An Old Tool with a New Twist:
Innovating with Inductive Teaching Methods

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Abstract

A major emphasis in the Nova Scotia Community College (NSCC) School of Trades and Technology is the adoption of an inductive teaching and learning philosophy. Teaching inductively starts with real-life applications as the context for learning. This is not something new; in fact, the approach comes by many names. The emphasis is on starting with the particular applications and moving to the more general principles. A focus on inductive methods has implications in how we approach teaching and learning in individual classrooms for individual learners, but it also has broader implications for how the school conducts its academic planning and operations. This necessarily involves everyone at all levels of the organization. We all need to be thinking about how we can be integrating inductive applications in what we do and how we do it. The challenge here is to think about how to create learning environments that use a more inductive approach. Inductive teaching and learning methods help ensure that learning is more workplace authentic and relevant. This approach promotes a culture of collaboration—working together through a real-world application of how and why things work. This paper provides a synopsis of how inductive teaching and learning have been woven into our school academic planning and the way we do business. It is our emphasis on inductive teaching that will assist us in achieving our articulated graduate profile.

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Nova Scotia Community College (NSCC) is a pan-provincial community college system that has campuses and community learning sites across the small eastern province of Nova Scotia, Canada. NSCC's new strategic plan emphasizes "education without boundaries," focusing on the ability of our learners to blend learning, community service, and work in ways that put them at the innovative edge of the global economy, where the world places a premium on knowledge, imagination, and skill [1].

The NSCC School of Trades and Technology is the largest of five academic schools in the organization and offers a wide range of academic programs in aerospace, engineering and applied science, transportation, manufacturing, energy, oceans, the built environment, and natural resources and environment. The school stays true to the historical roots of the skilled trades and has adopted a school vision embracing a broadened apprenticeship approach to help prepare applied learners for the skills and knowledge required in a 21st century economy that places a premium on sustainability [2]. Within this broadened apprenticeship approach, a major focus for the school is on the inductive methods that are so much a part of the apprenticeship model of learning. The premise is to start with the particular applications and move to the more general principles. Much work has been done to document the importance of inductive teaching and learning at the level of the individual program, course, and classroom environments [3]. Teaching inductively starts with real-life applications as the context for learning. A central tenet of the inductive approach is starting with the application first. This is not something new; in fact, the approach is known by many names: case-based teaching, inquiry-based learning, problem based learning, project-based learning, discovery learning, and the list goes on. Inductive approaches are well established teaching and learning methods [3]. The NSCC School of Trades and Technology is focusing attention on inductive teaching for individual learners in individual classrooms, but it is also taking action to make inductive teaching and learning a part of our academic planning and the way faculty and staff at the school do business.

Step 1: Start at the End with the Application

NSCC School of Trades and Technology's focus on inductive methods has implications for how we approach teaching and learning in individual classrooms. Building on the strength of the apprenticeship tradition in the skilled trades, inductive methods have been and are being integrated at the classroom level for the benefit of individual learners. However, on a larger scale, this focus on inductive methods reaches beyond the classroom to the broader sphere of the school's academic planning and operations. This necessarily involves everyone in the school. It involves the facilitators for the programs and courses, as well as the senior executive, managers, administrators, and support staff all of whom play a role in modeling the inductive approach. We all should be thinking

about how we can be integrating inductive applications in what we do and how we do it. There is opportunity for using inductive methods with all types of learning—formal and informal, in all semesters, all the time. The challenge is thinking about how to create learning environments that use a more inductive approach. Inductive methods help ensure that learning is more authentic and relevant. This approach promotes a culture of collaboration by working together through a real-world application to learn how and why things work [3]. Inductive approaches can work at the classroom level and can also work on the larger organizational level.

The NSCC School of Trades and Technology is modeling the desired outcome by taking the inductive approach to a different level of implementation, which is done by being inductive in the way we do business. Using the famous mantra of Mahatma Gandhi, the NSCC School of Trades and Technology is "modeling the change we want to see [4]." An important art of how we accomplished this, and continue to do so, is by modeling inductive methods in our academic planning. We took action to collaborate in creating a plan for the entire school that started at the end and worked backwards. The starting point for the school plan became a collaborative statement of where we would like to be in 20 years, along with a statement of our school's graduate profile. The school plan is similar to a blueprint for the future of our school, and we wanted it to showcase and model the teaching and learning philosophies that form the important foundation of the plan. The graduate profile and vision for where the school will be in 20 years is our inductive application that makes the desired learning relevant. For the purposes of academic planning, the inductive approach provided the immediate context and motivation for learning what the plan was about, where we were going, the desired characteristics of our graduates, and working to connect people with their role in attaining that vision.

Step 2: Ensure Active Involvement

The inductive approach requires that people are actively involved and work together in teams to solve a challenge. To involve people is to connect and engage them. Active involvement means taking that connection and engagement to a heightened level of change evoking motion and action [5]. Active involvement is akin to Paulo Friere's conception of praxis [6]. Praxis is a practical application or exercise of a branch of learning. Friere saw education as a change agent because many people associate education with danger, recognizing knowledge can mean power. Friere asserted that every human being is capable of looking critically at their own world in a dialogical manner with others and that the purpose of education to create a better society; a society where humans actively transform their society to make it better [6]. This praxis is essential. Active involvement is essential to ensure there is a collaborative element to what is happening. This collective praxis is an important component of what inductive teaching and learning is all about.

Engagement in the school plan was a key component of how the plan would be operated and truly come to life. A School of Trades and Technology Regional Summit event was held in May 2008 at one of NSCC's regional campus locations, located approximately one hour outside the metropolitan area. Modeling the inductive approach, this summit started at the end of where we want to be and worked backwards from there. Part of what was accomplished at this session was familiarity with the desired end—the graduate profile and the vision for the school in 20 years time. However, the regional summit provided the opportunity for participants to collaborate on ideas for being able to further implement the school plan. People considered action avenues in relation to four main areas:

- ❑ Action Strategies for Our College/Our School
- ❑ Action Strategies for Our Employers/Our Industry Partners
- ❑ Action Strategies for Our Classrooms/Our Learning Environments
- ❑ Action Strategies for Our Local Communities/Our Broader Communities

This activity helped promote engagement with the school plan and how people saw themselves and their respective areas of responsibility fitting into the school plan. Engagement in the school plan was rated as fairly high by participants at the regional summit, but the important part of the engagement will come as we continue to build on strength and further maximize the tenets of the plan.

As a part of the regional summit event, participants were asked to quantify their level of engagement with the school plan. They were asked to rate their knowledge, attitudes, and behaviors on a scale of one (low) to 10 (high) as they related to the school plan. For knowledge, summit participants were asked to rate their level of perceived understanding from one (low) to 10 (high). For attitudes, summit participants were asked to rate their level of perceived value from one (low) to 10 (high). For behavior, summit participants were asked to rate their level of perceived engagement from one (low) to 10 (high). This is shown in Figure 1.
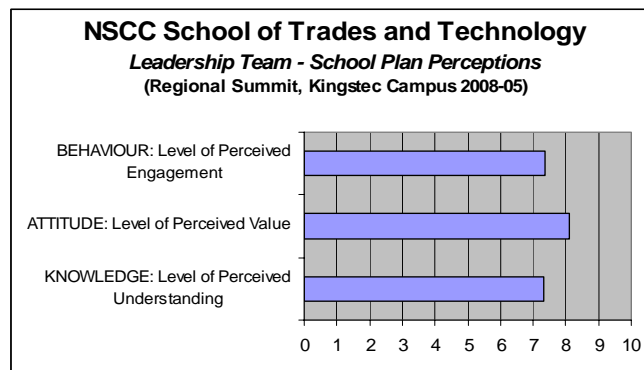

Figure 1: School Leadership Team–School Plan Perceptions

Results from the School Leadership team indicated a relatively high level of perceived understanding, value, and engagement with the school plan. The mean rating for KNOWLEDGE –Level of Perceived Understanding was 7.33 (n=27). The mean rating for ATTITUDE–Level of Perceived Value was 8.11 (n=27). The mean rating for BEHAVIOUR–Level of Perceived Engagement was 7.35 (n=27). This is shown in Figure 2.

NSCC School of Trades and Technology
Faculty and Support Staff - School Plan Perceptions
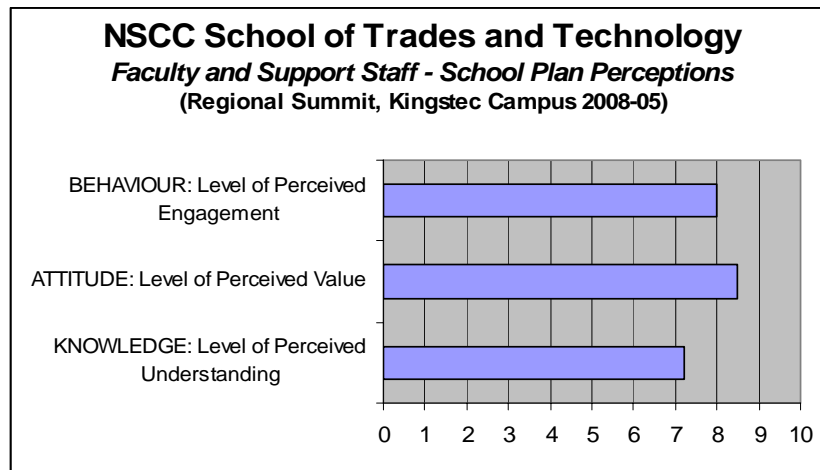**(Regional Summit, Kingstec Campus 2008-05)**

Figure 2: Faculty and Support Staff Team–School Plan Perceptions

Results from the Faculty and Support Staff team once again indicated a relatively high level of perceived understanding, value, and engagement with the school plan. The mean rating for KNOWLEDGE–Level of Perceived Understanding was 7.2 (n=32). The mean rating for ATTITUDE–Level of Perceived Value was 8.5 (n=32). The mean rating for BEHAVIOUR–Level of Perceived Engagement was 8.0 (n=31).

The school plan is the blueprint, and we are just starting the process of engaging further action relating to this school plan. An end-of-year message was sent to the entire school by the dean, again focusing attention on and modeling inductive teaching. The message shared the ideas and strategies generated at the regional summit. These ideas were also posted on a collaborative wiki located on the school portal site. The word "wikiwiki" means "quick" in Hawaiian, and a collaborative wiki is a shared document that any user can easily edit. In business environments, a wiki provides a low-maintenance way to record knowledge, share, and collaborate. Although there was not much of a response to editing the collaborative pages, once again, the desired action was modeled, and this speaks volumes to all involved.

Building on the strength of the regional summit, the momentum of implementing the school plan was again ignited after summer vacation with a school teaching and learning

symposium that engaged faculty over a period of four days and three nights before the formal start of the academic year. In August 2008, faculty, support staff, and management from the School of Trades and Technology participated in an active teaching and learning symposium at an off-site location along Nova Scotia's south shore. The event engaged participants in a process to explore, document, and develop course assessment and evaluation strategies, cross collaborative (theme integrated) projects, and a plan for the journey to 2010, when a new NSCC Trades-focused Campus building is completed. The symposium was planned to model the inductive methods and actually started with the end point of where the group needed to be by the end of the four day collaborative experience. Participants evaluated the experience highly and even found (some much to their surprise) that they got a lot out of working together and exploring ways to collaborate on integrated project-based learning opportunities. Work is now underway to build on the strength of this event and to continue the collaborative journey towards 2010. Additional action has taken place through the OURNSCC SharePoint portal, and a diversity of strategies will be used to help continue to bridge active engagement. The next stop will be a number of additional regional summits that will use an inductive approach to bridging understanding and engagement in the school plan. This is the shared praxis, collective vision, and action that is so much a part of the inductive approach at all levels of an organization.

Step 3: Provide Scaffolding

The inductive approach requires that people be given some initial structure to help them get started. They may need an initial process to assist them in working through the challenge. By definition, scaffolding is a temporary framework used to support people and material during the construction or repair of large structures [5]. Similar to the modular system of metal pipes used in construction, cognitive scaffolding assists with building the mental structures and schema necessary for solving large-scale challenges. The school distributed its draft plan internally, sharing the information in a form that was relevant and accessible to the respective faculty and staff audiences. Different versions of the school plan were drafted for the various audiences, but each version maintained access to the information for all and provided that immediate connection of application in terms of what the plan was for and how it was relevant to the school stakeholders.

As a learning organization, we provide different types of scaffolding relating to the different dimensions of learning. The idea of dimensions of learning identifies the qualitatively different components of the learning process. In 1992, Robert Marzano proposed five dimensions of learning: positive attitudes and perceptions about learning; acquiring and integrating knowledge; extending and refining knowledge; using knowledge meaningfully; and productive habits of mind [7].

To provide scaffolding towards the vision of what the school plan is directed towards achieving, the NSCC School of Trades and Technology School Plan built on and extended these foundational learning dimensions to include the following elements:

❑ **Realization of self:** The learner realizes their strengths and talents and how to accentuate them while acquiring, extending, and using knowledge.

❑ **Respect for others:** The learner appreciates that they must live and work in a world economy where they necessarily interact with individuals who have different strengths, talents, cultures, and beliefs. They will see the value in recognizing and celebrating diversity.

❑ **Realization of good work practices:** The learner gains an appreciation for being a good worker by infusing elements of teamwork, safety, diversity, professionalism, and other employability skills.

❑ **Making a difference:** The learner takes meaningful knowledge and subsequent action through mechanisms like service learning, which catalyze a spirit of the entrepreneur, inventor, and researcher. In other words, a sense of making a difference.

It is essential to help provide different types of scaffolding to provide a possible and accessible pathway for achieving the desired application. These learning dimensions are just one example of the type of scaffolding provided to the school plan to give it depth of possibility for involved stakeholders. As a school, we will continue to provide linkages and different types of scaffolding to help faculty, staff, and management stakeholders connect what they do on a daily basis to the strategic directions of the school and the college.

Step 4: Reflect on Learning Together

An essential aspect of the inductive approach is to debrief as a larger group to share in the learning. Reflecting involves thinking seriously, pondering, and considering [5]. Related to this emphasis on reflection, in 1990, Ernest Boyer published, "Scholarship Reconsidered: Priorities of the Professoriate," where he proposed four areas of productive scholarship [8]. These include:
❑ Scholarship of Discovery–new knowledge
❑ Scholarship of Integration–making connections across disciplines
❑ Scholarship of Application–applying new knowledge
❑ Scholarship of Teaching and Learning–communicating and sharing new knowledge

These components provide a sound theoretical basis for moving forward with our school plan. We also propose that there be a new category added to Boyer's established categories and that is a Scholarship of Reflection. Reflection is an essential, albeit often overlooked, component of scholarship. It is an integral part of inductive methods, portfolio learning, and our school plan.

As a part of the regional summit event, participants were asked to reflect on the summit event and provide comments and feedback about the school plan. Here are a few examples:

- *"I feel I have been thinking along those lines for years. So it is a welcome change."*
- *"Being a new faculty member, I feel I have the ability to adapt well to any change."*
- *"I'm just starting out. It will grow. Ask me the same question next year!!"*
- *"I'm there! I'm in!"*
- *"Great plan!"*
- *"Can't wait to get started."*

There is much truth in these comments. The comments illustrate the diversity of the audience, which was comprised of faculty with many years experience (as indicated in the first comment) and newer faculty (as illustrated in the second and third comments).

The new school plan is intended as a blueprint to drive out the implementation of new methodologies for teaching and learning. A one-page briefing on inductive teaching was shared with the school team in an effort to connect people to what it is and what is expected of them. The dean encouraged the school team to read more, learn more, reflect more, be ready for additional dialogue, and action.

School personnel were encouraged to reflect on the school plan, as well as take the time to review and reflect upon the school plan documentation and resource materials. The information and action strategies from the school summit were not only collected and shared with participants, but we also went a step further by posting this same information to the NSCC School of Trades and Technology Faculty SharePoint portal (OUR NSCC site) as a collaborative wiki to allow people to expand these ideas, share other ideas, and share action strategies. School personnel were reminded that together we are strong and were encouraged to visit the site and add ideas to the collaborative wiki. It was inspiring to be able to document and share more broadly the amazing things happening in the school, as well as to consider all the different kinds of things that are happening and could be happening to build on strength and to help achieve the mission.

The school plan provides the foundational philosophies; a blueprint from which we can evolve and grow to create a different type of graduate; and, a graduate who, through portfolio learning, service learning, and applied research, is poised to succeed in the 21st century. The idea is to create a new type of graduate—a new type of learner and a new type of worker. This means "21st Century Teaching and Learning." A big part of this is an inductive approach to teaching and learning in our classrooms and in our school.

However, it is much bigger than just inductive methods; it also encompasses the cognitive apprenticeship methodology, environmental stewardship, collaborative apprenticeship, portfolio learning, service learning, and the list goes on. There are linkages amongst all of these associated school initiatives, all a part of the inductive approach and all a part of achieving our school plan. The school plan provides a blueprint for how we will meet emergent labor force needs by doing things in a more flexible and collaborative way. Connecting school stakeholders to the school plan and the larger academic planning processes is a key part of how that works and will continue to work.

Of course, the steps in inductive teaching do not exist in isolation of each other, and there are necessary and important overlaps, particularly in relation to the area of reflection. Donald Schon [9] put forward some thought-provoking ideas around the reflective practitioner, involving both reflection-in-action and reflection-on-action. Reflection-in-action would be happening throughout the inductive teaching and learning process but particularly during steps two and three. However, it is in step four of the inductive process that the focus on reflection is highlighted though a formal reflection-on-action process. Schon never deeply analyzed his own theory, and he seems to have missed the importance of sharing the reflection-in-action and reflection-on-action with peers and others.

A True Inductive Approach: Finishing at the Beginning

Reflection is in essence what this paper is all about. This paper represents an important example of sharing both reflection-in-action and reflection-on-action with peers and our broader communities of practice. The NSCC School of Trades and Technology is modeling the behavior we want to see within our faculty by using the things we do every day toward applied research activities and initiatives.

As Friere [6] taught us, dialogue and praxis are inextricably linked. Engaging in dialogue hastens action. In our classrooms, as a school, and as an organization, we need to work at finding ways of ensuring modes of dialogue and, hence, action. We need to ensure that people are encouraged to consider and talk about their role in achieving these articulated goals. It is about the actions completed each day and a shift in focus to encourage thinking about and seeing oneself as a part of that action plan.

Having started with the desired end point—the vision for the school in 20 years and the graduate profile—we then moved from the application through to the more general principles of the inductive approach. Whether happening in a classroom or at the level of school academic planning, an inductive approach involves the four essential steps shown in Table 1.

Table 1: General Principles of an Inductive Approach

	Step 1: Start with the Application The inductive approach always starts with the application first. Determine the appropriate application that makes the learning relevant.
	Step 2: Ensure Active Involvement The inductive approach requires that people be actively involved and work together in teams to solve the challenge.
	Step 3: Provide Scaffolding The inductive approach requires people be given some initial structure to help them get started and to assist them in working through the application.
	Step 4: Reflect on Learning Together An essential aspect of the inductive approach is to debrief as a larger group to share in the learning.

Reflecting upon the principles for inductive teaching and learning, it would appear that as a school, we are in fact modeling the change we want to see. The NSCC School of Trades and Technology focuses on an inductive teaching and learning philosophy as formally a part of our school plan for the first time in 2008; but with the apprenticeship tradition of the skilled trades, it is something that has been a part of our classrooms and our school for some time. Building upon this strength is a major part of taking us as a school to the place we want to be in 20 years. The focus on inductive teaching and learning is about building on strengths and helping to coordinate, strengthen, integrate, and embed these efforts as a part of how we do business. We are validating, building upon, and encouraging the growth of inductive teaching and learning in our classrooms, as well as in our school and college. As a school, we will continue to model the change we want to see and implement inductive methods in our academic planning and ongoing operations. The NSCC School of Trades and Technology is not done with inductive teaching and learning; in fact, we are just beginning. We will keep you posted on how it goes with achieving our vision for 2028.

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