the post-secondary level are in assistive technologies, creativity in educational practice, education for the environment, and promoting resiliency in children with ADHD ("MEd Interdisciplinary", n.d.).

Why teach with an interdisciplinary approach?

Interdisciplinary teaching increases student learning: Engaging students and helping them to develop knowledge, insights, problem-solving skills, self-confidence, self-efficacy, and a passion for learning are common goals that educators bring to the classroom, and interdisciplinary instruction and exploration promotes realization of these objectives. Repko (2008) asserts that interdisciplinary instruction fosters advances in cognitive ability and other educational researchers (Field, Lee & Field, 1994; Kavaloski, 1979;

Newell, 1990) have identified a number of distinct educational benefits of interdisciplinary learning including gains in the ability to:

- Recognize bias
- Think critically
- Tolerate ambiguity
- Acknowledge and appreciate ethical concerns ("Why Teach with an Interdisciplinary Approach?", 2013).

Interdisciplinary teaching promotes significant learning

Facilitating meaningful and lasting learning experiences is what significant learning is all about. When teachers impart students with a range of skills and insights about the learning process – and when the work is engaging and meaningful to students, greater learning occurs. Fink identifies six elements that lead to significant learning. Note that each is a common feature of interdisciplinary forms of instruction:

- Foundational Knowledge – Acquiring information and understanding ideas.
- Application – Acquiring an understanding of how and when to use different skills.
- Integration – The capacity to connect ideas.
- Human Dimension – Recognition of the social and personal implications of issues.
- Caring – Acknowledgment of the role of feelings, interests and values.
- Learning how to learn – Obtaining insights into the process of learning.

Interdisciplinary instruction fosters the acquisition of foundational knowledge, promotes integration of ideas from multiple disciplines and provides insight on how to apply knowledge all of which advance a students understanding of how to learn. Moreover, students are encouraged to account for the contribution of disciplines that highlight the roles of caring and social interaction when analyzing problems ("Why Teach with an Interdisciplinary Approach?", 2013).

When teachers design interdisciplinary studies it is important to be selective about what is in and what is out. Here teachers need to attend to what approaches and methods are required in order to solve the problem or carry out the investigation. Avoid the temptation to focus the interdisciplinary study around a theme. Sometimes teachers find themselves laminating math facts on the rings of Saturn. This would be an investigation gone wrong. It may be cute and appealing to the eye, but it has nothing to do with the mathematics that makes space exploration possible or engaging.

Authentic work across subjects allows the big questions to weave in and out in a sensible and compelling way. There will be times that the work in defining understanding of the topic seems to slip into the background as you work on tasks and activities that allow students to develop their understanding of fundamental concepts. Questions and issues relevant to the topic move to the foreground when it's appropriate. Connections are built and explored, not forced.

What Does the Research Say?

The following citations and studies support the authentic learning and deep understanding that results when classroom topics, tasks and activities support an inquiry-based learning philosophy:

- …there's a growing body of literature urging educators to design curricula, teaching and learning experiences where students have the opportunity to "learn their way around a discipline" (Bransford, Brown & Cocking, 2000, p.139) by engaging in authentic intellectual tasks and opportunities for genuine knowledge creation (Darling-Hammond, 2008; Jardine, Clifford & Friesen, 2008; Organization for Economic Cooperation and Development OECD, 2008; Perkins, 2009; Sawyer, 2006). Educators advocating for this approach argue that each discipline (e.g., science, mathematics, history) has its own particular ways of generating knowledge, verifying what counts as quality work, and communicating. The job of educators thus becomes to apprentice young people into these practices.
- Researchers assert that discipline-based approaches to inquiry learning, if designed well, support students in deep learning (Bransford, Brown & Cocking, 2000; Darling-Hammond, Barron, Pearson, Schoenfeld, Stage, Zimmerman, Cervetti & Tilson, 2008; Sawyer, 2006).
- When teachers treat answers as the primary or even sole evidence of learning, lessons end once students have given these answers. Students become conditioned to guess what the teacher wants, and even when they get an answer right, they're not sure why." -Judith A. Langer (2001)

Learning and Technology:

- Most of today's jobs require specialized knowledge and skills, including the capacity to design and manage one's own work, communicate effectively and collaborate with others; research ideas; collect, synthesize, and analyze information; develop new products; apply many bodies of knowledge to novel problems that arise (Darling-Hammond, 2008, p.1).
- In the past, when most jobs required manual labour, only a small elite needed to possess abilities like these. Today the vast majority of the population needs these competencies to flourish in an economy where there is "greater dependence on knowledge, information and high skill levels, and the increasing need for ready access to all of these by the business and public sectors" (Darling-Hammond, 2008, p.1)
- Web 1.0 was dominated by browsers containing static screens full of information, with the user working in isolation. The second generation of the Internet, Web 2.0 is different because "it is more interactive, allowing users to add and change context easily, to collaborate and communicate instantaneously in order to share, develop, and distributed information, new applications, and new ideas" (Schrum & Levin, 2009, p.183). With applications such as wikis, blogs, voice threads, RSS feeds, social networking (e.g., MySpace, Facebook), and Google Apps, users can work online with multiple users within a collaborative space. (Friesen & Scott, 2013)
- Within this new landscape digital technologies will play an integral role in supporting learning and knowledge-building activities (Friesen & Jardine, 2011). Students will be able to "engage collab-

oratively in idea improvement, problem solving, elaborated forms of communication, consulting authoritative sources and knowledge advancement as they undertake real problems, issues and questions". Emerging technologies provide students with elaborated forms of communication such as publishing and movie-making technologies. In the past these technologies were expensive and only available to a small professional elite but they are now available to a much wider population. (Friesen & Scott, 2013, p.4)

Interdisciplinary Learning:

- Much research has shown that the most creative thinkers are those people who can make links between different areas of study, thought, commerce, arts etc. For example Prof Sir Ken Robinson says, "Creativity depends on interactions between feeling and thinking, and across different disciplinary boundaries and fields of ideas" (Robinson, 2011, p.268). It is these sorts of creative thinkers that are most valued in business, politics, media, creative industries, engineering, research etc.
- Interdisciplinary teaching increases student learning: Engaging students and helping them to develop knowledge, insights, problem-solving skills, self-confidence, self-efficacy, and a passion for learning are common goals that educators bring to the classroom, and interdisciplinary instruction and exploration promotes realization of these objectives. Repko (2008) asserts that interdisciplinary instruction fosters advances in cognitive ability and other educational researchers (Field, Lee & Field, 1994; Kavaloski, 1979; Newell, 1990; Repko, 2012) have identified a number of distinct educational benefits of interdisciplinary learning including gains in the ability to:
  - Recognize bias
  - Think critically
  - Tolerate ambiguity
  - Acknowledge and appreciate ethical concerns. –Why Teach with an Interdisciplinary Approach?
  - …the emerging popularity of interdisciplinary teaching is grounded in the student gains that various researchers have identified.

> *According to The National Council for Teachers of English (Consortium for Interdisciplinary Teaching and Learning, 1995) "educational experiences are more authentic and of greater value to students when the curricula reflects real life, which is multi-faceted rather than being compartmentalized into neat subject-matter packages." In their view, real-world problems are complex, so no single discipline can adequately describe and resolve these issues. Therefore, they are not surprised that interdisciplinary forms of learning are prevalent and growing in abundance and stature throughout higher education – Why Teach with an Interdisciplinary Approach?*

Studies:

- Newmann et al. (1996) conducted a large study evaluating elementary, middle, and high schools that had implemented authentic pedagogy and authentic academic performance approaches in their mathematics and social studies classrooms. They sought to determine to what extent student achievement improved in schools with high levels of authentic pedagogy involving higher-order thinking, deep-knowledge approaches, and connections to the world beyond the classroom. The research team observed 504 lessons, analyzed 234 assessment tasks, and systematically sampled student work. The researchers found that environments with high levels of authentic pedagogy led to higher academic achievement among all students. They concluded that differences between high- and low-performing students greatly decreased when students who were normally low achieving were offered authentic pedagogy and assessments.
- In another study examining 2,128 students in 23 schools in Chicago, Newmann et al. (2001) found that students instructed in mathematics and writing organized around more authentic work made higher-than-normal gains on standardized tests. They defined authentic intellectual work as follows:
    - Authentic intellectual work involves original application of knowledge and skills, rather than just routine use of facts and procedures. It also entails disciplined inquiry into the details of a particular problem and results in a product or presentation that has meaning or value beyond success in school. We summarize these distinctive characteristics of authentic intellectual work as construction of knowledge, through the use of disciplined inquiry, to produce discourse, products, or performances that have value beyond school. (pp.14-15)
- To determine the effectiveness of this approach on learning, Newmann et al. (2001) examined the level of authentic intellectual work in writing and mathematics assignments in Grades 3, 6, and 8 classrooms. After examining the quality of the assignments against the quality of student work, they correlated this data with students' scores on standardized tests

Research on how teachers can maximize the effectiveness of inquiry-based learning:

- Discipline-based approaches to inquiry should not be confused with forms of inquiry calling for minimally-guided instruction (Kirschner, Sweller, & Clark, 2006), where students are given little guidance or support in their learning. As Friesen (2012) notes, inquiry involves a spirit of investigation always linked to a particular topic or field of study. Consequently, inquiry moves away from a purely teacher- or student-centered approach to a form of learning that takes its cue from what the field of study requires of those coming to know it. As they pose guiding questions, problems, or tasks that professionals in the field would recognize as important, students and teachers work and learn from experts to develop responses and performances of learning that are meaningful, sophisticated, and powerful.
- Darling-Hammond (2008) and Barron et al. (1998) argued that scaffolding activities, frequent opportunities for formative assessment, as well as powerful guiding questions are vitally important

for ensuring inquiry-based projects to lead to deep understanding. Although there is widespread disagreement in the field as to what constitutes a scaffolding activity, in general it involves tools, strategies, and guides to support students in gaining levels of achievement that would not be otherwise possible. Simons and Klein (2006) argued that an effective scaffold involves bracketing out elements of a task initially beyond the learner's capability in a way that allows the learner to concentrate upon and complete only those elements that are within their range of competence. Similarly, Pea (2004) argued that scaffolds involve a range of instructional measures including "constraining efforts, focusing attention on relevant features to increase the likelihood of the learner's effective action, and modeling advanced solutions or approaches" (p.446). Research suggests that scaffolding activities positively impact problem solving (Cho & Jonassen, 2002), reflection (Davis & Linn, 2000), research assistance (Brinkerhoff & Glazewski, 2004), concept integration (Davis & Linn, 2000), and knowledge acquisition (Roehler & Cantlon, 1997).

- Along with scaffolding, a large body of research concludes that the learning gains engendered by formative assessment were amongst the largest ever reported among any educational interventions (Bransford, Brown & Cocking, 2000; Darling-Hammond, 2008; Hattie, 2009; Heritage, 2010). This same body of research found that these learning gains are most dramatic with low-achieving students. Formative assessment must be embedded in the cycle of learning so that students receive ongoing descriptive feedback to improve the quality of their work and understanding. Heritage's (2010) review of the literature asserted that feedback designed to improve learning is most effective "when it is focused on the task and provides the student with suggestions, hints, or cues, rather than offered in the form of praise or comments about performance" (p.5). Students should be provided opportunities for self-assessment based on clear assessment criteria. Teachers can then use the knowledge gained from this process to adjust their teaching to foster the desired competencies.
- Barron et al. (1998) noted that well-designed inquiry projects should be organized around powerful driving questions that make clear connections between activities "and the underlying conceptual knowledge that one might hope to foster" (p.274). Guiding questions help focus the inquiry around enabling constraints. A powerful inquiry question should be significant to the discipline and connect students to the world beyond the school while also honouring the outcomes within the program of study.
- Teachers have a number of sources of support in designing inquiry projects. Scott and Abbott (2012) outlined a growing body of literature that promotes purposeful inquiry strategies and frameworks that enrich content understanding and promote the apprehension of disciplinary means and processes (Case, 2005; Den Heyer & K., 2009; Wiggins & McTighe, 2005). Key to these approaches is a shift away from predominantly information-transmission pedagogies to inquiry oriented around critical questions (Case, 2005) and essential questions (Wiggins & McTighe, 2005).
- Wiggins and McTighe (2005) promoted subject-matter understanding through essential questions that guide units around big ideas that emerge from the content. A question is an essential question if it lies "at the heart of a subject or curriculum (as opposed to being either trivial or leading), and [promotes] inquiry and uncoverage of a subject" (p.342). Examples of essential questions include:
    - To what extent do we need checks and balances on government power?
    - What are the common factors in the rise and fall of powerful nations?

    - Is the scientific method more like a toll way without any exits or an interstate highway with many exits?
    - How is thinking algebraically different from thinking arithmetically?
- School jurisdictions have invested significant time, money, and professional development support for teachers to integrate these inquiry models into their practice. For example, the critical thinking framework developed by Case (2005) forms the central organizing framework of the online support resources for curriculum and instruction for the social studies program. Similarly, school districts continue to provide ongoing professional development opportunities to aid teachers wishing to adopt Wiggins and McTighe's (2005) Understanding by Design and essential question framework into their teaching.

CHAPTER 3

The Importance of Assessment



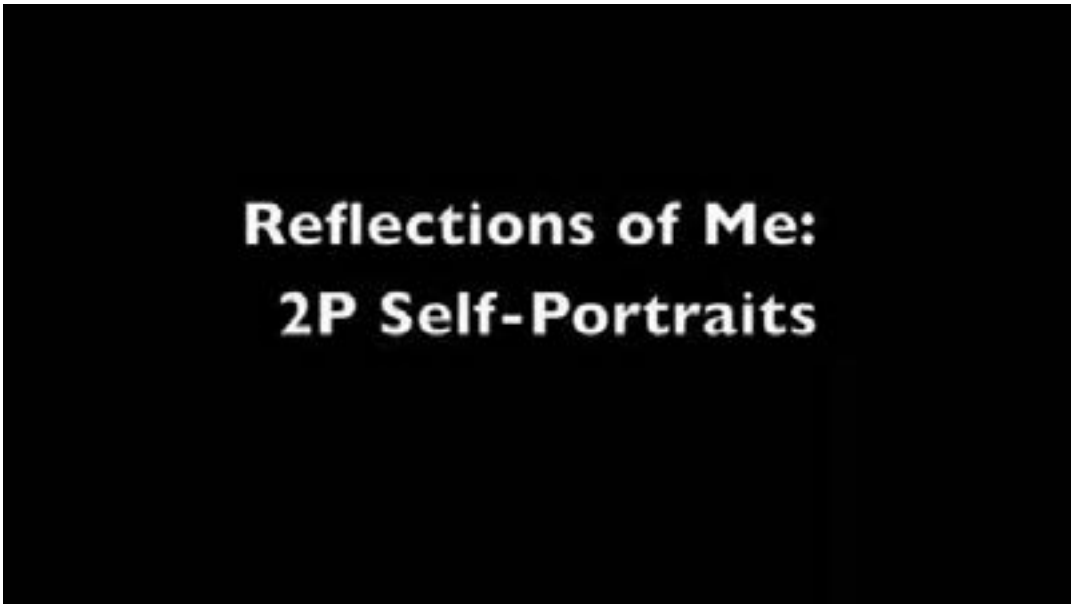
Centrality of Assessment Within Design



Determining what students understand is key to learning. But when it's based on test results and not actual performance, depth of understanding can be lost.

Assessment starts at the beginning – in the early planning stages and continues throughout the entire life of the inquiry, including the day-to-day teaching. Assessment guides the teaching and the learning throughout the inquiry.

Teachers are in the best position to identify what students need to learn. However, students have a strong role to play in discussing and debating what understanding might look like. What does exemplary work look and feel like? By involving students in establishing assessment criteria, everyone will have a clear understanding of how work will be assessed.



Video: **Reflections of Me** (https://vimeo.com/98454372)

Other points on how assessment is central to effective inquiry-based work:

- All assessment practices are tied to specific tasks that make up the study. Whatever students have designed and constructed must work. The impact of the work on others is an integral component of assessment.
- Standards of assessment are more closely tied to the actual standards of the disciplines as they currently exist. Students are the artists, the scientists and the explorers.
- Adults other than the teacher are involved in performance assessment. These can be experts and other community members.
- Exhibitions of learning become a valued component of assessment. Self and peer evaluation is also a critical component of assessment.
- Students' ability to defend their solutions, points of view or products is essential.
- The assessment program supports diverse points of view, different approaches to a problem and unique solutions, rather than standardization.

Once the teacher and the students have a clear idea of how the inquiry work will be assessed, it's time to share this information with parents. Communicate in clear, ordinary language what students need to know, what they should be able to do, and what high quality work looks like.

Understanding by Design

According to author and educator Grant Wiggins, we often neglect a key question when planning classroom learning: Regardless of the format of the lesson, what evidence of understanding do we need, and

where can we find it? What matters is how exams and projects are shaped, timed and assessed.

Here are three essential elements of understanding by design (Wiggins, 2014):

- **There has to be clear, constant and prioritized focus on 'understanding' as an educational goal.** Content mastery is NOT a sufficient goal in an understanding-based system; content mastery is a means, in the same way that decoding fluency is a means toward the real goal of reading – meaning, based on comprehension, from texts. This logic requires teacher-designers to be clear, therefore, about which uses of content have course priority since understanding is about transfer and meaning-making via content.
- **The assessments must align with the goals via 'backward design'; and the goals, as mentioned, should highlight understanding.** So, there can be quizzes of content mastery and questions on the exam re: content, but the bulk of assessment questions and tasks cannot possibly be mere recall of content kinds in an understanding-based system. The issue is therefore not whether or not there are final exams but what kinds of questions/tasks make up any exams given; and whether the kinds of questions are in balance with the prioritized goals.
- **The instructional practices must align with the goals.** Again, that doesn't mean content cannot be taught via lectures or that content-learning cannot be what lessons are sometimes about. But a course composed mainly of lectures cannot logically yield content use – any more than a series of lectures on history or literacy can yield high-performing historians or teachers of reading. The instructional methods must, as a suite, support performance with understanding.

Assessment Within Discipline-based Inquiry



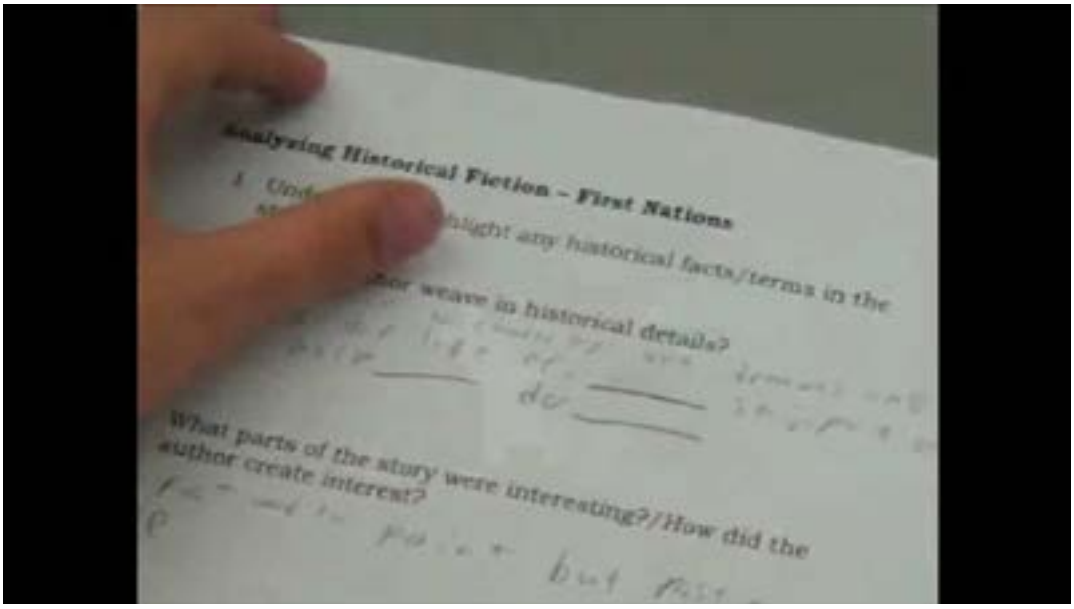
The primary purpose of assessment within a discipline-based inquiry is to improve students' learning and teachers' teaching as both respond to the information it provides.

John Hattie found that the most powerful single influence enhancing achievement is feedback (Hattie, 2009, p.12). Teachers need to be aware of what each and every student is thinking and knowing to construct meaning and meaningful experiences in light of this knowledge, and have proficient knowledge and understanding of their content to provide meaningful and appropriate feedback such that each student moves progressively through the curriculum levels (Hattie, 2009, p.239).

Assessment that occurs during the learning process informing next learning and teaching steps by providing feedback to both is known as formative assessment.

An assessment functions formatively to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have to make in the absence of that evidence (Wiliam, 2011, p.43).

- Formative assessment is designed to promote students' learning. Students need to know what success looks like (an understanding of the desired goal), where their learning is at (evidence about their present position in relation to that goal), and what they need to do to close the gap between where they are and the next step towards success (guidance on the way to close the gap between the two).



Video: **What Success Looks Like** (https://vimeo.com/136634085)

- Formative assessment is designed to inform teachers' next instructional steps, while students are in the process of learning. Teaching effectively in a discipline-based inquiry way means using the information the students are providing while they are engaged in learning. Remember, assessment isn't something that takes place only after all the work is complete. Discipline-based inquiry studies provide ongoing rich opportunities to assess student learning and work products, as well as at the end of the study.



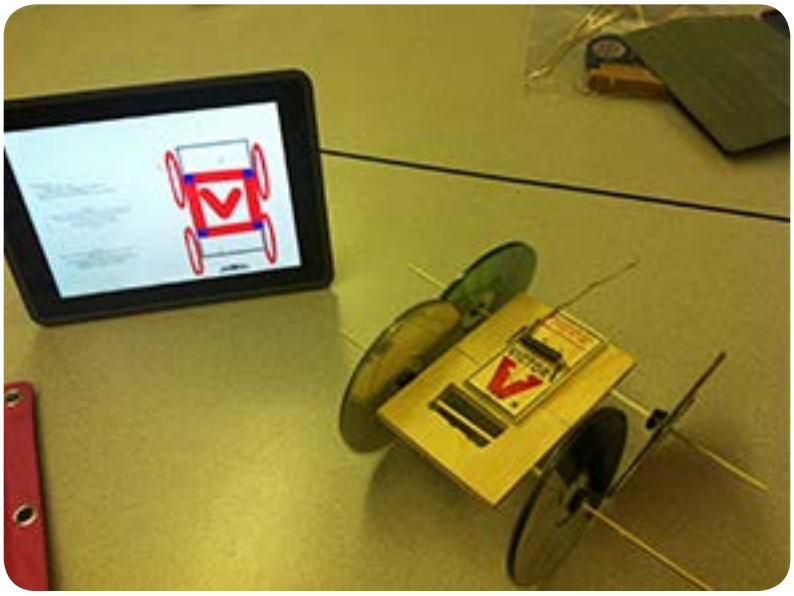
Video: **Assessing Instruction** (https://vimeo.com/136634089)

When teachers teach within discipline-based inquiry studies, the challenge is to figure out how to design formative to ensure student understanding and learning are maximized.



Figuring out what your students really understand and are learning involves:

- Understanding how students learn;
- Understanding disciplinary core concepts and connections contained in the inquiry;
- Understanding the curricular outcomes;
- Ensuring the task, activities and assignments within the inquiry are aligned with the formative assessment;
- Ensuring students have a clear understanding of the desired goal;
- Ensuring students have evidence about their present position in relation to the goal;
- Ensuring instruction is directed at closing the gap between the goal and the present position; and
- Ensuring students have access to and revisit the assessment criteria throughout the study and receive ongoing, specific feedback from a variety of sources and in a variety of different ways.



A note on “improvement” as a form of assessment:

In knowledge building, a feature of a discipline-based inquiry, idea improvement is an explicit principle, something that guides the efforts of students and teachers, rather than something that remains implicit and the related learning activities (Scardamalia, 2002). The direct pursuit of idea improvement brings schooling into much closer alignment with creative knowledge work as carried on at professional levels. Generating ideas appears to come naturally to people, especially children, but sustained effort to improve ideas does not. Developing a disposition to work at idea improvement should be a major objective in the education of scholars, scientists and designers, for without such disposition the likelihood of a productive career is slight (Scardamalia & Bereiter, 2006).

Discipline-based inquiry studies provide opportunities for several forms of assessment:

- Self assessment – Ultimately, students need to be able to determine their own strengths and weaknesses, and make plans for improvement. They should have a very clear picture of what understanding and good work looks like. And they should be able to discuss with confidence the degree to which their work meets established criteria. When teachers have involved students at every stage of the inquiry, students have a clear understanding of what they are doing—and why. And if teachers have worked with them to develop rubrics and other assessment measures, students will know exactly what good work looks like.



Video: **Self Assessment** (https://vimeo.com/135914507)



Video: **Self Reflection** (https://vimeo.com/135917779)

- Peer assessment – Teachers need to help students become effective at giving feedback to others. They can't assume students know how to give and receive helpful feedback. Teachers must work with students to understand how you can help others improve. And even more important, teachers should help students understand how good feedback is an essential part of improving any idea. It is teachers who help the class see that each person's ideas and contributions make the whole inquiry stronger, and help students develop a confident sense of responsibility to one another and to the work.



Video: **Peer Feedback** (https://vimeo.com/136009235)



Video: **Peer Feedback + Practice** (https://vimeo.com/136009356)

- Public performance as assessment – When people outside the school look at the work, what do they see? When parents are invited in for student directed conferences, how do they get to see and hear what their child knows? When students take positions on public issues and enter into community debates and problem solving, how robust and helpful is their contribution? When the community is invited into the school to celebrate student learning, how do the students get meaningful feedback on what the invited guests see as the strengths and weaknesses of their work? When students post their work online, or participate in global projects, how do they know their learning

really matters to someone else? Remember, The end of the study isn't where assessment begins – it's where ongoing assessment concludes. The conclusion of a great study is a time for celebration. The students are proud of their work, they understand how it will be assessed, and they want to share it with others beyond the classroom.

- Teacher assessment – Ongoing assessment practices gives teachers the confidence that students are building the knowledge, skills, understanding and attributes (competencies) needed to complete a great study. It also provides teachers with opportunities to focus their teaching where it will have the biggest impact. Teachers can use a variety of assessment strategies to:
    - Uncover gaps in understanding while there is still time to do something about them,
    - Construct their next lessons to ensure gaps are addressed,
    - Target mini-lessons to assist individuals or groups of students who have a specific need, and/or
    - Plan direct and intentional instruction for students who have misunderstandings.

As teachers work with groups and individuals during the course of a day, or as teachers observe students working in a variety of situations, it is important to jot down things they see: breakthroughs; demonstrations of understanding; misconceptions. Teachers need to talk to each student often about how, exactly, they are doing.

Using Feedback to Deepen the Inquiry

We know effective learning cannot take place without formative assessment practices to match. Formative feedback loops, in addition to scaffolding activities and the adoption of powerful questioning strategies, is an important, if not essential aspect of an inquiry-based education.

Feedback that signals progress in memorizing facts and formulas is different from feedback that signals the state of the students' understanding (Chi et al., 1994). Students also need feedback about the degree to which they know when, where, and how to use the knowledge they are learning (Bransford, Brown & Cocking, 2000).

Assessment should be a regular part of teachers' planning. Assessment allows teachers to develop a feedback loop that informs them of their next steps on a regular basis. It also needs to be ongoing. As teachers observe and coach students as they engage with a task or activity, teachers are assessing what students are learning, and what teachers need to teach them next. As a teacher sits with a student discussing the rough draft of a paper, he provides the kind of specific feedback that permits the student to learn from her first efforts. The student can then return to her original piece to improve it. Or, as a teacher listens to students' discussions and debates, she will hear what students understand, know and can do; what remains confused or uncertain; and what promising leads the students have offered for the teacher's next teaching step.

Not everything needs to be assessed formally. Sometimes people worry about giving students complex, open-ended tasks: what if somebody falls between the cracks? How does a teacher know that everyone is making progress?

One way to address concerns like these is to do fast status checks for understanding. Bring students together frequently throughout a task to answer these questions:

- Where is your learning in relation to the learning goal?
- What have you figured out so far?
- What difficulties or frustrations are you encountering?
- What strategies have you tried already to address these problems?
- What other kinds of strategies might work?

The answers students give to these questions make good prompts for reflective journals. Have students take pictures when they feel they that they are working through something they want to capture or write about later. Save or scan them as images that can be inserted into the reflective journal.

You can also record the class's collective answers to these questions on chart paper, a class blog, or collaborative online document to create a map of how the class' learning is developing. It builds a body of common knowledge, and keeps everyone connected to the topic, even though they may be working on it in quite different ways. Answers to these questions make wonderful summaries of the "big aha's" that

teachers might want to post on their class website or blog. They are great notes for use later as study guides. Parents like to see how understanding is developing on a regular basis, not just at report card time. When students go home with clearly articulated understandings of what they have learned and what they need to know next, they can answer that perennial dinnertime question: "So, what did you learn in school today?"

This emphasis on knowledge creation and elaborated communication will require new approaches to assessment. Rather than focusing on students' ability to recall content or follow basic procedures, these new emphasis will require assessment that involves asking students to solve real-world problems and participate in tasks and activities reflective of work engaged in by professionals in particular disciplines. Formative feedback loops that provide ongoing descriptive feedback will help students enhance works in progress. This renewed focus on formative assessment will help teachers modify their teaching to help students produce sophisticated and high-quality summative performances of understanding.

Assessment must be ongoing

On a day-to-day basis, students should know where they stand and where they are heading. It's not enough to assess students at the end of a task. Students and teachers must have ways to determine what understandings are emerging, where the gaps in understanding are and what to do next.

Completing a task is only part of learning. Students need to articulate what they are coming to understand and the problems they're having along the way. If teachers leave assessment to the very end of a task, there is almost nothing students can do to correct errors and misunderstandings. But if students get feedback while there is time for them to improve their learning, they can make real progress.

Research clearly indicates that if students do not receive on-going feedback during the learning process, they do not make learning gains. Students who start a task with strong understandings remain strong; those who are struggling when they start are still struggling at the end.

Designing Rubrics

Rubrics:

A good assessment tool has two components:

- **It identifies the fundamental concepts and other features of understanding** the task or activity is designed to uncover. Sometimes teachers can use the wording of the concepts or learning outcome to describe the features of understanding students will demonstrate when they perform the task or activity. Sometimes teachers will want to modify the wording while keeping the intention of those fundamental concepts and/or learning outcomes intact.
- **It identifies the degree of mastery of each of these understandings.** We call these levels of understanding.

Good assessment also gives feedback about the features of understanding and levels of understanding. How will students and their parents know the difference between what will count as exceptional performance or performance that meets expectations? What is missing from student performance when they fail to understand?

Teachers, parents and students should have a clear picture of what it looks like when students have a deep understanding of fundamental concepts and what it's like to work effectively to produce strongly crafted work.

Teachers are becoming familiar with the use of rubrics to accomplish assessment goals. A rubric is simply a table. How you populate the rubric is key.

There are two types of rubrics that are particularly helpful for teachers:

Each type can be used to assess both the products and processes of learning.

1. Generic Rubrics

These are used when teachers want to assess student understanding on similar types of tasks such as story-telling, problem solving, oral presentations, or web design. The most important thing about generic rubrics is that students encounter the same features of understanding each time they approach a similar type of work. Thus, each time they write a story, they know that certain key elements must be present, regardless the particular story idea, characters or setting. The specific features of understanding teachers include in a generic rubric should map to learning outcomes so that both teachers and their students are confident that they are developing required skills, knowledge and understandings.

Advantages of generic rubrics:

- Helping teachers focus on what matters most about certain kinds of tasks, processes and performance;
- Helping students consciously develop their knowledge, skills and abilities across different contexts;
- Assuring greater consistency in your assessment of tasks of a similar nature; and
- Developing consistency and alignment across grade and subject levels.

Disadvantages of generic rubrics:

- They are not finely grained enough to get at specific content, skills and understandings developed in a particular task or activity; and
- If not carefully constructed, they can be so vague that students have a hard time seeing what, specifically, good work looks like.

2. Analytic Trait Rubrics

An analytic trait rubric divides a product or performance into traits or dimensions so that each can be assessed separately.

Advantages of analytic trait rubrics:

- Assessing complex performances or products involving several significant dimensions; and
- Providing more specific information or feedback to students, parents and teachers about the strengths and weaknesses of a performance or product. Teachers can use the information provided to analytic assessment to target instruction to particular areas of need.

Disadvantages of analytic trait rubrics:

- Time consuming to learn how to create and apply.

Creating rubrics:

Whether a rubric is generic or analytic-trait, it will have three main elements:

- **Features of understanding:** Each row in a rubric identifies a specific concept, skill or other feature that is an essential element in demonstrating understanding. This is the place where teachers must look closely at the task or activity they have designed and at the relevant Programs of Study and ask themselves what must the students understand as they work on the various tasks and activities.
- **Levels of understanding:** The columns in a rubric clearly identify the differences between levels of student understanding and performance. Most commonly, a four-point scale is used, although sometimes you'll see a five-point scale as well. Secondary teachers tend to use a five-point scale because it corresponds to letter grades. Some encourage teachers to use an even number of levels of understanding to avoid the tendency to huddle responses in the middle of the scale. On a 4-point rubric with 4 being the highest level, 3 is generally assumed to indicate grade-level per-

formance. Increasingly, teachers avoid giving labels to the different parts of the scale and just use numbers. This avoids emotionally loaded or vague terms such as “Poor” “good” excellent” and “outstanding”.

- **Descriptors of understanding:** Writing clear descriptors of understanding for each level helps you clarify what work looks like at each level of performance. Here are some helpful tips:
  - Clearly think through and communicate the differences between each level of understanding. Will students know what they need to do to perform at the top level, or to move from one level to a higher one?
  - Describe each level of understanding, try to make the differences between each level equal. Try to avoid a situation where there is a minor difference between a 2 and a 3, but it takes a huge jump for students to achieve a 4.
  - Focus on understanding as the descriptors are developed to distinguish between levels of understanding. Weak descriptors may rely on a quantitative difference between levels. Do not to distinguish between levels by the number of resources, examples or questions a student has addressed. Are five weak resources actually better than 3 strong ones? Or is it really better to ask 10 predictable questions than 2 inspired ones?
  - Avoid the temptation to distinguish levels of understanding by focusing on how independent a student was in completing a task. In today’s world, students need to learn how to be effective members of productive teams, so it’s not a good idea to tie our assessment only to their ability to work alone.

Involving Students in Creating Assessment

Working with your students to develop rubrics is a very powerful way to help students build understanding of what good work looks like. This does not mean each student creates his or her own rubric. Teachers have a strong role to play in guiding students to identify the understandings they must develop.

Students have a role to play in discussing and selecting the features of understanding on which their work will be assessed. However, this takes a lot of time, debate, discussion and examination of appropriate examples from expert performances. When teachers do not have the time to devote to a careful development of features of understanding, it is better for teachers to identify them, and then make sure students understand what is meant.

A second way to involve students in a very meaningful way in the construction of rubrics is to work with them as a class to identify what different levels of understanding actually look like. What do they think about the difference between powerful and weak work? What performance or product criteria do students think are important, and is the teacher sure that everyone understands what each of these levels of understanding mean? Again, this takes time—and teachers must be prepared to devote enough of it to ensure that their contributions are really strong. If teachers feel they do not have a lot of time, it is better to populate the cells of the rubric themselves, than discuss them with students.

It can be very helpful to pre-populate some of the cells in the levels of mastery columns of the rubric before taking the rubric-in-progress to students. Specify what does an exemplary performance look like, or what does it looks like if students missed something crucial. Leave lots of empty cells in between and work with your class to tease out important differences.

As you guide students through the work of populating all the cells, both you and they will achieve clearer understanding of understanding.

The structure of observed learning outcomes (SOLO) created by John Biggs and Kevin Collis in 1982 provides a means for classifying learning outcomes in terms of their complexity that are particularly effective in and relevant to discipline-based inquiry. SOLO provides a robust model for identifying three levels of understanding.

According to Biggs and Collis (1982), there are five stages of “ascending structural complexity.” Those five stages are:

1. Prestructural – incompetence (they miss the point).
2. Unistructural – one relevant aspect
3. Multistructural – several relevant and independent aspects
4. Relational – integrated into a structure

5. Extended Abstract – generalized to new domain



Video: Rubric Creation - Elementary - Part 1 (https://vimeo.com/135913583)



Video: Rubric Creation - Elementary - Part 2 (https://vimeo.com/135914033)



Video: Rubric Creation - High School (https://vimeo.com/135911921)

What Does the Research Say?

- A large body of research concludes that the learning gains engendered by formative assessment were amongst the largest ever reported among any educational interventions (Bransford, Brown & Cocking, 2000; Darling-Hammond, 2008; Hattie, 2009; Hattie & Yates, 2014; Wiliam, 2011). This same body of research found that these learning gains are most dramatic with low-achieving students. Formative assessment must be embedded in the cycle of learning so that students receive ongoing descriptive feedback to improve the quality of their work and understanding. Hattie's (2009) synthesis of 23 meta-analysis found that feedback was among the most powerful influences on student learning. "The effect sizes reported in the feedback meta-analysis show considerable variability, which indicates that some types of feedback are more powerful than other" (Hattie, 2009, p.174). Several significant observations arose from the extensive review of the literature. Specifically:
    - It is important to focus on how feedback is received rather than how it is given.
    - Feedback becomes powerful when it renders criteria for success in achieving learning goals transparent to the learner.
    - Feedback becomes powerful when it cues a learner's attention onto the task, and effective task-related strategies, but away from self-focus.
    - Feedback need to engage learners at, or just above, their current level of functioning.
    - The learning environment must e open to errors and to disconfirmation.
    - Peer feedback provides a valuable platform for elaborative discourse. Given opportunities, students readily learn appropriate methods and rules by which respectful peer feedback can be harnessed.
    - Feedback cues teachers to deficiencies within their instructional management and can lead to efforts to improve teaching practices. (Hattie & Yates, 2014, p.70)
- Bransford, Brown & Cocking (2000) indicate that when experts from within a discipline were asked to verbalize their thinking as they worked, it was revealed that they monitored their own understanding carefully, making note of when additional information was required for understanding, whether new information was consistent with what they already knew, and what analogies could be drawn that would advance their understanding. These monitoring activities are an important component of what is called adaptive expertise. Research has demonstrated that children can be taught these strategies, including the ability to predict outcomes, explain to oneself in order to improve understanding, note failures to comprehend, activate background knowledge, plan ahead, and apportion time and memory.
- Dylan Wiliam (2011) has identified five key strategies of formative assessment:
    - Clarifying, sharing, and understanding learning intentions and criteria for success.
    - Engineering effective classroom discussions, activities, and learning tasks that elicit evidence of learning.
    - Providing feedback that moves learning forward.
    - Activating learners as instructional resources for one another.
    - Activating learners as owners of their own learning. (Wiliam, 2011, p.2)

CHAPTER 4

Teaching & Learning in a Discipline-Based Inquiry Classroom



Creating a Community of Learners

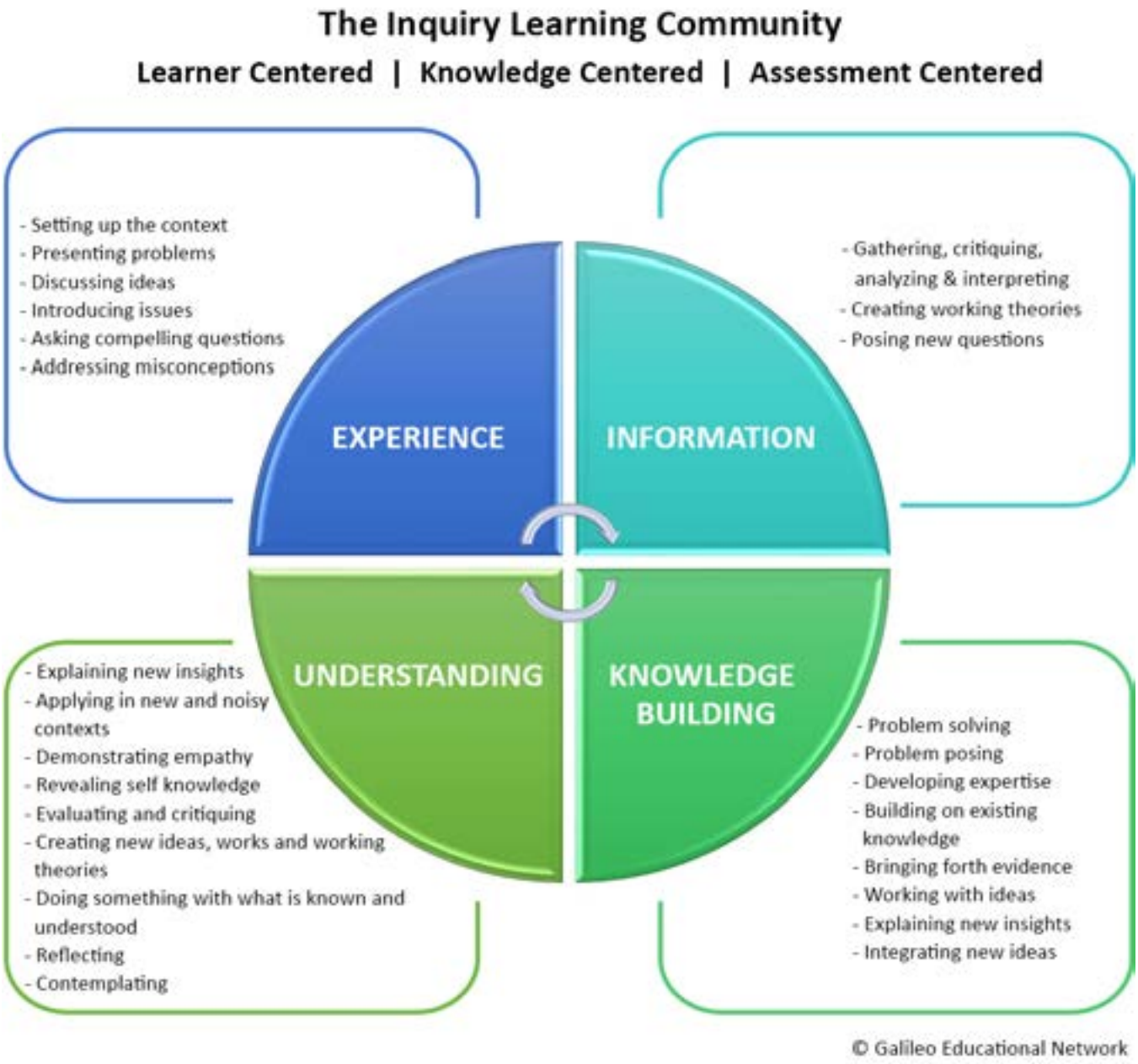
The learning environment and conditions teachers create for students is essential to their success. When the atmosphere is warm, inclusive and inviting, students are more likely to speak up in class and feel like valued members of the classroom community. In their book, How People Learn Bransford, Brown & Cocking (2000) state that learning environments designed around how people learn are learner-centered, assessment-centered, knowledge-centered within a community.



Bransford, Brown & Cocking, 2000

The term learner-centered refers to learning environments in which teachers pay close attention to the competencies (knowledge, skills, attitudes and beliefs) that students bring with them into the classroom. Learning environments that are only learner centered would not necessarily sponsor the type of deep understanding that would be found in an inquiry learning environment. Learning environments designed around the features of strong inquiry are also knowledge-centered classrooms. Teachers in knowledge-centered classrooms take seriously the need create an inquiry learning environment. The knowledge-centered component of an inquiry learning community is organized so that students combine experience and information in order to engage in knowledge building. Students learn to work with information through manipulating information and ideas by synthesizing, generalizing, explaining, hypothesizing, or arriving at conclusions that produce new meaning and understandings for them. Using experi-

ences and information they learn to engage in knowledge building. They learn to solve problems, pose problems, build on existing knowledge, bring forward evidence, improve upon existing ideas, explain new insights, and integrate new ideas while developing expertise. Through the processes of knowledge building students engage in extended conversational exchanges with the teacher and their classmates about subject matter in a way that builds an improved and shared understanding of ideas or topics. An inquiry learning community is one that is focused on developing deep and complex understanding in all students so that they are able to make connections between substantive knowledge and either public problems or personal experiences in their lives outside of school.



In addition to being learner-centered and knowledge-centered, the learning environment must also be assessment-centered. Paying close attention to the competencies (knowledge, skills, attitudes and beliefs) that students bring with them into the classroom with an emphasis on knowledge building and deep understanding requires new approaches to assessment. Formative assessment including feedback loops that provide ongoing descriptive feedback will support students as their learning progresses. An assessment-centered learning environment that incorporates formative assessment focus helps teachers modify their teaching in order to support and ensure students produce sophisticated, deep understanding. (Refer to chapter 3 for full explanation)

The classroom itself can be seen as a living, breathing thing; a dynamic space that continually recreates itself. This re-creation is built on solid connections between students, teachers and parents, and it's based on students' evolving needs (Alberta Education, n.d.). Creating a community of learners is the foundation of effective teaching (Bransford, n.d.).



Video: **Class Culture** (https://vimeo.com/135987381)

Link: **Virtual Museum Project** (http://www.galileo.org/initiatives/vmuseum/index.html)

Inside The Classroom



Throughout the preceding three chapters, video exemplars have been used to not only illustrate various key features of discipline-based inquiry, but also to provide a glimpse into the living character of inquiry within the classroom. This section highlights the ways in which the designs teachers create are enacted within a classroom. The classroom is the place where teachers actively create the conditions for learning weaving together knowledge of the discipline or field of knowledge; ways of working in that discipline or field; their knowledge of how to make the various concepts, content and procedures in that discipline or field learnable by students; and their knowledge of the learner. Teachers who engage students in deep, meaningful learning know how to situate what is to be learned within an interconnected field of knowledge. That is there is no breakdown between a field and the ways in which it is practiced in the world. These ways in which knowledge is working in the world are constitutive, multiple, diverse, and all of them involve specific applications of knowledge to issues in the real world.

Different disciplines are organized differently and have different ways of knowing, doing and being. While the key features of inquiry design are the same, the pedagogical approaches to inquiry are different depending on the discipline or field of knowledge. This means that the activities and assignments that teachers would need to design to ensure students work in the ways of the discipline would be different, discipline-to-discipline. For example, "bringing forward evidence needed to support a set of historical claims is different from the type of proof required to resolve the truth or falsify a mathematical conjecture, and both of these differ from the evidence needed to test a scientific theory. Lee Shulman (1987) introduced the term pedagogical content knowledge (knowledge about how to teach in particular disciplines) rather than only knowledge of a particular subject matter" (Bransford, Brown & Cocking, 2000, p.155). Teachers require pedagogical content knowledge in order to teach effectively for inquiry.

Pedagogical content knowledge is different from knowledge of general teaching methods. Teachers who engage students in inquiry know the

> *structure of their disciplines, this knowledge provides them with cognitive roadmaps that guide the assignments they give students and the assessments they use to gauge students' progress. In short, their knowledge of the discipline and their knowledge of pedagogy interact. However, it is important to highlight that knowledge of the discipline structure, in and of itself, is not sufficient (Bransford, Brown & Cocking, 2000, p.155).*

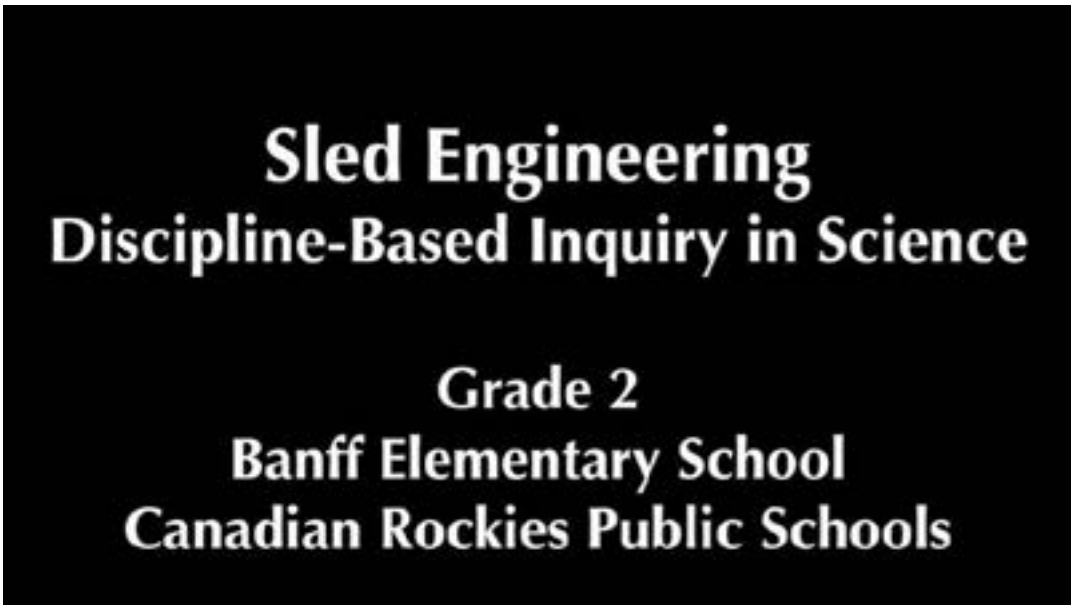
As you watch the following videos observe the ways teachers in these videos actively create the conditions for learning weaving together:

- Knowledge of the discipline or field of knowledge with the ways it is practiced;
- Knowledge of how to make the various concepts, content and procedures in that discipline or field learnable by students;
- Knowledge of each learner;
- Assessment and instruction; and
- Student-centered and direct pedagogies to ensure students are learning what they need to learn to deepen knowledge and understanding.

SCIENCE INQUIRIES

An Engineering Inquiry into Building Sleds

A Science topic in the Grade Two Alberta Education Program of Studies took on life when it was mapped onto engineering design to create a strong, robust discipline-based inquiry.



Video: **Sled Engineering: Discipline-Based Inquiry in Science** (https://vimeo.com/133368858)

An Inquiry Into Decomposition



Amy and Deirdre designed an inquiry into decomposition. They wanted their students to understand the biological cycles of decomposition in deep and meaningful ways. Students learned to take careful measurements of the fruit and vegetables as they decomposed.

The students created digital lab reports to document the scientific process. Amy and Deirdre ensured that their students worked in ways that were recognizable to those whose work and research is in the sciences.



Video: **Decomposition Lab** (https://vimeo.com/135752168)

A Botanical Inquiry into Growing Tomatoes

The students took their learnings from the inquiry into decomposition (see Science Inquiries) into this next inquiry on growth cycles of plants. Through this inquiry, students learned to identify and manipulate variables. Observe as students learn to set up their experiments on the growth cycle of a tomato plant. Pay close attention to the ways in which the teaching weaves together scientific concepts, content, pedagogical content knowledge and assessment.



Video: **Tomato Farm** (https://vimeo.com/136847864)

An Applied Physics Inquiry Into Simple Machines

What began as a science topic in the Alberta Program of Studies for Dave Bennett quickly became something more than just one more topic as he started to examine the topic in some depth. Dave designed an inquiry into the ways in which bicycles work and the ways in which they can be modified to various purposes. Students worked through the design process of engineering: defining the problem, researching and designing, creating a prototype, modifying the bicycle, testing the modification and evaluating the modification.



Video: **Inquiry Lives Here Episode Four- Grade 4 Science -Simple Machines** (https://vimeo.com/136848422)

An Inquiry into Energy Flow in Global Systems

Climatic factors largely determine the flora and fauna found in each of the world's major biomes. The United Nations Intergovernmental Panel on Climate Change has stated that the balance of evidence suggests a human influence on global climate. Scientists from various fields are studying this relationship to determine the potential impact on biomes. This study was designed so that students uncover relationships between biomes, energy and climate. Their question was: "Knowing that going up 300 meters is like going 950 Kilometers north, can we learn anything about northern biomes by making observations as we walk up a slope?"



Video: **High School Science Field Study** (https://vimeo.com/136136352)

A Glimpse Into A Teaching Moment

Kenzie teaches chemistry to high school students. He wanted to make the learning more visible in his classroom to ensure that students were grasping the concept he needed them to understand.



Video: **Making Learning Visible in High School** (https://vimeo.com/111864015)

MATH

Planting Tomatoes: Mathematics Within the Sciences

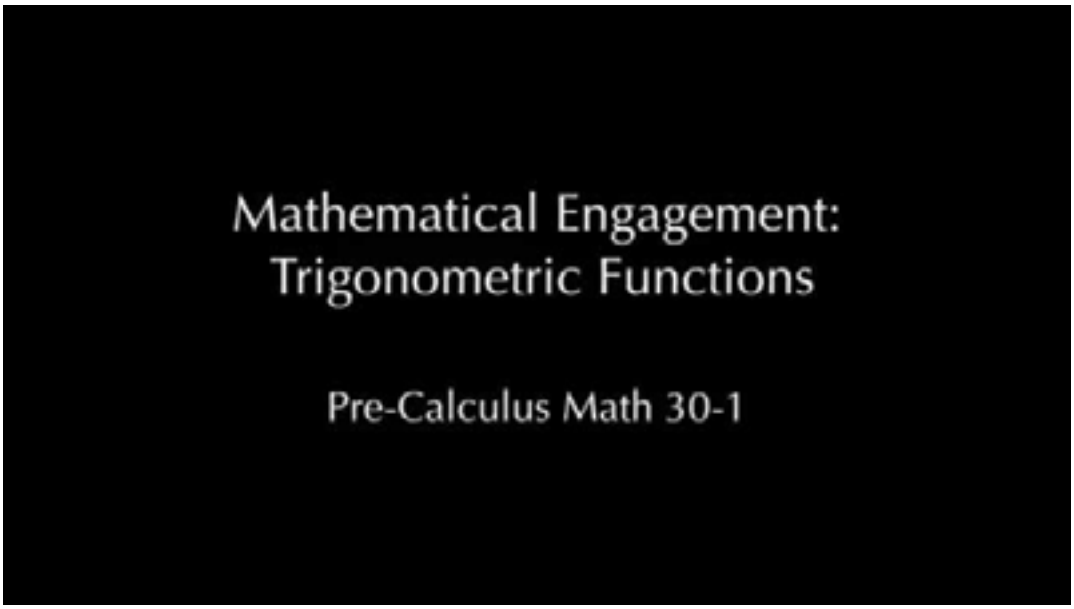
It is one thing to work through scientific inquiry to design and carry out a lab using scientific processes and procedures; it is another to extend the learning into the next inquiry. Amy and Deirdre wanted to ensure that students had the opportunity to plant the surviving tomato plants into the community garden in the school yard. They also wanted their students to understand how and why mathematics is essential within the sciences.



Video: **Planting Tomatoes** (https://vimeo.com/136848370)

An Inquiry into Trigonometric Functions Using Real-World Models

Kathy designed a study in mathematics in which students inquired into the features of trigonometric functions by working through a series of labs. She designed ten labs that highlighted the key concepts of trigonometry within different applied contexts. In the following video observe the ways Kathy's knowledge of the subject matter interact with her pedagogy and knowledge of the students as learners of mathematics.



Video: **Mathematical Engagement** (https://vimeo.com/135695728)

A Glimpse Into Teaching Moments

Margaret realized that the students in her class had memorized a formula for determining perimeter. As she provided them with various shapes to measure she noticed that they were either confusing the formula for area and perimeter or unable to use the formula appropriately or accurately when the shape was not a rectangle or a square. She had the students work on geoboards to manipulate their shapes each time calculating the perimeter of the shape. Watch how she intervenes with the students when she notices that they have formulated a false conjecture.



In order for the students in this class to accurately analyze and compare various 2D and 3D shapes, the teacher needed to ensure the students were measuring, calculating and reporting accurately. Observe the ways in which assessment and instruction weave together in this teaching episode.



Video: **Math Shapes** (https://vimeo.com/136136831)

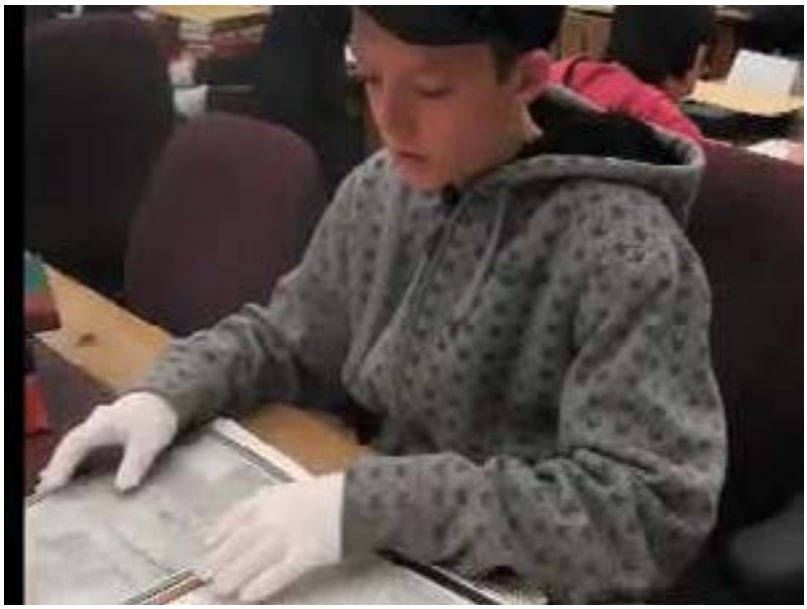
INSIDE A HISTORY CLASSROOM

An Inquiry Into Canada's Past

Link: The full study can be found at http://www.galileo.org/schools/millarville/archaeology/index.html.

Neil invited the students in his class to work with primary sources as historical evidence. The students examined historical artifacts and re-mixed images and designs from historical documents to produce fresh interpretations of the stories that helped to shape Canada's past and our current national identity.

Observe how the teaching mirrors the ways in which historians work with primary sources.



Video: **Historical Artifact 1** (https://vimeo.com/136138365)

After students had created new historical panels they engaged the expertise of Sheldon Posen, a historian and curator at the Canadian Museum of Civilization, to provide feedback on their work. Listen to the way he takes the students' work working with the evidence on their panels and providing them with expert feedback.



Video: **Historical Artifact 2 (**https://vimeo.com/136138386)

Developing historical imagination is important within the discipline of history. It is important for students to determine why people acted the way they did or why they might have acted the way they did. Neil had the students create videos, written and told in first person. Having the students use evidence from primary sources to discern the stories of each of the explorers was an important component of this inquiry.



Video: **History - Henry Hudson** (https://vimeo.com/136138612)

An Inquiry Into The Millarville Community: What Stories Do Artifacts Tell?

Link: The full study can be found here http://www.galileo.org/schools/millarville/archaeology/index.html

As part of an inquiry into their local community teachers, Loretta and Patti had students undertake an archaeological dig in their schoolyard. The students had noticed that forks and spoons and other types of objects made their way to the surface every year after the winter snow thawed. An archaeologist from the University of Calgary worked with the teachers and students because in Alberta an archaeological dig can only be done with a permit and under the supervision of an archaeologist.

Observe the ways in which students were taught to survey the site and begin the process of excavation.



Video: History - **Archaeology Site Preparation** (https://vimeo.com/136138695)

Observe the ways that students learned to record their artifacts and begin the process of analysis of the artifacts they found.



Video: **History - Archaeology Dig Preparation** (https://vimeo.com/136138752)

What does the research say?

Contemporary Learning Environments and Effective Teaching

Researchers content that the goals of education in today's world have changed necessitating a change to the ways that learning and teaching occurs in this environments (Bransford, Brown & Cocking, 2000; Friesen, 2009; Sawyer, 2006, 2008, 2014; Stone Wiske, 1998). In creating the conditions for learning within these contemporary learning environments, teachers require a deep understanding of the discipline or field of knowledge, as well as an equally thorough understanding of the kinds of teaching tasks and activities that help students achieve deep levels of understanding (Bransford, Brown & Cocking, 2000; Friesen, 2009; Ladwig, Smith, Gore, Amosa & Griffiths, 2007; Newmann, Bryk & Nagaoka, 2001; Newmann, King & Carmichael, 2007; Sawyer, 2006, 2008, 2014).

Sawyer (2006, 2014) highlights a number of the learning sciences research findings in the following chart:

Learning Knowledge Deeply (Findings from Cognitive Science)	Traditional Practices (Instructionism)
Deep learning requires that learners relate new ideas and concepts to previous knowledge and experience.	Learners treat course material as unrelated to what they already know.
Deep learning requires that learners integrate their knowledge into interrelated conceptual systems.	Learners treat course material as disconnected bits of knowledge.
Deep learning requires that learners look for patterns and underlying principles.	Learners memorize facts and carry out procedures without understanding how or why.
Deep learning requires that learners evaluate new ideas and relate them to conclusions.	Learners have difficulty making sense of new ideas that are different from what they encountered in the textbook.
Deep learning requires that learners understand the process of dialogue through which knowledge is created and can examine the logic of an argument critically.	Learners treat facts and procedures as static knowledge, handed down from an all-knowing authority.
Deep learning requires that learners reflect on their own understanding and their own process of learning.	Learners memorize without reflecting on the purpose or on their own learning strategies.

Based on the findings from a multi-year research and development study initiative What did you do in school today? (Willms, Friesen & Milton, 2009), Friesen (2009) developed a resource to guide teachers as they develop teaching practices to sponsor deep understanding in students. Some teachers in schools across Alberta are using the document Teaching Effectiveness: A Framework and Rubric to develop and strengthen their pedagogical practices. The five principles of effective teaching are:

- Teachers are designers of learning
- Work students are asked to undertake is worth their time and attention
- Assessment practices improve students learning and guide teaching
- Teachers foster a variety of interdependent relationships
- Teachers improve their practice in the company of peers

Research conducted for the National Board for Teacher Standards (NBPTS) found that expert teachers were adept at shifting their students' work products over from surface to deep response requirements. The students of such teachers were found working on tasks likely to promote deep conceptual understanding for the majority of class time. The overall findings were as follows:

- Expert teachers possess pedagogical content knowledge that is far more flexibly and innovatively employed in instruction.
- Expert teachers are more able to improvise and so alter instruction in response to contextual features of the classroom situation.
- Expert teachers understand at a deeper level the reasons for individual student success and failure on a given task.
- Expert teachers' understanding of the students is such that they are more able to provide developmentally appropriate learning tasks that engage, challenge, and even intrigue students without boring or overwhelming them—they know 'where to next'.
- Expert teachers are more able to anticipate and plan for difficulties students are likely to encounter with new concepts.
- Expert teachers can more easily improvise when things do not run smoothly.
- Expert teachers are more able to generate accurate hypotheses about the causes of student success and failure.
- Expert teachers bring a distinct passion to their work (Hattie, 2009, p.261).

Authentic Intellectual Work

Newmann et al., (1996) conducted a large study evaluating elementary, middle, and high schools that had implemented authentic pedagogy and authentic academic performance approaches in their mathematics and social studies classrooms. They sought to determine to what extent student achievement improved in schools with high levels of authentic pedagogy involving higher-order thinking, deep-knowledge approaches, and connections to the world beyond the classroom. The research team observed 504 lessons, analyzed 234 assessment tasks, and systematically sampled student work. The researchers found that environments with high levels of authentic pedagogy led to higher academic achievement among all students. They concluded that differences between high- and low-performing students greatly decreased when students who were normally low achieving were offered authentic pedagogy and assessments.

In another study examining 2,128 students in 23 schools in Chicago, Newmann et al. (2001) found that students instructed in mathematics and writing organized around more authentic work made higher-than-normal gains on standardized tests. They defined authentic intellectual work as follows:

> *Authentic intellectual work involves original application of knowledge and skills, rather than just routine use of facts and procedures. It also entails disciplined inquiry into the details of a particular problem and results in a product or presentation that has meaning or value beyond success in school. We summarize these distinctive characteristics of authentic intel-*

lectual work as construction of knowledge, through the use of disciplined inquiry, to produce discourse, products, or performances that have value beyond school. (pp.14-15)

To determine the effectiveness of this approach on learning (Ladwig et al., 2007; Newmann, Bryk & Nagaoka, 2001; Newmann, King & Carmichael, 2007) examined the level of authentic intellectual work in writing and mathematics assignments in Grades 3, 6, and 8 classrooms. After examining the quality of the assignments against the quality of student work, they correlated this data with students' scores on standardized tests. Students in classrooms where teachers had

The Disciplinary Mind

A number of researchers (Bransford, Brown & Cocking, 2000; Gardner, 2000, 2006; Newmann, Bryk & Nagaoka, 2001; Newmann, King & Carmichael, 2007; Sawyer, 2006, 2008, 2014).

"Students must see information not as an end in itself or as a stepping stone to more advanced types of information, but rather a means to a better practice" (Gardner, 2006, p.30). He contends that the vital reason for work in disciplinary knowledge is the learner gains deeper understanding and in turn that deeper understanding become a yearning.

Gardner (2006) identifies four steps to creating a disciplined mind:

1. Identify truly important topics or concepts within the discipline.
2. Spend a significant amount of time on this topic.
3. Approach the topic in a number of different ways.
4. Set up performances of understanding and give students opportunities to perform their understandings under a variety of conditions (pp.32-34).

CHAPTER 5

Creating A Scholarly Practice



Teaching as a Scholarship

As professionals, teachers perform a variety of complex and contextualized activities on a daily, and lesson-by-lesson basis. From interpreting what different students are doing and feeling at each moment, to knowing how to explain, question, discuss, construct tasks, and give feedback – it's not easy work (Darling-Hammond & Bransford, 2005).

Teachers work in increasingly diverse environments, both multiculturally and in terms of student ability. They make effective use of information and communication technologies for teaching. And they're also expected to engage more in planning within different frameworks while doing more to involve parents and the broader community in their schools (OECD, 2009).

What teachers do in the classroom has the single greatest effect on the quality of student learning – so teachers constantly adapt their practice as they respond to their students. **Developing a powerful and effective professional practice is a career-long endeavor, which ideally, teachers build and strengthen in the company of their peers.** Great teachers create a common ground of intellectual commitment. They stimulate active, not passive learning, and encourage students to be critical, creative thinkers (Higgs & McCarthy, 2005).

Whether it's teachers in a classroom of students, or post-secondary faculty who are educating the teachers of tomorrow, essentially, **all teaching is about learning** (Higgs & McCarthy, 2005).

The processes of professional learning and student learning are very similar. Clearly, teachers bring a far richer set of knowledge and skills to the table, but the key processes through which both learn are identical:

- Engaging one's prior conceptions about how the world works.
- Developing a deep foundation of factual knowledge understood within conceptual frameworks.
- Developing meta-cognitive, or skills of self-awareness, so learners are able to take control of their own learning.

Professional learning requires active cognitive, emotional and practical engagement from teachers. Just like their students, teachers won't learn much from professional development that requires them to just sit and receive. Yet, these approaches underpin most professional development opportunities today (Timperley, 2011).

Addressing the gap between classroom practice, professional learning and educational research marked the work of educator Ernest Boyer. He used the term **scholarship of teaching** to validate teaching as a scholarly activity, not "as a routine function, tacked on, something almost anyone can do." He argued excellent teaching is much more than artfully transmitting information to students – it's about transforming and extending knowledge and is marked by the same habits of mind that characterize other scholarly work (Hutchings & Shulman, 1999). Teaching, he believed, should be taken more seriously as a profes-

sion, much like medicine or law.

Why should we treat teaching as a scholarship, and not just promote excellent teaching?

Teaching – good teaching – is serious intellectual work and it should be rewarded. Boyer also believed that when teaching was defined in terms of a scholarship, it both educates and entices future scholars, contributing to the profession as a whole. He developed four distinct, but interrelated dimensions of scholarship: Discovery, integration, application and teaching. (This chapter focuses on teaching and professional development, with Chapter 6 addressing what needs to happen at the university and school administrative level.)



Video: **Graphic Designer in the Classroom** (https://vimeo.com/137391462)

What is the distinction between the scholarship of teaching and scholarly teaching?

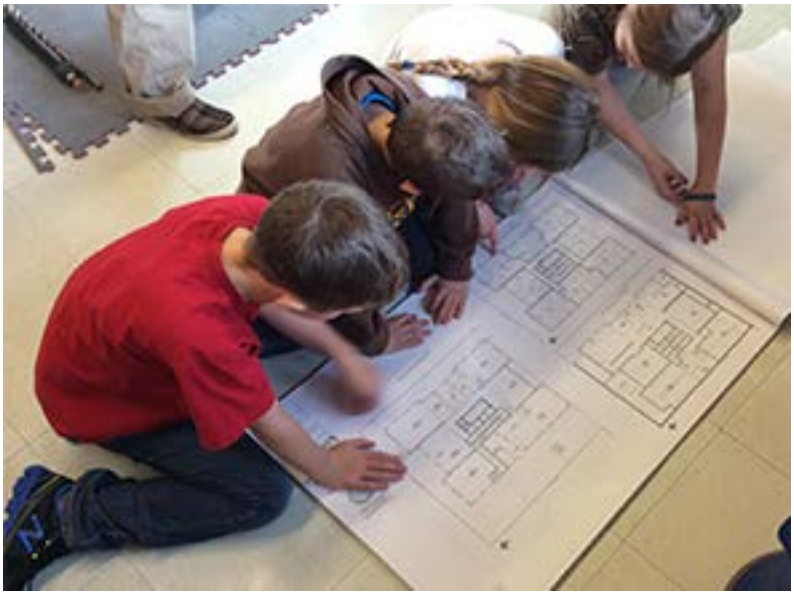
Whether it's at the university or the classroom level, all educators have the obligation to teach well and to foster important forms of student learning. A more **scholarly approach to teaching** entails practices of classroom assessment and evidence gathering informed not only by the latest ideas in the field, but by current ideas about teaching the field and the effectiveness of its impact on student learning. It invites peer collaboration and review. **Scholarly teaching is what teachers should be engaged with on a daily basis** – whether with students in a classroom or in the office- tutoring, lecturing, conducing discussions; all the roles teachers play in terms of pedagogy. The work as teachers should meet the highest scholarly standards of groundedness, of openness, of clarity and of complexity. But the **scholarship of teaching requires that we step back and reflect systematically on the teaching we have done**, recounting what

we've done in a form that can be publicly reviewed and built upon by our peers. It is this difference that moves scholarly teaching to a scholarship of teaching (Higgs & McCarthy, 2005). In addition to teaching being made public, it must also be open to critique and evaluation and be in a form that others can build on:

> *A scholarship of teaching will entail a public account of some or all of the full act of teaching – vision, design, enactment, outcomes and analysis in a manner susceptible to critical review by the teacher's professional peers and amenable to productive employment in future work by members of that same community. (Shulman, 1998)*

Another attribute of the scholarship of teaching is it involves question asking, inquiry, and investigation, particularly around issues of student learning. The Carnegie Academy for the Scholarship of Teaching and Learning, for example, calls for investigations "not only into teacher practice, but the character and depth of student learning that results (or does not) from that practice." (Hutchings & Shulman, 1999).

So to be clear, it is too simplistic to refer to the scholarship of teaching as merely excellent work by educators. It requires an ongoing conversation or process in which questions of student learning are systematically investigated – the conditions under which learning occurs, what it looks like, and how to deepen it. Teachers do this with the goal of not only improving their own classroom, but to advance their practice beyond it. **The scholarship of teaching is the mechanism through which the profession of teaching itself advances**, through which teaching can be something other than a seat-of-the pants operation, with teachers making it up as they go. So, the scholarship of teaching has the potential to serve all teachers and all students.



Beyond Professional Development

Professional development opportunities are a ubiquitous part of a teacher's career. Sessions, workshops and seminars aim to update teachers' knowledge and skills in light of new teaching techniques and educational research, enable them to apply changes to teaching practice, and to exchange information and expertise amongst colleagues and other academics (OECD, 2009).



Professional development has been defined as "activities that develop an individual's skills, knowledge, expertise and other characteristics as a teacher" (OECD, 2009). Yet in a 2009 OECD (Organisation for Economic Cooperation and Development) survey, **a significant proportion of teachers said professional development does not meet their needs.** One of the main reasons is a lack of suitable development opportunities. This suggests a real need for policy makers and school leaders to ensure the chances teachers have to improve and learn from their practice are effective and meet their needs (OECD, 2009).

Consider the typical professional development session: The learning focus is typically on the acquisition of new educational knowledge and usually involves attendance at an externally provided conference or workshop. Basically, it's an isolated event, focused on practices decontextualized from the immediate demands of the classroom (Fullan, 2013). The take away of it is that teachers might find the information interesting, but it's rarely applied in their classrooms. They are too busy with the competing and immediate demands of their students and the curriculum content that needs to be taught to spend time trying to fit in something new that does not seem to be directly relevant (Timperley, 2011).

It's clear much of the current investment in professional development has failed to meet its goals, particularly when it comes to improving student learning and engagement.

Thinking of it as professional learning instead of professional development is key to improving these opportunities. The term professional development has connotations of delivery of information to teachers in order to influence their practice, whereas professional learning implies an internal process in which teachers create professional knowledge through interaction with colleagues and other educators in a way that challenges previous assumptions and creates new meanings. Challenge and meaning making are essential because **solving entrenched educational problems requires transformative rather than additive change to teaching practice.** Professional learning requires teachers to be seriously engaged in their learning, and it needs to be ongoing and in depth – not the brief and superficial engagement of teachers that occur in present PD programs.

Additionally, effective teacher professional learning needs to be motivated by a need to know, not someone else's desire to tell (Timperley, 2011).



What are these shifts in thinking about professional learning? (Timperley, 2011)

- **Students must be at the centre of the process:** Having students at the centre means being committed through professional learning to create the conditions where everyone learns, including leaders, teachers and students. It is no longer acceptable for teachers and leaders to say they provided opportunities for students to learn but they did not learn (Kaser & Halbert, 2009).
- **Focus on professional knowledge and skills:** The knowledge and skills developed through professional learning must meet the double demand of being both practical and understood in principled ways that can be used to solve teaching and learning challenges encountered in the future.
- **Professional learning as systematic inquiry:** This is about the nature of professional learning. Professional learning is an active process of systematic inquiry into the effectiveness of practice for student engagement, learning and well-being. This inquiry process has many parallels to formative

assessment practices found to be effective in promoting student learning. The same processes are applicable to teacher learning. The main difference is that teachers must reference their learning to both themselves and their students. Teachers frame their learning by identifying goals for both; they create partnerships with those with expertise to ensure their learning is focused and achieves desired goals; and they generate information about the progress they are making so that they can monitor and adjust their learning. There's more on how to take an inquiry stance on practice later in this chapter.

- **Professional learning at all levels:** Just like teachers, facilitators of professional learning and school leaders need to engage in ongoing inquiry into the impact of their policies and practices. An important question to ask is whether approaches to professional learning are consistent – is the rhetoric around developing motivated professionals who can make informed decisions about their practice based on deep knowledge, then contradicted by approaches to professional learning that involve brief workshops about how to teach something? Chapter 6 explores this more in-depth.

Knowledge For, In and Of Practice

Teachers must work with different types of knowledge; subject knowledge, pedagogical knowledge (deep knowledge about the processes and practices of teaching) and assessment knowledge. All three are integrated and work hand in hand with one another. For example, a teacher might assess a group of students and find they have not understood a particular concept. Unless the teacher understands the concept deeply, he or she is unlikely to be able to analyze possible misconceptions and create alternative approaches to teaching it. Teachers are always selecting particular teaching strategies moment by moment in classroom. Making the right choice and being able to retrieve them and apply them requires an understanding of why one approach is better than another (Timperley, 2011).

Teaching is a complex, theoretically informed activity and the theories underpinning practices are inevitably personal. If personal theories are not deeply informed by wider knowledge about effectiveness and why things work, then teaching becomes a personal rather than professional enterprise. Many teachers resist the need to understand theory because they perceive that their job is about practice. When they understand how theory informs practice and the two are intrinsically linked, they usually come to be more open to the possibility that theory really matters (Timperley, 2011).

Knowledge for practice: Is theory in practice, or the kind of knowledge teachers may need to rely upon in developing their practice (Darling-Hammond & Bransford, 2005). Teachers go to university, take courses, go to in-services or have professional development days geared to learning new ideas, models, theories, programs or applications.

Knowledge in practice: Is practical knowledge and reflective practice. Teachers keep their own journals and reflections, probing their own experiences and expertise as makers of wise judgments and designers of rich learning interactions in the classroom.

Knowledge of practice: Emphasizes the relationship between knowledge and practice and the theoretical aspects of both, assuming that "the knowledge teachers need to teach well emanates from systematic inquiries about teaching, learners and learning, curriculum, schools and schooling. This knowledge is constructed collectively within local and broader communities" (Cochran-Smith & Lytle, 2001). It emphasizes the role of the teacher in constructing knowledge and learning, and growing through that process. It also suggests the importance of ongoing inquiry by teachers in their own classrooms and into other practical sources of knowledge for addressing problems of practice (Darling-Hammond & Bransford, 2005).

Communities of practice play a central role in developing and transmitting knowledge from practice to research and back again. These notions of knowledge for practice, developed within a professional community of inquiring teachers, inform many of the emerging pedagogies in teacher education associated with the implementation of new teaching strategies and improvements in student learning (Darling-Hammond & Bransford, 2005).

An Inquiry Stance on Practice: How the Process of Inquiry Produces Knowledge

An important part of developing an inquiry stance to teaching practice involves having solid knowledge of practice, knowledge in practice and knowledge for practice. With this awareness, teachers within an inquiry frame of mind are able to take more control of their learning. Developing an inquiry habit of mind is essentially, the habit of needing to know and valuing deep learning (Cochran-Smith & Lytle, 2001).

Being a professional involves not simply "knowing the answers" but also having the skills and will to work with others in evaluating their own performances and searching for new answers when needed, both at the classroom level and the school level. Helping teachers learn to work in teams where they learn from one another is therefore extremely important (Darling-Hammond & Bransford, 2005).

This must be done in an environment of respectful challenge. Teachers cannot readily engage in cycles of inquiry and knowledge building when they feel criticized or put down for not being good enough. Focusing on what makes a difference is important in establishing a non-blame orientation to teaching and learning (Cochran-Smith & Lytle, 2001).

Learning can no longer be understood as a one-way exchange where "we teach, they learn." It is a process that requires teachers to help students learn with understanding, and not simply acquire disconnected sets of facts and skills. Effective teaching practices also recognize how important strong relationships are in educating students, building social cohesion and producing minds that thirst for knowledge for a lifetime (Friesen, 2009). Similarly, teacher education should lay a foundation for lifelong learning – and it must be something more than a cliché (Darling-Hammond & Bransford, 2005). Teachers themselves need to engage in sustained inquiry into their practice in order to support students' inquiry in the classroom (Beck, 2001).

The cycle of inquiry begins and ends with the knowledge and skills students need: (Timperley, 2011, p.22)

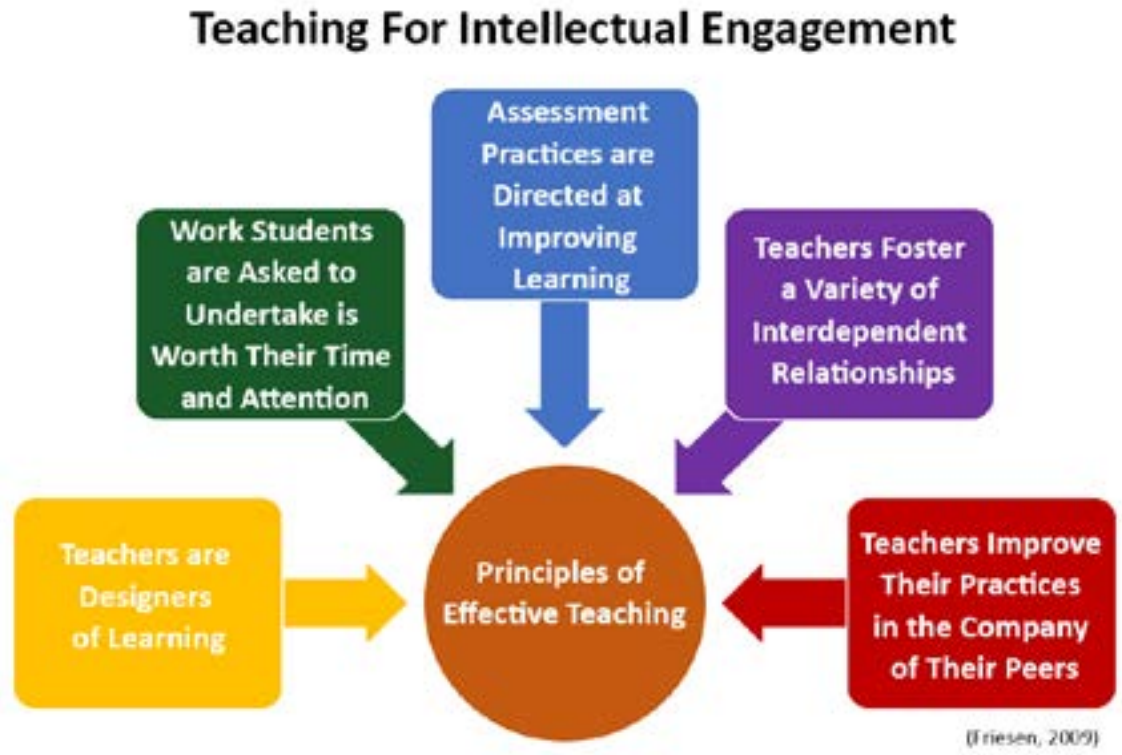


Additionally, professional learning should start with teachers asking themselves direct and focused questions about what students need to know and do: (Cochran-Smith & Lytle, 2001)

- What knowledge and skills do our students need to meet curricula, personal and social goals?
- What do they already know?
- What sources of evidence have we used and how adequate are they?
- What do they need to learn and do?
- How do we build on what they know?

Answering these questions requires focused assessment. Leaders and teachers need to know how to gather detailed diagnostic information about the knowledge and skills of individuals and groups of students to determine what is limiting their engagement and learning – and what is getting in the way of their learning.

Principles of effective teaching practice: (Friesen, 2009)



- **Teachers are designers of learning:** Learning opportunities must be thoughtfully and intentionally designed to engage students both academically and intellectually. While academic engagement draws our attention to on-task behaviours that signal a serious engagement in class work, intellectual engagement refers to an absorbing, creatively energizing focus requiring contemplation, interpretation, understanding, meaning-making and critique. Learning that invites students to engage intellectually results in more of a personal commitment on the part of learners to explore and investigate ideas, issues, problems or questions for a sustained period of time.

When designing learning for academic and intellectual engagement…

- Start with students' prior knowledge.
- Organize and use knowledge conceptually
- And build assessment into the fabric of the study.

These principles, along with the need to make meaningful connections to the students' lives and the world, require teachers to enter a cycle of defining, creating, assessing and redesigning that is essential in creating effective learning environments. Teachers speak and consult with colleagues throughout this process. Students, then, are better equipped to inquire into questions, issues and problems; build knowledge; and develop deep understanding.

- **Work students are asked to undertake are worth their time and attention:** To develop compe-

tence in an area of inquiry or study, students must have a deep foundation of factual knowledge. They must understand facts and ideas in the context of a conceptual framework and organize knowledge in ways that allow for its retrieval and application. These conditions can be achieved through work that is designed for and with students, and is relevant and connected to the outside world.

- **Assessment practices improve student learning and guide teaching:** Assessment should make up a large part of the school day as a seamless part of the learning process:
  - Assessment is embedded in the design of the teaching and learning
  - Students know the learning goals
  - They recognize the standards they're aiming for.
  - They're involved in self-assessment
  - The feedback provided enables students to take their next steps
  - Teachers hold the belief every student can improve; and
  - Assessment involves both teacher and pupils reviewing and reflecting on the assessment data. Wiliam et al. (2004) also stress the importance of teachers deliberately and directly teaching the habits and skills of collaboration in peer-assessment, which supports self-assessment by helping pupils see their own work more objectively, through the eyes of their peers. In order for students to guide their own work and to become more self-regulated learners, they need to be encouraged to keep the aims of their work in mind and to examine their progress towards meeting these aims through the lens of the assessment framework that they have collaboratively designed.

- **Teachers foster a variety of interdependent relationships:** Effective learning environments are characterized by interdependent relationships that promote and create a strong culture of learning. These relationships take place between teachers and students, amongst students, and between students and the broader community.

- **Teachers improve their practice in the company of their peers.** For too long, teachers have worked in isolation with only brief interludes to discuss professional learning. Research is clear, however, that learning improves when teacher learning happens in the classroom, teacher leadership receives consistent support and teachers have opportunities to learn from one another. Using networked communities of inquiry, educators can work collaboratively to investigate ideas and engage in pedagogical conversations about their own work and practice. In this environment, there are frequent professional conversations through network / school based communities of inquiry, access to other's classrooms, and collaborative planning. These are all effective professional learning practices well supported by research (Friesen & Jardine, 2011; Friesen & Lock, 2010; Hattie, 2009, 2012; Timperley, 2008, 2011; Willms, Friesen & Milton, 2009).

Cultivating an Evidence-based Practice

Professional learning is more than a process of acquiring, then applying new knowledge. Creating an evidence-based practice is founded on a basis of "know-how" and "know-why". Bereiter (2014) calls this principled practical knowledge. Working on ones own teaching practice as a design endeavour means that problems of practice serve as a starting place to being the iterative cycles of improvement. Collecting and analyzing student learning data to inform teaching improvement is integral to the professional learning process. Principled practical knowledge enables the continual and occasionally radical improvement of practice ensuring that teaching becomes a scholarly activity.

At the same time, the importance of having a solid foundation of knowledge cannot be underestimated. The knowledge and skills for teaching are acquired as much through the process of implementation as they are through someone describing or explaining theories and how to put them into practice. It is only when situational knowledge is understood in terms of the theory or principles underpinning it that teachers are able to retrieve and apply it appropriately in the moment-by-moment decisions they make every day in their classrooms (Timperley, 2011).

Teachers as adaptive experts:

Through engaging in the ongoing cycles of inquiry and building knowledge, teachers develop adaptive expertise. They're able to retrieve, organize and apply professional knowledge when old problems persist or new problems arise. Teachers continually expand the breadth and depth of their expertise and are tuned into situations when their skills are inadequate. They can identify when known routines do not work and they seek new information about different approaches when needed (Hammerness, Darling-Hammond & Bransford, 2005; Timperley, 2011).

Indeed, "letting go" of previously learned ideas and routines, or incorporating new information into teaching practice – choosing what to abandon and what to keep or modify – is a big part of what it means to be a lifelong learner and an adaptive expert. For an adaptive expert, discovering the need to change is perceived not as a failure, but instead, as a success and an inevitable, continuous aspect of effective teaching (Darling-Hammond & Bransford, 2005). Additionally, true adaptive expertise for a teaching professional involves a deep appreciation for the value of actively seeking feedback from many sources in order to make the best decisions for children and to continue to learn throughout one's life (Darling-Hammond & Bransford, 2005).



Video: **Wind Test** (https://vimeo.com/137391463)

Building adaptive expertise by assessing the impact on students: This is a continuous cycle of ongoing inquiry – assessing impact is not the end, but part of the process of delving deeper into information about students while developing a greater awareness of one's own practice. Teachers ask themselves:

- How effective has what we have learned and done been in promoting our students' learning?
- What should we keep going and what should we stop?
- What should we change or refine?
- What new challenges have become evident?

Remember, assessing effectiveness is not a periodic event that takes place outside regular daily activities. It happens on a lesson-by-lesson, week-by-week and more long-term basis. This checking process is an integral part of developing professional self-regulation – a key ingredient to deep learning (Darling-Hammond & Bransford, 2005).

> *"My role, as teacher, is to evaluate the effect I have on my students, to understand this impact, and to act on this knowing and understanding."*

- When teachers gather defensible and dependable evidence from many sources and have collaborative discussions with colleagues and students about this evidence, the effect of their teaching visible to themselves and to others (Hattie, 2012).

As the research base on adaptive expertise expands, a clear finding is that positive outcomes for students are more evident in professional learning initiatives that develop adaptive expertise than those that do not.

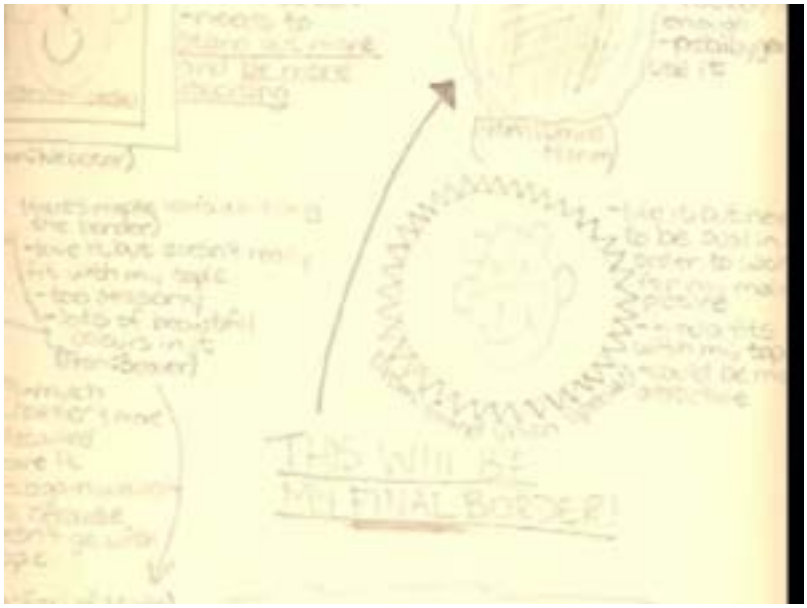
Schools with high adaptive capacity develop the adaptive expertise of their teachers as they help them to construct and reconstruct their environments through cycles of inquiry and knowledge building to meet student needs better.

Adaptive capacity of the school as an organization is not developed through bypassing the learning needs of leaders. While it may be appropriate at times for specialist experts to work directly with teachers, sustainability depends on the extend to which leadership capability to undertakes this role is developed within the school (Darling-Hammond & Bransford, 2005).

Making Teaching Public

How do teachers learn to become members of a professional community that improve student learning? As mentioned previously, ongoing conversations and observations of teaching practice with colleagues, through the lens of inquiry, is a crucial step. Developing skills of adaptive expertise and letting go of the idea that honing on and improving professional practice is not a sign of weak teaching, are also important.

A professional learning community refers to a group of educators working together to learn about their practice for the purpose of improving student learning (Stoll, Fink & Earl, 2003). Within these communities, Stoll, Fink and colleagues refer to learning becoming "a collective enterprise that ensures individual learning adds up to a coherent whole, driven by high quality pupil learning as its fundamental purpose (Timperley, 2011). The result of these attitudes towards teaching is that it becomes community property, visible not only to the teachers and students themselves, but also to the wider community and to the scholarly community, where teaching needs to be viewed through more of a scholarly window.



Video: **Evaluating the Design Process** (https://vimeo.com/137391461)

What does it look like? Sharing documentation with colleagues:

Focusing the documentation

- Review a lesson or recurring classroom routine or activity such as a student feedback session, preparation and presentation of a project or report, or group work.

- Explore a question about teaching and learning (How are students making sense of a concept? What are the strengths and challenges of group work in your classroom?)
- Determine the impact of an activity or lesson on student learning, attitudes, or behavior

Collecting the documentation

- Think ahead to the moment when the activity, routine, demonstration of understanding, or other behavior is most likely to occur
- Decide on the documentation tools you will use (camera, notebook, tape recorder, video camera)
- Arrange to have a parent, colleague, or student help you document or watch the rest of the class while you document
- Focus on capturing the thinking and activity of one small group rather than trying to document multiple groups

Shaping the documentation to share with colleagues

- Select photographs, video-clips, and/or excerpts from your notes or recordings that relate to your inquiry.
- Be sure to include enough material for a group to engage in a meaningful conversation, but not so much that there isn't time to both look at and discuss.
- Put documentation into an easily shareable format.

Discussing the documentation

- What are students learning and understanding?
- What are the key concepts or skills the students are working on?
- What evidence do you see of student learning?

How is the group learning?

- How do the interactions or conversations among students help them learn or make learning more difficult? (Consider size and composition of the group, the language and strategies used, the roles students take, and what they choose to share with each other.)
- When does one person's thinking seem to affect the thinking of another or the whole group?
- What does the documentation suggest about creating better conditions (physical space, time materials, nature of the task, etc.) for learning in groups?

Where do you go next?

- What might you try next to deepen or extend students' thinking or learning?
- What might be the value of sharing some or all of this documentation, and perhaps your own reflections, with the students? What might you select and how might you frame it?

- What is still puzzling or interesting to you after viewing the documentation? (Reeves, 2008)

Treating teaching as community property not only contributes to improved student learning, it also legitimizes teachers as members of a scholarly community who analyze and contribute to their profession on a regular basis. The way teaching is treated is removed from a community of scholars. There are three strategies that would aid in this transformation:

- **Reconnecting teaching to the disciplines:** Institutional support for teaching and improvement usually resides in a university where teachers are trained and faculty – regardless of department – can go for help in improving their practice. It's a perfectly fine idea, except it conveys a message that teaching is generic, technical and a matter of performance; that's it's not part of a professional community – it's something general you lay on top of what you really do as a scholar in a discipline.
- **If teaching is going to be community property, then it must be made visible through artifacts that capture its richness and complexity.** In the absence of such artifacts and documentation, teaching is a bit like dry ice; it disappears at room temperature. Scholarship in fields of study such as medicine doesn't dispute the importance of documenting and recording findings. The same approach should be lent towards teaching as well.
- **If teaching is considered community property, it must then be open to peer review:** Research papers and other documents of teaching have a value, and therefore, an obligation exists to judge it. This is for the progression of the field itself. Evaluations, whether negatively or positively received, have important ramifications for legitimizing teaching as a scholarly endeavor. Teaching then gets treated more seriously, more systematically, and becomes central to the lives of individual faculty and institutions. It also results in procedures from which faculty are likely to learn how to teach better (Shulman, 1993).

What are some of the practices within professional learning that need to take place for this to happen? First of all, there has to be support from individual teachers, group and whole schools that professional learning must be targeted towards learning and school improvement. Teachers' professional learning plans, and particularly, the teaching practices that are the focus of these plans, should be made public. This way, teachers with a common learning focus can support each other within a professional learning community, and those who may be using a certain practice effectively can share what they've learned. These learning plans should also be created to capitalize on specified learning goals and draw on specific teaching skills through effective, targeted professional learning. The plans should be reported on and reviewed regularly (Fullan, 2013).

Essentially, direct observations of the professional practices of teachers by teachers must become the new foundation of professional learning. Colleagues, classroom experience and students are a teacher's key influences (Reeves, 2008). "Teachers must be high-level knowledge workers who constantly advance their own professional knowledge as well as that of their profession" (Schleicher, 2012, p.11).

CHAPTER 6

Leadership Imperative



Instructional Leadership

What is Instructional Leadership?



Permeating every aspect of school life, the school principal is an educator, administrator, coach and mentor. The principal's role has evolved over time; from the top-down lone authority tasked with rescuing vulnerable schools from failure, to an effective leader who encourages those qualities in students and teachers, motivating them to step out beyond classroom boundaries to transform the school from a workplace to a learning place (Hallinger, 2005).

Twenty years ago, teachers and even assistant principals didn't take on school leadership roles. In order of importance, the usual responsibilities of a principal were managerial, political and instructional in nature, and the roles were separate. Now, many principals are experiencing diminished managerial and political priorities in favour of increased instructional and student learning priorities, and the roles are more interconnected (Hallinger, 2005).

The principal remains the designated leader of the school, but today, leadership is distributed across different people and situations – it's more like patterns of influence across many players. Leadership effectiveness depends on how this influence promotes leader and teacher learning (and sometimes parent learning), in ways that improves the engagement, learning and well-being of all students. This is not the work of one person.

Distributing leadership does not mean the principal delegates responsibility to others and remains aloof from what is happening in students' learning environments. It involves interacting with teachers and developing relevant materials, routines and structures to promote learning (Timperley, 2011). The principal

sets the tone for the entire school – studies over the past 25 years have shown the school principal's effects on classroom instruction operate more through the school's culture and by modeling rather than through the direct supervision and evaluation of teaching (Reeves, 2008).

An instructional leadership mindset includes an intense moral purpose focused on promoting deep student learning, professional inquiry, trusting relationships and seeking evidence in action (Timperley, 2011). Great leadership requires attention to daily management tasks involved in running an organization; Creating a safe and secure learning environment and effective interventions for students in need, catching great teachers doing things right, and supporting them with genuine appreciation and emotional intelligence.

Educational leadership is more than a spot on a hierarchical organization chart. The quality and practice of leadership at every level has a demonstrable impact on organizational health in general and on student achievement in particular. (Reeves).

A number of recent research studies have shown that school leaders have an impact on student learning (Leithwood & Seashore-Louis, 2011; Robinson, 2011). Vivian Robinson (2011) conducted a meta-analysis of 30 studies which examined the impact of educational leadership on student learning. Her analyses of the studies identified five different leadership practices that made a significant difference to student learning.

Leadership Practice	**Effect Size**
Establishing goals and expectations	0.42
Resourcing strategically	0.31
Ensuring quality teaching	0.42
Leading teacher learning and development	0.84
Ensuring an orderly and safe environment	0.27

These five leadership practices or dimensions "tell leaders what to focus on to have an impact on student learning; however they say very little about the knowledge, skills, and dispositions needed to make the practices or dimensions work" (Leithwood, Seashore-Louis, 2011; Robinson, 2011). Robinson contends that there are three capabilities that are needed to engage in these five practices:

- The capability to apply relevant knowledge within a leader's practice
- The capability to solve complex problems.
- The capability to the type of trust needed for doing the hard work of improving and strengthening teaching and teacher learning.

Helen Timperley contends that if principals are going to lead teacher learning and development they must know their class of teachers. They need to know what teachers already know and do well and when teachers need to learn. They also need to learn and do what makes a difference to teacher learning and student learning. Principals learn to lead teacher learning and development when they, themselves, undertake a process of cycles of inquiry for leadership learning (Timperley, 2011).

Providing Leadership Through a Disposition of Inquiry

When teachers work together bringing forward evidence from student learning to improve classroom practice and learning, they're tapping into the most important source of instructional improvement in schools –teacher-to-teacher professional learning and collaboration. Some of the most important forms of professional learning occur in daily interactions among teachers – whether it's improving lessons, deepening understanding of content, analyzing student work or examining student performance (Sparks, 2013).

The central challenge faced by all leaders is to create situations that promote teacher learning about teaching practices that make a difference for students. This kind of knowledge-building work must become the core business of school leaders (Timperley & Hulsbosch, 2010).

One approach to building knowledge could be to help teachers learn how to diagnose the learning needs of individual students and how to teach them in specific ways, together with finding out why particular approaches and strategies were more likely to work than others. This type of knowledge building is very specific to the students and the task at hand. At the same time, the knowledge is developed in ways that teachers could use it with other students and situations. **When professional learning is focused on cycles of inquiry into students' needs, then making changes in students' learning environments becomes an integral part of building knowledge** (Timperley, 2011).



Of course, this is only realized when positive and respectful relationships are cultivated – amongst teachers and between teachers and principals/leaders.

Relationships between teachers and leaders are central to well-functioning schools. They are the platform from which school improvement and improvement in student learning takes off. For these relationships to succeed, trust and respect must become core values. Listening to others, having a willingness to extend beyond what is formally required, and believing that colleagues have the knowledge, skills and capacity to deliver on intentions and promises, all go a long way in both teachers and leaders feeling respected and acknowledged (Timperley, 2011). In this environment, leaders can challenge teachers to think more about student outcomes, their practice, and what is needed when it's evident change needs to happen. And teachers, through their own work, are committed to making this happen. Because everyone has the same goals, teachers aren't targeted and made to feel that their practice isn't 'good enough' – both teachers and leaders are working together to maximize and improve student learning.

"Leaders are the stewards of organizational energy…they inspire or demoralize others, first by how effectively they manage their own energy and next by how well they manage, focus, invest and renew the collective energy (resilience) of those they lead." (Loehr & Schwartz, 2013)

Teachers need learning leaders who can provide the right support for, so that they in turn, promote their students' learning. These leaders care about and focus on the learning needs of pupils and the professional growth of teachers, and work hard to enhance the role of the schools as an agent of social change. The quality of leadership matters in creating, developing and broadening intellectual social and emotional capital within and beyond the school and providing optimal conditions for resilience, commitment and effectiveness amongst staff. Supportive organizational communities don't happen by chance. They require good leadership (Day & Gu, 2014).

When leaders and teachers engage in ongoing inquiry and knowledge-building cycles, inquiry habits of mind become part of how things are done. These are habits of using inquiry and reflection to think about where you are, where you are going, and how you will get there – and then turning around to rethink the whole process to see how well it is working and make adjustments. It means things are focused, but sufficiently flexible to meet individual teacher and student needs as they are identified. Opportunities for professional learning reflect the structure and rhythm of what typically happens throughout the school day, week and year. Some are formal, and some are informal. Some are in school, and others out of class. Other opportunities for professional growth may be individualized and situated within student learning environments. All move in the same direction. Coherence across professional learning environments are not achieved through the completion of checklists and scripted lessons, but rather through creating learning situations that promote inquiry habits of mind throughout the school (Timperley, 2011).

Indeed, engaging in inquiry and knowledge building cycles at all levels of the school organization is seen as core to professionalism – leaders and teachers become deeply knowledgeable about both the content of what is taught and how to teach it and create the organizational structures, situations and routines to develop it further. Everyone becomes aware of the assumptions underpinning their collective practice so they know when they are helpful and when to question them, and if necessary to let them go. They become expert in retrieving, organizing and applying professional knowledge in light of the challenges presented by the students they are teaching. The routines involve being constantly vigilant about the impact of leadership and teaching on students' engagement, learning and well-being (Timperley, 2011).

What else does this mean for teachers?

With an inquiry stance on leadership, teachers challenge the purposes and underlying assumptions behind educational change, rather than simply helping to specify or carry out the most effective methods for predetermined ends (Cochran-Smith & Lytle, 2001). As teachers investigate their practice more deeply, they adopt a scholarship of teaching. They're doing more than transmitting information to students – they investigate, transform and extend knowledge, using the same habits of mind that character-

izes the scholarly work found in the field of medicine or law, for example—the type of practice that is the hallmark of discipline-based inquiry (Hutchings & Shulman, 1999).

Looking into practice and adopting a scholarship of teaching gives teachers the ability to self-reflect. To get to the fullest, deepest questions about teaching, educators will have to learn and borrow from a wider array of fields and put a larger repertoire of methods behind their practice (Hutchings & Shulman, 1999).

What does this mean for leaders?

Just like teachers, school leaders need to engage in ongoing inquiry into the impact of their policies and practices. They need to identify personal learning goals and seek the appropriate response to achieving them. When it comes to the issue of teacher learning and improvement, an important question to ask is this: is the rhetoric around developing motivated professionals who can make informed decisions about their practice based on deep knowledge, but then contradicted by approaches to professional learning that involve brief workshops about how to teach something? (Timperley, 2011). Teachers need learning leaders who can provide the right support for teachers to learn, so that they, in turn, promote their students' learning. They need to work in a system that learns. And a system lift requires a systemic response.

> *The way schools are organized and run needs to be consistent with the broadening outcomes and the balance of, or selection between, the forces on them. Schools and their leaders will need to move from the bureaucratic and mechanistic to organic living systems, from thin to deep democracy, from mass education to personalization through participation, and from hierarchies to networks. (Mulford, 2008)*

How to get there from here: school systems

Improving learning for students over an entire school system is a daunting task. Where do leaders begin? All too often, they're told to start change efforts from a perspective or point different from their current reality. Educators in a moderately performing system, for example, are better off seeking inspiration from other moderately performing schools that are seeking to improve, rather than a system configured and positioned very differently, even if they are the among the best-performing systems in the world (Mourshed, Chijioke & Barber, 2010).

A small number of critical factors go together to create the chemistry of widespread improvement. A school system can develop and implement a journey to improvement, but to achieve success, these five points must be in place: (Mourshed, Chijioke & Barber, 2010)

- **The status quo, or performance stage**, which identifies an awareness of where the system cur-

rently stands, while having an appreciation for the ongoing journey towards school and student improvement. It's a snapshot of a moment in time. Student outcomes determine where a school system stands in relation to others.

- **The intervention cluster**, which is all about what is needed to make the desired improvement in student outcomes. Leaders must take into account the performance of the system currently, while deciding on interventions to improve performance while considering the socio-economic, political and cultural context in which they operate.

Peer-based learning through interactions that are school-based and system-wide, is one intervention that makes a great system become excellent. School systems that are struggling, however, would experience a different set of interventions – teaching is more tightly controlled and consistency in learning processes would be similar across all classrooms because minimizing variation is the core driver of performance improvement at this level.

What is common to all types of school systems seeking to improve, however, are interventions related to revising curriculum and standards, ensuring an appropriate reward and remuneration structure for teachers and principals, building technical skills, assessing students, establishing data systems, and publishing effective policy documents and the implementation of education laws.

- **The system's adaptation to the interventions,** taking into account the history, culture, politics and structure of the school system and surrounding communities.
- **Sustaining is all about ensuring improvement over the long term.** School systems that do this have learned how to navigate the challenges of their context, or situation, and use it to their advantage. This is accomplished by a strong pedagogy supported by practices that are collaborative in nature.

  How is this accomplished? Through the creation of an environment in which teachers and school leaders work together to embed routines that nurture instructional and leadership excellence. This includes making classroom practice public, and developing teachers into coaches of their peers. These practices are supported by an infrastructure of professional career paths that not only enable teachers to chart their individual development, but also make them responsible for sharing their skills across the system. Because these collaborative practices shift the drive for change to the front lines of schools, it causes system improvement to become self-sustaining.

Continuity in leadership is also an important sustaining factor. The most successful school systems actively foster the development of the next generation of system leadership from within.

- **Ignition** describes the necessary conditions that allow a school system to embark on its reform journey. The starting point for every school system embarking on improvement is to decide just how to overcome any present inertia. School systems that have successfully ignited reforms and sustained the momentum have all relied on at least three events to get them started: They have either taken advantage of a political or economic crisis, or commissioned a high-profile report critical of the system's performance, or have appointed a new, energetic and visionary political or strategic leader.

> **As the performance of the school system rises as a whole, professional development shifts away from a focus on technical training delivered by central coaches to a greater reliance on teacher-peer collaboration and development.** *This leads to further innovations in teaching and learning, and more of a feeling of professional fulfillment among educators. Accountability for student learning also expands and improves, from the sole indicator of assessment being standardized tests, to the inclusion of school and teacher self-evaluation. -How the world's most improved school systems keep getting better. McKinsey & Company. 2010.*

In order for learning leadership, of which instructional leadership is a subset, to flourish – and with it, teaching, and system-wide school improvement, two important factors must be in place: A culture of creativity, which gives space for innovation to happen; and a system that fosters communication and understanding to ensure success, not stagnation, becomes reality.

Creating a Culture of Creativity, Risk-Taking and Innovation

School leaders are the architects of the social, emotional and intellectual organization of the school. They weave different human and material resources into a significant cultural tapestry (Deal & Peterson, 2009), which incorporates individual strengths and commitments into a collective and collaborative whole and provides a platform for effective discourse and eventually, improvements, to take place.

Promoting and cultivating healthy individual and collective learning and achievement cultures in schools is essential to how teachers feel about their work and how they think about themselves as professionals. The extent to which they are able to find continuing professional and personal fulfillment through their work, and through these, sustain their commitment to teach to their best over time, will depend to a large extent upon the opportunities they have to grow, sustain and renew their capacities to be resilient (Day & Gu, 2014).

It's an essential consideration, given the degree of a teacher's professional fulfillment affects classroom practice, and classroom practice has a large effect on pupil learning and achievement (Deal & Peterson, 2009; Hallinger, 2005; Hanushek, Kain & Rivkin, 2005; Leithwood, Day, Sammons, Harris & Hopkins, 2006; Rockoff, 2004).

Learning to teach and developing an identity as a teacher:

Developing an identity as a teacher is an important part of securing a teacher's commitment to the work and adherence to professional norms of practice. The identities teachers develop shape their dispositions, where they place their effort, whether and how they seek out professional development opportunities, and what obligations they see as intrinsic to their role (Darling-Hammond & Bransford, 2005).

Ideally, new teachers should learn to teach in a community that enables them to develop a vision for their practice; a set of understandings about teaching, learning and children; dispositions about how to use this knowledge; practices that allow them to act on their intentions and beliefs; and tools that support their efforts:

"Teacher candidates must form visions of what is possible and desirable in teaching to inspire and guide their professional learning and practice. Such visions connect important values and goals to concrete classroom practices. They help teachers construct a normative basis for developing and assessing their teaching and their students' learning" (Feiman-Nemser, 2001).

Learning to teach in a community, and extending that, to engaging in professional practice as a community, are both powerful influences on learning (Cochran-Smith & Lytle, 2001).

Teacher quality is the single most important variable influencing pupil achievement (Organization of Economic Cooperation and Development, 2005). **So, making teaching a more attractive and more effective profession must be the priority in all school systems if they are to secure and enhance effective learning** (OECD, 2009; Organization of Economic Cooperation and Development, 2011). Indeed, reports detailing the experiences of the world's best performing school systems concluded that getting the right people into the teaching profession and, once in, developing them to become effective teachers, has played a central role in enabling these systems to come out on top, and more importantly, continuing to improve (Barber & Mourshed, 2007; Mourshed, Chijioke & Barber, 2010).

A strong school isn't possible when leadership from the principal is weak or ineffective, Grissom (2011) analysis of national school and teacher surveys showed that **teacher satisfaction is likely to be lower, and the probability of teachers leaving school significantly greater when school leadership is lacking or is ineffective** (Day & Gu, 2014).

Schools will improve for the benefit of every student only when every leader and every teacher are members of teams where the culture reflects a synergy in problem solving, and emotional and practical support. In this environment, leadership is distributed to better tap the talents of members of the school community, and interpersonal accountability, which is necessary for continuous improvement, is promoted. Such teamwork not only benefits students, it also creates supportive leadership, as well as time for the meaningful collaboration that allows teachers to thrive and address the complex challenges of their work (Sparks, 2013).

Indeed, school improvement and innovation doesn't come from heroic individuals who overcome the system's inherent inertia, but from committed communities of educators who are empowered by a system that nurtures curiosity, seeks innovation and displays a bias for action. At the same time, it's only when the individual professional commitment of teachers is aligned with structures and strategies that encourage innovation is there any chance for systemic change (Beairsto, 2012).

Effective teams:

- Use protocols to help guide the group work and provide a consistent framework.
- Agreements put in place are clear, purposeful, and understood.
- Must be committed to agreed-upon decisions and plans of actions.
- There is a sense of accountability and obligation to the team for its progress.

Ineffective teams:

- An inattention to results
- Avoidance of accountability
- Lack of commitment
- Fear of conflict
- Absence of trust.

(Sparks, 2013)

Practical ways to promote networks of teams in schools:

- Ask teachers to keep weekly journals on just two students, one who is underperforming and one who needs to be challenged beyond the current curriculum. Have them consider questions such as what did you try/what worked/didn't work /what's next. Taken alone, it's difficult to draw conclusions from the observations of just one person. But when the entire faculty contributes to such an effort, isolated practices can be highlighted and shared frequently and systematically.
- Make faculty meetings an announcement-free zone, in which all administrative announcements are relegated to paper or email, and all faculty meeting time is focused on professional sharing.
- Create a best-practices book every year, with each teacher contributing just a single page. Present the booklet as a going-away present at the end of the year, and as a welcome at the beginning of each year as a recognition of great, local teaching practices. Over the years, the great work of a single teacher will influence the best practices of colleagues years into the future.
- Create a best practices club with student involvement – students help identify teaching practices that positively affect learning. In this ways, students can see themselves as part of the learning process.
- Allow anonymous sharing of best practices during each faculty meeting and professional development session for questions, challenges and success stories. Teachers know who the most effective professionals are, but the technique of anonymity shields the authors of success from accusations of self-promotion (Reeves, 2008).

The importance of respect:

Superintendents must take the impact of respect for employees seriously, as it is directly related to one of the key challenges of educational leadership today – retaining and recruiting teachers and leaders. (Reeves, 2008)

- Recognize excellence
- Emphasize freedom to use judgment
- Listen to and act on teacher ideas
- Encourage innovation – many senior leaders are masters of innovation. That's great, but it's also a potential limitation. Because when a senior leader is innovative and thoughtful, the positive impact on other innovative colleagues may be diminished. If you want to encourage teacher leadership, encourage innovation and get out of the way.
- Provide feedback and coaching – must take place more frequently and at every level – students, teachers and leaders.
- Value people as individuals. This is perhaps the greatest challenge in transforming respect from a song title to daily reality.
- Provide a sense of being included.
- Apprentice diverse perspectives, ideas and work styles. Every challenge and diverse perspective is an opportunity.
- Encourage full expression of ideas without fear.

- Listen to, and fairly handle complaints.

Promoting teamwork while achieving coherence as a learning system:

- Requires high levels of energy and innovation with students' engagement, learning and well being at the forefront.
- New areas of learning and inquiry are linked to previous areas of inquiry. When thinking about what's next, consideration is given to what has been learned before. The main purpose of linking areas is to facilitate the transfer of key ideas from one focus to another. This kind of coherence requires a whole school strategic approach to professional learning. Professional learning plans come to mirror student learning plans, with both tied to strategic goals for the school as an organization. This does not mean professional learning plans look the same for everyone. It means they all pull in the same direction.
- Approaches to professional and student learning are consistent with the principles underpinning the inquiry and knowledge-building cycle (Reeves, 2008).

Strategies for bringing implementation closer to reality:

- **Create short-term wins:**

  Effective leaders design plans in the spring and summer that will produce short-term wins within the first few weeks of school. For example, every two weeks, principals can post the percentage of faculty who agreed on the score of a collaboratively evaluated student assignment. A higher percentage indicates a more effective collaboration and a clearer scoring guide. This type of effort is particularly important when turnover occurs during the summer and staff members are unintentionally sending very different signals to students about their expectations.

  Formative assessment is one important way to provide short-term wins throughout the year (Ainsworth & Viegut, 2006; Chappuis, Stiggins, Chappius & Arter, 2011; Popham, 2006). (Ainsworth & Viegut, 2006; Chappuis, Stiggins, Arter & Chappuis, 2004; Popham, 2006). It is absolutely vital the true meaning of formative assessment is understood. It is an ongoing activity designed to give meaningful feedback to students and teachers and improve professional practices and student achievement.

  The key to effective short-term wins is that the objectives are meaningful, attainable, and provide immediate feedback to reinforce effective practice and modify ineffective practice. Without short term wins, the pain of change often overwhelms the anticipated long-term benefits.

- **Recognize effective practices simply and clearly throughout the year.**

School leaders can display professional practices and student achievement data on simple three-panel boards: Student data on one panel, adult actions on the middle, and inferences and conclusions on the right-hand panel. This can be district-wide initiative, kind of like an adult science fair.

- **Emphasize effectiveness, not popularity.**

  Too many change efforts fail because leaders have underestimated the power of the prevailing culture in undermining change. To challenge that culture, leaders must be prepared to stand up for effective practice even if changes are initially unpopular. If the litmus test for goal achievement is the short-term popularity of the changes necessary to implement the goals, then the strategy is doomed. Change inevitably represents risk, loss and fear, which is never associated with popularity.

- **Make the case for change compelling and associate it with moral imperatives rather than compliance with external authority.**

  Instead of citing administrative requirements, inspire staff members with a call for their best. Close the implementation gap with immediate wins, visible recognition of what works, a focus on effectiveness rather than popularity, and an appeal directly to the values that brought us all into this profession in the first place (Reeves, 2008).

Fostering Communication and a Commitment to Understanding

"Know thy impact:" It's an essential mantra for classroom, school and system wide change. All adults involved in student learning must pay close attention and seek evidence of the impact their interventions have on students (Hattie & Yates, 2013). It's important at the system-wide level, an instructional leadership level, and also at the classroom level. But when it comes to the subjects they teach, few teachers are given the opportunity to reflect on its essential ideas and modes of inquiry.

General policies and broad guidelines are not specific enough to help teachers design curriculum, plan educational activities and assess student work. Before they can teach for understanding, teachers need answers to the following questions:

- What topics are worth understanding?
- What about them must students understand,
- How can we foster understanding, and
- How can we tell what our students understand? (Timperley, 2011)

Educational leaders can help teachers do the following:

Identify students' learning needs:

- Assists teachers to use evidence to investigate what students know and need to learn.

Identifying teachers' learning needs:

- Use evidence to judge current teaching practice
- Unpack links between personal theories and current teaching practices
- Close gaps between teaching and student learning
- Relate the specifics of practice to conceptual frameworks
- Co-construct a plan to address teachers' learning needs
- Link sites of learning to deepen knowledge and to aid transfer to different contexts
- Understand purpose and rationale of facilitator actions.

Identifying leaders' learning needs:

- Scaffold leaders to set up processes to support teacher learning.
- Co-construct a plan to address leaders' learning needs by identifying their responsibilities to lead the learning in their schools.

Checking effectiveness:

Assist teachers and leaders to use evidence:

- Of teaching practice to understand changes for students
- Of student learning to monitor progress
- Of both the above to guide decisions about future actions. (Timperley, 2011)

Teacher Leadership

Leading Teacher Inquiry

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. Within a framework for teacher leadership, it's suggested turning the recognition of teaching challenges into a process rather than an event, engaging more in education-related research, reflecting on results, and developing an attitude of resilience, all contribute to effective, successful teachers who are also leaders. Developing an evidence-based practice and mentoring colleagues allow the characteristics of leadership to flourish in all teachers.

> *"Part of our responsibility as teachers working to create a professional identity must be self-examination. 'Is my present practice as effective as I think it is?' As teachers, we must we willing to confront this question every day of our professional lives if teacher leadership is to become a reality rather than a slogan." (Reeves, 2008)*

Leadership Building Block: Resilience

Resilience in teachers is about managing the everyday challenges of the realities of teaching, while sustaining a sense of moral purpose and care. There's a determination to ensure the students' progress and achievement, which is accomplished through the quality of the teaching.

The nature of resilience and the resilience-building process is embedded in a web of interpersonal relationships. **Resilience is the culmination and continuation of collective and collaborative endeavors driven by a common understanding of moral purpose.** It's also nurtured by the social and intellectual environments where teachers work and live (Day & Gu, 2014).

The entire system must be resilient:

Accountability should not merely be something done to children or a threat to classroom teachers, but rather a system-wide ethic from the classroom to the boardroom. When such a pervasive focus occurs, there is a high probability that a resilient system will be sustained (Day & Gu, 2014).

Teacher leadership is critical to a successful school system. The single greatest influence on the professional practices of teachers is the direct observation of other teachers. And **with systemic support, that network of direct observation can transform a large and complex system with dramatic effect.**

Without systemic support, great teachers remain islands of excellence, surrounded by oceans of well-intentioned teachers who lack the information, skills and opportunities for practice that distinguish their most effective colleagues. A framework for teacher leadership, explained more fully later on, describes two stark alternatives: rejection or resilience. When teacher initiative and insight are repeatedly followed by rejection, the lack of systemic support will undermine the framework and render teacher leadership nothing more than a hollow slogan. When policymakers, administrators, and leaders at every level embrace the framework, then they contribute to the establishment of a resilient system that will endure disappointments and hardships because of the confidence in a culture of evidence and support for teacher leadership (Reeves, 2008).

Barriers to teacher leadership:

It's the three Bs: Blame, Bureaucracy and Baloney (which refers to prejudices and deeply held convictions without evidence). All three undermine research and teacher leadership. When we give evidence over baloney, supplant bureaucracy with networks and give evidence power over baloney, doors to the teacher leadership framework are open. (Reeves, 2008)

Leadership Building Block: Inquiry

Taking an inquiry stance means teachers and student teachers work within communities to generate local knowledge. They envision and theorize their practice, and interpret and interrogate the theory and research of others. The work of inquiry communities is both social and political – that is, it involves making problematic the current arrangements of schooling; the ways knowledge is constructed, evaluated and used; and teachers' individual and collective roles in bringing about change (Cochran-Smith & Lytle, 2001).

It's important to remember that inquiry is a stance, not a project or strategy:

- Through conversations and writing, teachers make what they know visible. Assumptions about common practices are called into question, and a variety of alternatives are considered. Descriptive talk and writing makes day to day classroom events and practices of teaching visible and accessible not only to other teachers, but to students, administrators and families. This is an important part of the culture of a community of inquiry.
- Taking an inquiry stance on leadership doesn't involve specifying or carrying out the most effective way to implement proposed educational change. Teachers aren't 'trained' in workshops or staff development projects, either. Instead, they challenge the purposes and underlying assumptions behind such change.
- When inquiry is a stance on teaching, learning, and schooling, there is an activist aspect to teacher leadership. From this perspective, inquiry communities exist to make effective changes in the lives of teachers and, just as importantly, in the lives of students and in the school environment.
- When inquiry is a stance on teaching, it is assumed that professional development is inextricably linked to larger questions about the consequences and ends of professional development:

- What are or should be the purposes of professional development?
- Who makes decisions about these purposes and consequences?
- In what ways do particular initiatives for professional development challenge and/or sustain the status quo?
- What are the consequences of teachers' learning for students' learning?
- What part does professional development play in school reform?
- How is professional development connected to larger social, political, and intellectual movements? (Friesen & Jacobsen, 2015)

Professional learning should start with teachers asking themselves some direct and focused questions about what their students need to know and do, together with more specific questions:

What capabilities (knowledge, skills, attitudes, and values) do our students need to meet curricula, personal and social goals?

- What do they already know?
- What sources of evidence have we used and how adequate are they?
- What do they need to learn and do?
- How do we build on what they know?

Answering these questions requires focused assessment. Leaders and teachers need to know how to gather detailed diagnostic information about the knowledge and skills of individuals and groups of students to determine what is limiting their engagement and learning – and what is getting in the way of their learning (Timperley, 2011).

Checking that students have new opportunities to learn is also a way to deepen teachers' professional understandings and to identify what needs to be refocused and refined to continue improvements. **Monitoring practice and its impact on students is not about checking that teachers are complying with requirements to practice in new ways, but rather, finding out what else needs to be learned.** Through trying things out in practice and checking to see if students are responding differently, learning is deepened. Teachers further develop metacognitive skills and come to take more control of their own learning. **They are able to work in partnership with others who have specialist expertise to identify what is working well so it can be retained and what is not working so well in order to change** (Timperley, 2011).

As mentioned previously, inquiry habits of mind can be developed through examining assessment information. This is true only if it's treated as a learning opportunity and discussions are conducted in respectful, yet challenging ways. What areas and which students have shown improvement? Is the improvement adequate? What areas and which students have not shown improvement?

One of the most contested issues around interpretation comes when people try to identify possible causes of improvement or non-improvement. **Investigating possible causes is fundamental to promoting an inquiry habit of mind and further learning.** This process is aided greatly by bringing together evidence of student learning. By doing so, the group can investigate possible causes over which teachers have some

control. It's also important to consider the lens through which individuals are bringing to interpretation (Timperley, 2011).



The Framework for Teacher Leadership:

The seven elements below are part of a perpetual cycle. It does not lead to a destination, but rather illustrates a continuous process that begins with the recognition of a challenge and proceeds to research by teachers and leaders. The results of the research can then stimulate reflection and reinforcement. This stage is critical because many inquiry processes stall at this point. Will future actions of the system be based on the evidence, or will the filter for action research be a fact-free debate in which personal preferences, traditions and opinions not only take precedence over evidence but also prevent a rational discussion of the evidence from taking place? (Reeves, 2008)

- **Recognition of challenge** – the power of comfortable convention frequently exceeds the attraction of potential benefits of change. Recognizing an educational challenge as a process and not an event, is key. When recognition is an event, it is characterized by information that is isolated, late and disconnected from the daily reality of the school or system. Newspaper articles about district and school average scores, elaborate data analysis, and new initiatives, whether presented with breathless enthusiasm or stern commands, are all events – and the reactions are predictable.

- **Research by teachers and leaders** – research holds an important, even hallowed place in education. Perhaps it is too hallowed, according to Ronald Wolk (2007), chairman of the board of Editorial Projects in Education, which publishes Education week. "Research is not readily accessible – either physically or intellectually – to the potential users…Even if research findings were widely available and written in clear prose that even a dimwit like me could understand, the reports would

not be widely read. Most teachers are not consumers of research, nor are most principals or superintendents."

It is not, however, merely the availability and accessibility of research that is the issue – too much research fails to meet teachers where they are, leaving them in a sea of ambiguity, filled with conflicting studies and findings.

When teachers work in an inquiry-based community of practice, they become educational innovators, capable of identifying and expanding upon what works in the classroom, with the ability to pass their knowledge on to other professionals.

- **Results in a public forum for students, schools and systems** – for research to have meaning for teachers, results must be compelling, transparent and public. It can be presented in a science fair-format with panel boards featuring student data, observations, results and inferences. Each teacher team can publish a report that includes research questions, hypothesis, research methods, findings, conclusions, personal reflections and suggestions for future research. This type of forum leads directly to reflection and reinforcement.

- **Reflection** – no matter what works in theory, the actual implementation of effective practice depends on providing teachers with the opportunity to reflect on research and consider the personal and professional implications of compelling research findings. Reflection is hardly a natural event among teaching professionals. It is not that they are unenthusiastic about reflection, but rather that few school schedules provide the time and structure for meaningful reflection on professional practices. Although many educators embrace the notion of professional learning communities, even the foremost proponents of the concept, Richard DuFour (2004), lament the use of the label without the supporting structure, time and leadership to allow for meaningful reflection.

  In an evidence-based culture, systems nurture and encourage teacher leaders and the insights they offer from their research. Even when the results are disappointing, the culture displaces blame with inquiry. The fundamental questions, then, aren't 'who was wrong', and 'where does the blame belong,' but rather "What can we learn from the results? and "how can we save time and resources by applying these valuable lessons."

  When results are encouraging and validate effective teacher leadership practices, the response should be ones of celebration, encouragement and genuine enthusiasm. Most important, the desired response to any research result – whether discouraging, encouraging or perplexing – is resilience.

  To be sure, the challenges are difficult as teacher leaders strive to achieve widespread implementation of action research. The goal will require a commitment of time for research, public sharing of results, and personal reflection. Data systems must be sufficiently sophisticated to provide frequent reinforcement and avoid the unproductive exercise in annual feedback that is too frequently late

and irrelevant.

- **Reinforcement –** depends on consistent feedback about student achievement, professional practices and leadership decision-making. Annual test scores are demonstrably inadequate to serve to reinforce instructional strategies that require daily perseverance.

- **Rejection –** for teachers, it's a visceral, emotional and powerful experience. Teachers invest their intellect, creativity, energy and emotion into an idea. With personal and professional courage, they engage in action research, exposing their successes and failures to the critical reviews of colleagues, friends and strangers. This is again, why strong, supportive learning and teaching environments are so important (Reeves, 2008).

Cultivating an Evidence Based Practice

Teaching is a complex activity, and the practices a teacher adopts are inevitably personal. But if teaching practice isn't deeply informed by a wider knowledge about educational research, research based on direct observation of classroom activity, and the theory underpinning it, then teaching becomes a personal, rather than a professional enterprise.

Many teachers resist the need to understand educational theory because they perceive their job is about practice. But when they understand how theory informs practice and the two are intrinsically linked, they usually come to be more open to the possibility that theory really matters (Timperley, 2011).

Personal practice develops over time and for experienced teachers, this takes place over years, often without ever being challenged. Questioning practice could be construed as challenging what it means for a teacher to be an expert.

That's why a top-down approach to professional learning and development isn't very effective in engaging teachers – **if the introduction to a particular professional learning focus begins with new approaches to teaching and learning rather than analyzing students' needs, resistance is more likely to arise because competition between theories of practice immediately becomes an issue for many of those participating** (Bransford, Brown & Cocking, 2000).

Teacher engagement in professional learning is essential – by focusing on evidence about students in their class and the challenges they present, the need to find out how to meet these challenges becomes the motivating force. Professional learning opportunities that are perceived as immediately relevant to their teaching situation is an essential factor. Through an evidence – informed process, initial resistance mostly disappears (Timperley, 2011).

It's already been mentioned that observation of classroom practice is the best way of finding out about student learning. Classrooms are complex places with multiple teaching and learning interactions occurring at once and it is difficult to determine what should be observed and how to decide. A few important principles to guide this decision- making (Timperley, 2011):

- What is observed relates directly to the professional learning area of focus and includes teachers' learning goals that have been developed to address a specific problem of practice.
- The focus should be jointly decided by the observer and the person being observed. Learning partnerships should not have unpleasant surprises associated with them.
- The criteria for determining what constitutes effectiveness are determined through references to the research and professional literature agreed in advance by the observer and the person being observed. Having a learning partnership means everyone is on the same page as far as possible with the partners drawing on the best sources of information available.

Classroom observations provide evidence of individual or school-wide practices. School-wide observa-

tions using consistent criteria allow teachers and leaders to obtain profiles across a whole school and thus provide a picture on which to base professional learning. With guidance, teachers can then discuss the profiles to help work their focus for learning. This approach might be important in the early stages to develop collective understandings and focus. Through identifying the criteria for effective practice together and discussing the findings from the observations, these discussions can deepen collective understandings of particular practices, especially if students' responses form part of the criteria.

Delving into students' understanding of their learning provides immediate feedback to teachers about their next teaching moves. It is also important to assess progress over the longer term, such as a year or more, with more standardized evidence to ensure that the students' progress is adequate (Timperley, 2011).

Having and using high-quality evidence (Timperley, 2011)

- Assessment information must be fit for the purpose of promoting teacher learning.
    - Assessment instruments and processes selected must provide the information required to inform what needs to happen for students to reach the outcomes desired. It means using fit-for-purpose assessment tools. For example, if the goal is to improve student engagement, then as assessment instrument or process that provides profiles of situations associated with high and low engagement for different groups of students is more useful than a generic engagement index.
    - Quality of information tends to improve as teachers and their leaders engage in iterative cycles of inquiry to build their pedagogical content knowledge, identify better questions to ask and seek more detailed evidence to answer them. As they become more sophisticated in analyzing student needs, the evidence sought becomes a search for answers to specific questions about specific puzzles evident in students' learning profiles. Teachers are likely to draw on a mix of norm-referenced assessments, teacher designed assessment tasks, and more informal processes such as observing students and analyzing student work.

- Procedures are used to attend to issues of validity and reliability.
    - It's important teachers have confidence in the quality of evidence they are considering. Data collection and analysis need to provide information on levels and rates of progress plus diagnostic information (Timperley, 2011).

When teachers are given the opportunity to engage in action research on a sustained basis in a collaborative environment, three things happen (Timperley, 2011):

- Teacher researchers frequently (although not always) have a direct and measurable impact on student achievement, behaviour and educational equity as a result of specific practices during their

research.

- Whether or not the teachers' hypotheses are supported by their research, teacher researchers affect the professional practices of their colleagues.
- Participation in action research and the observation of and reflection on research results can lead to what Collins (2001) calls the flywheel effect. Effective professional practices are reinforced and repeated not only by the original teacher researchers but also by many other teachers who are influenced by these observations and practices (Timperley, 2011).

Mentoring Colleagues

Teachers not only exert significant influence on the performance of students, they also influence the performance of other teachers and school leaders. And for many, the professional practices and action research from peers has far more impact than reading journal articles or even undergraduate or graduate courses.

This supports what has been mentioned previously: The direct observation of the professional practices of teachers by teachers must become the new foundation of professional development (Reeves, 2008).



Encouraging teacher mentors:

When teachers have a question about special education, assessment, instruction or classroom management, they do not ask the principal or the central office, they ask a colleague. In Malcolm Gladwell's (2002) terms, teacher leaders are mavens, the people to whom everyone turns when they have a question. Almost every school and system has such a maven. The problem is that they are largely unknown to the hierarchy and almost certainly not a part of it. So, the challenge for teacher leadership is to cast a wide net for the next generation of leaders, not only discovering those who call attention to themselves but also finding those many quiet teacher leaders who can serve our students and our society very well (Reeves, 2008).

Above all, in developing respect and challenge in school communities, teachers must trust their colleagues and have confidence they will be supported to make the changes and improvements that are necessary (Timperley, 2011).

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