Teacher Professional Development Essential to Incorporating Inquiry-Based Learning in the Indoor and Outdoor Classroom

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Abstract

John Hoffman is a partner with four local schools benefiting from an Ohio Environmental Education Fund (OEEF) grant that created outdoor learning centers (OLCs), and provided materials to support inquiry-based learning (IBL). IBL is a question-driven process of learning. Learning and teaching science requires skills necessary to conduct scientific inquiries. In today's schools it is required that students are taught methods of inquiry that utilize student-generated questions. However, teachers' background and knowledge of the inquiry process is limited. Teacher professional development (PD) involving teachers in inquiry and its process is necessary to improve student achievement. Teachers' knowledge and beliefs about IBL leading to implementation in the classroom can be achieved through PD programs. Hoffman's role as a grant partner was to support PD of teachers. His focus was on helping teachers acquire the skills they need in the classroom with a practical, hands-on workshop that focused on inquiry-based learning. A full day IBL workshop was prepared and titled "Inquiry Based Learning for Educators". It was a hands-on practical workshop that was a model of what was expected in the classroom. Hoffman's participation in the OEEF grant served as a foundation for this research and led to the creation of an IBL workshop by Hoffman and Randolph that they are currently active in presenting to educators.

Outdoor Learning Center Grant

Hoffman was a partner with four local schools benefiting from an Ohio Environmental Education Fund (OEFF) grant that created outdoor learning centers (OLCs) at each school, and provided materials to support inquiry-based learning. It was this grant that provided the foundation for this research. The name of the grant was *Linking and Engaging Through Outdoor Learning Centers*. The project description was "to link 2197 students in four Allen County School systems through a collaborative community effort to create and integrate outdoor learning centers where students can engage in discovery and inquiry-based learning (IBL)… Training of teachers and community members will enhance the educational impact and continuation of the four outdoor learning centers" The grant mandates 10 PD programs. The purpose of the OEEF grant was to engage teachers and students in IBL through the OLCs created.

There were five primary objectives of this grant. The first was to create OLCs where students could engage in discovery and inquiry-based learning. The second was to provide students with the opportunity to perform hands-on scientific and environmental investigations and studies. The third was to maximize the learning experiences and investigations through connections and communications via the use of technology. The fourth was to involve the community in activities that surround the OLCs. The fifth objective was to maximize the impact of the four outdoor learning centers through training of teachers and community members.

Introduction to Inquiry-Based Learning

Inquiry refers to the various ways researchers observe and study our world. There are various forms of inquiry, and inquiry can either be structured, guided, or open in nature (Liang & Richardson, 2009). IBL is a process of learning that is question driven; it stimulates curiosity in student-led explorations (Spronken, et. al. 2008). The IBL approach to educating students provides frequent opportunity for students to engage in the process of observing their surroundings, generating comparative questions, creating hypotheses, making predictions, testing them and sharing what they have discovered. Rather than being a teacher-driven approach to learning, inquiry-based learning is very much a student-driven process (Buch & Wolff, 2000).

Why teachers do not use IBL

Because teachers have limited personal experience with IBL as a student and in their teacher training programs, they are ill-prepared to meet the challenges they will face when trying to implement IBL in their classrooms (Kazempour, 2009, & Blanchard, et. al., 2009, & Anderson, 2007). Few of today's teachers "…encountered this type of teaching during their own K-16 education and did not learn to teach in this fashion…" (Kazempour, 2009). It is not ingrained as part of their core beliefs and before a change in approach is possible, some transformation needs to occur within the teacher (Kazempour, 2009). Since very few teachers have first-hand experience with and knowledge of inquiry, they often have misguided conceptions of it (Blanchard, et. al., 2009). A sense of commitment to IBL is necessary to help overcome the lack of IBL incorporated into many curricula throughout the education system (Kazempour, 2009).

Some teachers view traditional teaching and IBL to be opposed to each other as evidenced by studies indicating teachers do not have time to incorporate IBL. Many feel they must teach to state exams, and they do not have additional time in their schedules, or their curriculum is too rigid (Tobin & McRobbie, 1996). Teachers' adherence to traditional views and lack of experience with inquiry does not provide them with a changing and dynamic view of science (Anderson, 2003).

A teacher's core teaching concepts also determine how likely IBL will be incorporated into the classroom. When teachers view science as a matter of collecting facts, their views tend to work against implementation of IBL. However, when teachers view science as exploration of independent thought, receptiveness to IBL results in utilization of the process (Lotter, et.al. 2007). Also, teachers are perhaps likely to teach as they have been taught to teach.

Why is IBL important?

Inquiry is considered to be pivotal to teaching reform as it applies to the teaching of science and learning in general (Blanchard and Southerland, 2009). In today's schools, it is required that students be taught methods of inquiry that utilize student-generated

questions (Kazempour, 2009). The positive outcomes of inquiry-based learning for students are numerous. In a study of the relationship between inquiry-based instruction and student higher-order thinking, Marshall and Horton (2011) found that students who spend higher percentages of time engaged in exploration in science and math experience higher cognitive levels of thinking and learning than those students who do not. Further, when the educational goal is deeper student understanding, teachers should allow students increased time questioning, making predictions, testing predictions, collecting and analyzing data sets, drawing conclusions, and communicating findings (Marshall & Horton, 2011). Buch and Wolff (2000) assert that inquiry-based learning contributes to student cooperation with peers, team learning, the development of critical-thinking skills, problem solving, active participation, construction of learning, and increased use of creative thinking skills.

Improving students' understanding of inquiry is essential for developing a scientifically literate society (American Association for the Advancement of Science, 1993). Learning and teaching science alike requires fundamental skills necessary to conduct scientific inquiries (National Research Council, 1996, 2000). The NRC states "For students to understand inquiry and learn to use it in science, their teachers need to be well versed in inquiry and inquiry-based methods." The context of these documents recommends more resources be allocated to IBL strategies (Southerland, et. al. 2003). Practically all states are incorporating IBL into the standards (Kazempour, 2009). Inquiry is about participation and voice. *Inquiry: The Key to Exemplary Science* concludes "the health of the U.S. education system may depend on how each child answers a single question: Does my voice matter?" (Myers & Myers 2009). It seems reasonable then that inquiry is a process that may ultimately lead to new knowledge created by researchers and investigators to help solve an increasingly complex array of problems in our world.

Additionally, many states have been recently charged with implementing a new set of learning standards called the Common Core Curriculum. This curriculum emphasizes what are referred to as 21st Century Skills for students. Among these skills is the ability to effectively engage in critical thinking and problem solving. These critical thinking and problem solving skills are best served through an inquiry-based approach to learning (Buch & Wolff, 2000). Understanding this, those who created the Common Core Curriculum increased the emphasis on inquiry skills versus the previous standards in many states.

Bridging the gap between traditional teaching and IBL with professional development

For today's teachers, who are largely unfamiliar with the inquiry-based method of teaching, the task of implementing inquiry-based learning in the classroom is daunting (Kazempour, 2009). Having established that there is a need for teacher professional development in order to effectively implement the inquiry-based learning methods set forth by the new curriculum, it is important to determine the most effective methods for providing IBL professional development to teachers.

The first method is in-person, hands-on professional development experiences. Blanchard (2009) studied a research-based professional development experience that offered educators the opportunity to personally experience inquiry methods with marine ecology researchers who routinely use inquiry in their work. The program "acted to bridge teachers' authoritarian views of science by engaging them in authentic scientific inquiry" (Blanchard, 2009). The study ended with mixed results. Two of the four teachers included in the study reported a significant transformation in their attitudes towards and ability to use IBL in the classroom, whereas, the other two teachers did not experience positive changes in attitudes towards or use of IBL in the classroom (Blanchard, 2009). Blanchard (2009) attributed the effectiveness of IBL professional development to teacher readiness to learn from the professional development experience before being engaged in it.

In a second study, Kazempour (2009) evaluated the effects of a two week, in-person, hands-on training experience on participants' inclusion of IBL practices in the classroom. The study "provided further support for the need for effective inquiry-based professional development opportunities for teachers…to enhance students' science learning experiences" (Kazempour, 2009). The study draws two conclusions regarding in-person professional development. First, teachers who experience in-person IBL training, can struggle to adopt this method of instruction due to testing requirements and lack of flexibility on the part of administration and other teachers (Kazempour, 2009). Second, the study finds that for IBL professional development to be effective, it must "occur over an extended period of time," allow educators to actively participate in IBL methods and model effective IBL teaching methods (Kazempour, 2009).

In a third study, Hogan and Berkowitz (2000) studied a professional development approach that exposed teachers to inquiry practices in ecology through two-week summer workshops on school grounds or in green areas close to the school. The project found that using this intensive, in-person approach led to increases in teacher knowledge about investigative methods, an increased use of the school's outdoor green spaces for teaching science and that teachers increased the frequency with which they used IBL with their students (Hogan & Berkowitz, 2000). It is important to note that all three studies of in-person professional development in IBL emphasized giving teachers the opportunity to engage in multiple hands-on experiences with the inquiry process.

The second approach to IBL professional development is self-taught using written texts such as teacher manuals, educational journal articles, and IBL websites. Many curricular resources (e.g., *Science Fusion)* now being provided by schools include an overview of IBL methodology for educators that can be helpful in preparing educators to implement IBL concepts in the classroom (Houghton, 2012). In educational journals teachers can find guides to implementing inquiry-based learning. For example, Corder and Slykhuis (2011) published an article in the professional journal *Science and Children*, outlining a "prescriptive, step-by-step method" for "converting a cookbook-style lab into an inquiry-based science experience" (p. 60). The extent to which these

written materials are effective for educators is difficult to conclude due to a lack of published studies.

There are many professional websites that provide inquiry-based lesson plans for educators, as well as descriptions of the inquiry-based learning process. Duncan-Howell (2009) conducted a study to determine the effects of online professional communities on teacher practice. She asserts that online communities allow teachers to collaborate with other educators, reflect upon teaching practices, and access professional development (Duncan-Howell, 2009). While the study did not specifically address online communities related to inquiry-based learning practices, it did address the effectiveness of online professional development on teacher practice. The study determined that members of online communities were applying the professional knowledge they gained in their classrooms and that the communities appear to have a "positive impact on pedagogy" (Duncan-Howell, 2009). The study found that 55.56% of 546 coded messages reported "vicarious application to the real world" (Duncan-Howell, 2009).

This study investigates whether teachers who receive in-person, hands-on professional development in inquiry-based learning are more likely to increase the frequency with which they implement IBL methods in their teaching versus those who engage in self-taught professional development utilizing written materials such as manuals, professional journal articles and professional websites. The collected research would suggest that in-person methods of professional development may be more effective than self-taught methods, due to the hands-on experiences with IBL methods the teacher is engaged in. As they do with our students, hands-on experiences allow educators the opportunity to actively participate in the construction of their own knowledge of IBL (Kazempour, 2009).

University programs with an emphasis on IBL serve an important role in the professional development of teachers. Project Dragonfly at Miami University is one such program that helps bridge the gap. It was founded on the principles of participative education and inquiry-based learning that is reflected in the mission of Earth Expeditions "to build an alliance of individuals with first-hand knowledge of inquiry-driven, community-based learning for the benefit of ecological communities, student achievement, and global understanding." (Myers & Myers, 2009) The Dragonfly vision promotes learning via methods of inquiry and helps children develop as researchers (Myers & Myers, 2009).

Education reforms can succeed only if teachers are comfortable with IBL and utilize the process in the classroom (Weiss, et.al. 2003). Professional development involving teachers in inquiry and its process is central to most efforts designed to improve student achievement (Supovitz & Turner, 2000). Teachers' knowledge and beliefs about IBL leading to implementation in the classroom can be achieved through professional development programs (Kazempour, 2009).

Some professional development programs have been more successful than others. Professional development based upon lecture-type formats that teach how to teach are not

particularly effective (Hawley & Valli, 1999). Practical professional development models that are hands-on and follow the IBL process are deemed to be much more effective (Kazempour, 2009 & Hogan & Berkowitz, 2000). This research supports findings that research experiences for teachers (RETs) and practical, hands-on workshops that model the inquiry-based learning process would be more effective than lecture-type programs and other "readymade" formats. Teachers who are immersed in IBL have more confidence teaching IBL (Palmer, 2006). As a result, an important conceptual shift in how effective teaching is defined occurs. Learning becomes a little less content driven and more concerned with critical thinking and problem solving (Kazempour, 2009).

Outdoor learning centers (OLCs) have been found to enhance the inquiry experience for teachers and students as well. OLCs develop teachers and hone their skills. Those who use OLCs find themselves learning as well as teaching. They have opportunities to investigate their own questions. It is stimulating for them to learn alongside their students, and together teachers and students perceive opportunities for new knowledge to emerge. Teachers must understand and apply principles of IBL to effectively help students learn (Catapano, 2005). Outcomes from effective professional development programs include enhanced IBL skills and positive attitudes towards IBL. A stream study program conducted by Liang & Richardson (2009) supports this finding. The study program included some aspects of a research experience as well as use of an outdoor learning center. Teachers and students alike developed their scientific inquiry skills, and teachers became more confident and effective in teaching inquiry (Liang & Richardson, 2009).

Conclusions

For students to fully realize all of the benefits IBL has to offer, such as higher cognitive levels of thinking, problem-solving and the like, it is important that teachers are delivering high quality inquiry-based learning (Buch and Wolff, 2000). IBL is likely to be implemented by teachers who have experienced IBL in their own K-18 education and by those who attend in-person workshops. IBL is less likely to be implemented by teachers who have not received undergraduate or graduate level IBL instruction as part of their own education.

Core values are not easily changed. It will possibly take full implementation of the Common Core Curriculum incorporating and measuring IBL performance before there will be teacher interest in learning to incorporate or teach IBL. When comparing the previous Content Standards for Ohio with the new Common Core Curriculum, the new Common Core places a much higher emphasis on IBL methods than the previous standards did. One can conclude that teachers are not currently implementing IBL because of this previous lack of emphasis. As the new Common Core Standards are being fully implemented in 2014, teachers and school districts will find a critical need for professional development in the area of IBL. Therefore, it is important that we discover the most effective methods for delivering IBL training. There is clearly a need for more in-person professional development related to IBL.

IBL professional development, in any form, should occur over extended periods of time and provide models of inquiry-based instruction (Kazempour, 2009). The in-person workshop conducted by the authors did provide models of inquiry-based instruction and included reference materials participants could take back to the classroom and refer back to over time. Also, participants were given contact information for both authors so that further support could be provided on an as-needed basis. Studies conducted by Hogan and Berkowitz (2000), Kazempour (2009) and Duncan-Howell (2009) all referenced the need for models of inquiry-based learning instruction and training and support that is delivered over time. The authors will continue working together to conduct one-day and multi-day IBL workshops to provide another avenue of access to professional development that is much needed.

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