

Building a Community of Inquirers in your Classroom: Learning from our Global Colleagues

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Abstract

Attention to inquiry-based teaching practices has surfaced as one vehicle for supporting the development of critical thinking skills in science classrooms (Achieve Inc., 2013). Despite the endless dialogue, professional development, and standards to support the teaching approach, in practice, inquiry presents teachers with a great challenge. In fact “there has been a tremendous concern that our efforts are simply not resulting in the desired level of inquiry-based teaching” (Meyer, Meyer, Nabb, Connell & Avery, 2011). Limiting factors include teacher knowledge and an understanding of inquiry (Anderson 2002; Meyer et al., 2011; Minstrell & van Zee 2000). Ironically, the global use of this method allows us to learn how others have overcome these barriers and are making inquirers of their students. International studies of practices employed by top achieving countries such as Finland and China reveal effective strategies their teachers use to foster inquiry in their classrooms (Huang, 2004; Huann-Shyang, Jui-Ying & Su-Chu, 2002; Laukkanen, 2008; Lavonen & Juuti, 2012; Liu, 2005; Maes, 2010; Nivalainen, Asikainen, & Hirvonen, 2013; Wei, 2009; Yuwen Bianjishi, 1999). This summative analysis offers a rationale for learning from our “global colleagues,” defines the latest emphasis on inquiry-based teaching, and offers strategies for creating a community of inquirers in the science classroom as informed and evidenced by teachers in both China and Finland.

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Introduction

Embedded within the newly revealed Next Generation Science Standards (NGSS) (Achieve Inc., 2013) is a loud call for inquiry-based teaching in science classrooms. This approach for teaching and learning encourages the learner to investigate the natural world using similar methods as those performed by scientists. As such, it implies a shift from the memorization of facts to the active investigation of science concepts by students. The National Science Teacher Association (NSTA) maintains, “Students cannot comprehend scientific practices, nor fully appreciate the nature of scientific knowledge itself, without directly experiencing those practices for themselves” (NGSS Lead States, 2013, p. 5). According to the National Science Education Standards (National Research Council, 1996, p. 23),

Inquiry is a multifaceted activity that involves making observation; posing questions; examining books and other sources of information to see what is already known; planning investigation; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations. Students will engage in selected aspects of inquiry as they learn the scientific way of knowing the natural world, but they also should develop the capacity to conduct complete inquiries.

Intended to foster an environment where learning is “hands-on” and “minds-on,” the NGSS support teachers’ use of performance practices that require students to critically think, in order to rise to the needs of authentic challenges (Achieve Inc., 2013). Rapid advancements in science and technology have made this demand for higher critical thinking skills a reality, while “knowledge-fueled innovation economies” require individuals capable of problem solving real-world challenges (National Governor’s Association, 2012). According to the literature, inquiry teaching, “promotes students’ interest and motivation to learn science” (Nivalainen, Asikainen, & Hirvonen, 2013), inevitably fostering habits of the mind which develop these problem solving skills (Lavonen, 2008, Lavonen & Juuti, 2012). As such, inquiry-based instruction as a method of science learning is currently being embraced globally as a means for facilitating the development of students’ critical thinking and problem-solving skills through deeper and personally meaningful experiences (Lavonen & Jutti, 2012; National Governor’s Association, 2012). In doing so, teachers serve as guides (a) leading students to develop their own questions, (b) providing experiences to inspire questioning, (c) facilitating open-ended investigations, and (d) fostering a community of learners who work cooperatively in their investigations (Hayes, 2002). In the U.S. classroom, one model commonly proposed to support this method of science learning is the 5 E Learning Cycle model. Using the learning cycle’s 5 phases of learning, teachers create opportunities for their students to engage, explore, explain, extend, and evaluate science concepts (Lorsbach, 2006).

Despite the endless dialogue, professional development, and standards to support inquiry-based teaching, in practice, this type of instruction presents teachers in the U.S. with a great challenge. In 2000, the U.S. Department of Education reported that elementary science teaching methods continued to most prevalently reflect the use of worksheets and textbook reading of definitions (as cited by Rice & Roychoudhury, 2003), while still in 2011, Meyer, Meyer, Nabb, Connell & Avery assessed that “there has been a tremendous concern that our efforts are simply not resulting in the desired level of inquiry-based teaching” (p. 58). Limiting factors include teacher knowledge and an understanding of inquiry (Anderson 2002; Meyer et al., 2011; Minstrell & van Zee 2000).

Global use of inquiry-based teaching and learning allows us to learn how others have overcome these barriers and are making inquirers of their students. The most recent 2009 Programme for International Student Assessment (PISA) revealed China and

Finland as leaders in education, ranking 1st and 2nd in science respectively (OECD, 2011). Science teaching practices of educators in both China and Finland present us with distinct strategies and learning philosophies that our global colleagues use to respond to common challenges when creating a community of inquirers in their classroom. In addition to highlighting those practices, I propose suggestions for implementation that may help transform classrooms into a climate of inquiry in light of students' diverse needs.

Connections: Our Global Colleagues' Approach to Inquiry-based Teaching

Literature Integration Sets the Stage for Questioning and Investigation

Challenge: Question development is derived from examining a problem and should ideally lead students to devise investigative ideas for resolving them. While students' curiosity may be ignited by the observation of scientific phenomena, their ability to generate *strong* relevant questions and scientific investigation methods to respond to these questions is often a challenge (Bell, Urhahne, Schanze and Ploetzner, 2010).

- Practice: Teachers in China use folk stories and poem genres, integrated across all curriculum areas to model how questions are developed by characters in stories (Yuwen Bianjishi, 1999), as well as how children design investigations using a "rational mind and scientific attitude" to overcome the challenges (Liu, 2005).
- Application: While the use of trade books in the Engage phase of the 5 E learning cycle model is often encouraged for problem solving, "piquing curiosity" and "developing student questions," consider the potential of stories read to support reading, social studies and mathematics curriculum (Everett & Moyer, 2009). Explicitly broadening students' focus from the sole identification of a literary problem, to deeper examination of *how* characters approached and solved challenges in those stories serves students as a model for developing the scientific lens necessary to generate their own questions and investigative methods. Prompting questions that may be asked, "What methods were used by the characters to solve the problem? What questions did they have before selecting this approach? How else could you have approached the challenge?" This heightened awareness further communicates to students that the problem-solving power of science is highly valued in classrooms.

Inquiry as a Way of Life: "Necessity is the mother of invention"

Challenge: Problems encountered in children's everyday lives lead to challenges that they must learn to overcome. The concern is that problem-solving skills learned in the classroom are often not transferred to solving problems in real-world contexts.

- Practice: "Educating students to be able to apply scientific concepts and knowledge in their lives is one of the most important goals in science teaching" (Huann-Shyang, Jui-Ying & Su-Chu, 2002, p. 454). In Shanghai, teachers make experiential learning and inquiry methods explicitly relevant to students' "lives, society, and the development of science and technology" (Wei, 2009, p. 262). Teachers link science content to the needs of the country as well as to the local area with the purpose of producing citizens concerned with the nation's prosperity.

Using “students’ spirits of creativity and practical abilities” they are encouraged to think critically to consider ways for improving real-world challenges, and rising to the demands of current times (Wei, 2009, p. 262).

- Application: Science empowers students with the tools to rise to authentic need. Using current socio-scientific issues as a breeding ground for meaningful scientific inquiry supports the transition from understanding how to solve problems to authentically making it happen (Zeidler, Herman, Ruzek, Linder, & Lin, 2013). Take for instance the devastation left behind by hurricane Sandy in the Northeast of the U.S. Its devastation resulted in a dire need for protecting citizens, aiding in efficient and environmentally safe cleanup efforts, and responding to affected people and wildlife. Individuals grappled for scientific measures to respond. Students might use their knowledge of hurricanes to track the location of the hurricane’s epicenter, investigate the needs of areas hit the hardest, assess citizen’s risk of hypothermia and/or infectious diseases, and devise a plan to respond accordingly. Presenting current dire issues in the context of a science classroom inspires learners to use their scientific knowledge and skills to inquire about one area of need, as well as to investigate and even implement measures to effectively respond to the needs of others (Zeidler et al., 2013). This practice offers the potential for producing concerned citizens able to use their science inquiry skills for the betterment of our nation.

Owning Research Questions without Abandoning Content and Process

Challenge: Students have strong meaningful questions, but how do they investigate them?

- Practice: Teachers in Shanghai, teach learners to embrace research questions and engage in practice by establishing their own learning objectives, and drawing their own conclusions. Intermediate learners (10 years old and up) research their own inquiries by “choosing a theme, making a plan, putting the plan into effect and drawing conclusions on their own” (Huang, 2004, p. 107). Students are provided with the skills and space necessary to design their own inquiry.
- Application: In facilitating inquiry as commonplace in the classroom, provide students the *space* to ask and investigate their own queries as *they* see fit. This does not mean however, that we must unrealistically abandon teaching required content and skill. The research process is a means for using inquiry to support the understanding and authentic use of content, process and the nature of science. For younger students, teachers may feel led to identify a theme such as the food chain, maintaining in alignment with the unit of study you are in. Students can then inquire about what occurs to the food chain when a particular animal becomes endangered or extinct. They can research the context of this common problem, and devise an innovative plan for addressing it, as well as draw meaningful conclusions. This practice insures that students learn *how* to transfer knowledge and skills into effective action using research methods.

Guided Inquiry and Rich Discussion

Challenge: Students lack the skills to investigate their own queries as *they* see fit.

- Practice: Teachers in Finland most commonly use traditional direct teaching methods to model critical thinking and problem solving. Experiments and hands-

on teaching are often performed, though *always* under the direct guidance of the teacher (Lavonen & Juuti, 2012). Using guided inquiry, teachers provide the problem and materials of a hands-on investigation. As students examine the problem using several procedures, teachers circulate, providing feedback and questioning throughout the process (Maes, 2010; Nivalainen et al., 2013). Upon completion of an experiment, rich teacher-led discussions guide students to draw conclusions and personal meaning from their work. These discussions are specifically aimed at connecting science experiences to the real-world and providing students with opportunities to express their ideas.

- Application: Finland's teaching practices tell us that for an implemented inquiry approach to be powerfully effective in developing students' problem solving skills, it does not always have to be practiced independently by the student (Lavonen & Juuti, 2012). There is great potential in scaffolding the development of students' critical thinking skills by guiding them to explore a common inquiry, discussing and engaging in collaborative research and data collection methods, and collectively drawing conclusions. As such, ensure that students are provided with on-going high levels of feedback to mold their educational experience and enhance the learning process. Most importantly, rich discussion that leads students to explicitly link the experience to its ability to respond to real-world problems is highly essential to the process. Teachers can do this by making sure that "findings are discussed in terms of the original question or problem, and that they think about the meaning of what they found in terms of developing ideas about the subject of the investigation" (Harlen, 2001, p. 84).

Teacher as a Professional Inquirer

Challenge: Students are fearful of being wrong and desire finite results, rather than enjoying the journey of inquiry.

- Practice: Teachers model critical thinking by inquiring into their own practice and collaborating with peers to implement and study innovative methods for addressing classroom challenges. Students observe their teachers take risks, cultivate creativity, and learn from one another. They observe teachers inform and modify their practices continuously. Moreover, they are made aware that these same tenets are expected of them (Laukkanen, 2008).
- Application: Be transparent. Translate the characteristics of conceptual inquiry (observing, questioning, exploring what is known, investigating, gathering and interpreting analyzed data to communicate our findings and inform our practice) into practice right before your students' eyes (National Research Council, 1996). Teachers can inform them when trying a new approach and using feedback as data to determine its effectiveness in solving your problem. Work with colleagues [just as they will] to try out different strategies, and inform them when a strategy doesn't lead to the results anticipated. Most importantly, allow students to experience passion for the process of learning, rather than merely arriving at a finite solution. In striving to foster an inquiry-based learning environment, do not overlook the powerful tool that is a teacher's professional ability to model life-long learning, and thus inquiry as a *lifestyle*.

Conclusion

Inquiry-based teaching draws attention to the journey that underlies authentic scientific practices. It is not aimed solely at finding a solution, but using scientific methods to ask questions about the natural world, learn what is known about the topic, plan investigations for responding to personal queries, and using data to propose explanations and predictions (National Research Council, 1996; NGSS Lead States, 2013). As new knowledge is learned, questions are revised, and thus the learning process is ongoing. It is this process that our global colleagues evidence as powerfully effective in developing students' critical thinking and problem-solving skills (National Governor's Association, 2012). Suggested practices for fostering inquiry that are modeled on global initiatives include: literature integration, promoting inquiry as a way of life, students' ownership of research practices, guided inquiry and rich discussion, and utilizing your professional commitment to life-long learning to model passion for the process (Huang, 2004; Huann-Shyang, Jui-Ying & Su-Chu, 2002; Laukkanen, 2008; Lavonen & Juuti, 2012; Liu, 2005; Maes, 2010; Nivalainen et al., 2013; Wei, 2009; Yuwen Bianjishi, 1999). Consider implementation of inquiry-based teaching practices as the valuable journey that will lead learners to develop the critical thinking and problem-solving skills that makes for a true community of inquirers.

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