Beyond Traditional Teacher Professional Development: Innovations in Teacher Professional Learning in Environmental and Sustainability Education

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Abstract
Continued implementation of conventional professional development strategies will likely fall short of the innovations needed to prepare teachers to fully engage in and implement environmental and sustainability education. The Rivers2Lake education program based in Superior, Wisconsin, USA illustrates a transformational approach to teacher professional development. We examine the program as a working example of three UNESCO learning processes that have been identified as aligning with and contributing to education for sustainability (Tilbury, 2011): collaboration and dialogue; engaging the whole system; and active and participatory learning. Through a review of these processes, the article offers considerations for innovating teacher professional learning for environmental and sustainability education. Key recommendations include shifting from isolated professional development events to ongoing professional learning as well as further investigation of the specific mechanisms that drive each of the UNESCO learning processes.

Key Words
Environmental education teacher professional development, In-Service Teacher Professional Development, Collaboration, Dialogue, Participatory Learning, Systems

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Introduction

Effective education for sustainability helps students develop into agents of change who have the knowledge, skills, values, and behaviors required to transform our systems, communities, and greater society (Burns, 2016; Burns et al., 2019; Orr, 2004; UNESCO, 2014). Such transformation requires a host of complex and interconnected systems of thinking and acting (Cloud, 2017; Hogan, 2002; Verhoeff, et al., 2018). Thus, in order to develop these types of learners and future leaders, sustainability education requires educators who can apply systems-based thinking to challenge themselves and their students (Burns et al., 2019; Kadji-Beltran et al., 2013). In fact, transformational professional development is of such significance, that the importance of empowering educators and assisting them in developing new competencies is highlighted in the strategic plans of numerous international organizations focusing on Education for Sustainable Development (Council for the European Union, 2010; UNECE, 2011; UNESCO, 2014). Furthermore, the North American Association for Environmental Education (NAAEE) identifies the following objective as part of its 2020-2023 Strategic Framework: "Invest in creative, engaging, and effective professional learning that brings new ideas and thinking to the field" (p.7).

In seeking to achieve transformational professional development, it is important to recognize that much is already demanded from teachers. They are asked to maintain subject area knowledge and the skills for teaching that content in a rapidly changing world, while providing instruction that is responsive to the diverse needs of their students and communities. Further, they must manage numerous other aspects of the classroom environment such student behavior and responsive assessment strategies (TNTP, 2015). High quality and continuous professional development is recognized as critical in supporting teachers in meeting these demands, yet the quality and methodology of teacher professional development is highly variable, often resistant to change, and slow to innovate (Darling-Hammond et al., 2017; Hill et al., 2013). Environmental education teacher professional development could be characterized similarly.

Since the mid-1990s, there have been periodic nudges by researchers and leaders suggesting the need for re-evaluating how the field of environmental education is approaching teacher professional development. Among the criticisms are a lack of interdisciplinary emphasis, a focus on content knowledge or specific curriculum rather than demonstrating the potential of using the local environment for systemic and on-going authentic student learning, and the frequent use of "one-shot" and "one-size-fits-all" workshops rather than extended formats that allow for deeper teacher learning and change (Wade, 1996). Drawing from the teacher

professional development and environmental and sustainability education (ESE) literature, this article aims to offer considerations for those who work with teachers in the context of ESE. It is not meant to be an exhaustive review of the current state of knowledge regarding teacher professional development, but rather it serves to highlight an innovative program as a starting point for further consideration by those seeking to contribute to innovations in ESE through teacher professional learning. Further, the focus of this article is not to weigh in on the debate regarding the relationship between environmental education and education for sustainability. It is clear that there are numerous overlaps between the two disciplines and this article argues that in order for the truly transformative nature of education for sustainability to unfold, necessary educational shifts must occur.

Learning for a Sustainable Future

Environmental and sustainability education (ESE) can be a daunting undertaking, even for those who claim it as their primary field. Sterling (2004) identifies two of the primary sources of these challenges. First, a large amount of complexity and uncertainty surround most sustainability issues. Second, these issues often present ethical dilemmas and cannot be adequately understood or addressed through single disciplines. True learning doesn't take place in individual silos because real world issues require a host of interdisciplinary and connected skills (Lambrechts & Hindson, 2016). However, teachers and students often learn in isolation by focusing on one subject or skill, lending special attention to those prioritized on standardized tests (Koretz, 2017).

Additionally, learning in the context of sustainability requires participative and experiential methods that go beyond engagement and understanding, toward influencing values and actions (Burns et al., 2019; Sterling, 2012; Tilbury, 2011; UNESCO, 2014). Students and teachers also need to learn skills and dispositions that may run counter to conventional formal education and teacher preparations, such as learning to ask critical questions and clarify one's own values, learning to consider long-term and multiple perspectives, and perhaps most importantly, learning to think creatively, holistically, and systemically (Council of the European Union, 2010; Dawe et al., 2005; Sterling, 2012).

In order to guide teachers and schools toward fostering in students the applied knowledge, skills, and dispositions necessary for a more sustainable future, experts in the field have established frameworks containing standards and performance indicators that identify the knowledge, skills, and dispositions students should learn in order to thrive in and contribute to a healthy society (for example, Cloud (2017) *Education for a Sustainable Future Benchmarks: For Individual and Social Learning*). However, as cautioned in these frameworks, it is important to note that learning for a sustainable future must not be equated with simply gaining knowledge, skills, and dispositions. Checking off the standards must not be the end goal (Santone, 2010). If interpreted in that way, ESE will fall short of the transformative view of education it embraces.

Instead, the standards must be integrated into the larger practical context of what it means to truly contribute to a sustainable world (Santone et al., 2013). ESE cannot just teach about sustainable development but must also help students learn the competencies necessary to build a more sustainable world (Affolter & Mathar, 2016). Viewed as a holistic framework, rather than as a prescribed checklist, ESE may also serve as a unique context for entire schools as well as the grounding for curricular frameworks (Stone, 2009). ESE requires a shift in the way we see people, no longer focusing on humans as the cause of problems but rather shifting to a view that focuses on humans as initiators and facilitators of change (UNESCO, 2017; UNECD, 1992). It also requires a stronger emphasis on changing the thought processes and mental representations that influence behaviors, as well as a recognition of the need for not only individual behavior change, but structural and institutional change as well (Cloud, 2017; also see the March 2018 JSE Issue: Decolonizing and Sustainability Education).

The question remains, however, regarding which pedagogical pathways teachers can use toward the transdisciplinary learning that supports these shifting emphases. While there is a foundation of research on transformative learning from which to draw, the field of ESE is relatively new, and the plethora of associated outcomes makes understanding the mechanisms for achieving these outcomes challenging. Furthermore, a guide map leading to implementation of ESE in all schools does not exist (Stone, 2009). An expert review undertaken by UNESCO's Section for Education for Sustainable Development (Tilbury, 2011) identified key learning processes that most clearly align with education for sustainability and have strong potential for effectively contributing to sustainable development. These learning processes include processes of collaboration and dialogue, processes that engage the whole system, and processes of active and participatory learning. The identification of these overarching learning processes offers insight into the pedagogical approaches that should be used in ESE learning at different education levels and in varied educational settings, and thus can guide the development and implementation of ESE-related programs and activities (see *Education for A Sustainable Future, Benchmarks: For Individual and Social Learning* for further guidance on pedagogical approaches and practices, Cloud, 2017).

Teaching for a Sustainable Future

Even with these ESE learning processes identified, the question remains: How do we prepare teachers to carry out these learning processes with their own students? While the answer is not simple, full preparation is unlikely to be accomplished through more of the same teacher professional development that typically has been used in environmental education and ESE contexts. Without intentional and overt change, teacher education and professional development may continue to reproduce the transmissive practices toward assimilative learning that are counter to transformational sustainability education (Greenwood, 2010). Thus, with this need for innovation in mind, two existing and overlapping efforts are important to note. Both offer valuable frameworks to help shape how educators learn, teach, and cause change in issues surrounding sustainability.

The first of these efforts stems from the collaborative, international work underway through Environment and School Initiatives (ENSI). The organization strives to both support and initiate new educational efforts that further environmental understandings and integrate active approaches to teaching and learning. A key facet of their work involves identifying and documenting innovative case studies in school-level incorporation of principles and actions for sustainability (Affolter, & Mathar, 2016). Recognizing that integrating environmental and sustainability learning into mainstream school curricula requires a thorough re-thinking of teacher professional development, they have developed a framework, *Competencies for Education for Sustainable Development Teachers* (Sleurs, 2008), which provides guidance for integrating ESE in the curriculum of teacher preparation and teacher training institutes.

A second guiding effort resulted in the adoption of the *Learning for the Future* framework of core competencies in ESE by the United Nations Economic Commission for Europe. This framework identifies what educators should know and be able to do, as well as how they should live and work with others if they are to contribute to a more sustainable future (UNECE, 2011). These competencies are centered on three essential characteristics of ESE: a holistic approach, envisioning change, and achieving transformation. Similar to the aforementioned student benchmarks, these competencies serve as goals rather than minimum standards to be met by all teachers.

While collectively these two frameworks provide invaluable direction, there are still many unknowns and complexities involved in putting these frameworks into practice. One approach for implementation, offered here for consideration, is to design teacher professional development using the aforementioned learning processes identified by UNESCO (Tilbury, 2011) for guiding environmental and sustainability learning (processes of collaboration and dialogue, processes that engage the whole system, and processes of active and participatory learning). In essence, this involves reframing isolated professional development as ongoing professional learning. By recognizing teachers as learners who are in dynamic relationships with their students, their colleagues, and the wider society, teachers can act more fully as agents of change (Sleurs, 2008). Professional learning grounded in these environmental and sustainability learning processes can serve to not only motivate teachers to bring about change, but also help them realize their capacity as agents of change (Bourn, 2016).

When redesigning professional development, it is also important to recognize not only the complexity of the issues and skills surrounding environmental and sustainability learning, but also the powerful constraints teachers face when trying to implement these practices with their students. For example, accountability pressures and narrow perspectives regarding student achievement can limit teachers' receptivity to new ideas that won't show up on high-stakes standardized tests (Koretz, 2017). Expectations of administrators, parents, and even community members can also serve as powerful constraints on innovative teaching (Ernst, 2007; Koretz, 2017; Schumacher et al., 2012). These are just a few of the pressures that create the reality within which educators work each day. Thus, solutions that are not rooted in these realities are limited in their utility.

In order to illustrate a working, transformational approach grounded in the UNESCO learning processes, this article highlights an existing program that demonstrates sustained positive teacher change outcomes: the Rivers2Lake education program based in Superior, Wisconsin, USA (Ernst & Erickson, 2018).

The Rivers2Lake Education Program

The Rivers2Lake education program (R2L) is a teacher professional development program that utilizes the Lake Superior Watershed as a foundation for transformational place-based learning, environmental literacy, and engaged stewardship for teachers and the PK-12 students in their classrooms. The program provides extensive support to teachers, schools and districts through experiential professional development, co-teaching and bi-monthly mentoring during a year of implementation. R2L is situated within the Lake Superior National Estuarine Research Reserve, a state/federal partnership between the University of Wisconsin-Madison Division of Extension and the National Oceanic and Atmospheric Administration. The program houses an additional staff member with the Superior Rivers Watershed Association in Ashland, Wisconsin USA.

By shifting teacher practice towards experiential learning and stewardship actions focused on the Lake Superior Watershed, students in the classrooms of R2L teachers develop an expanded understanding of the Laurentian Great Lakes, a stronger sense of place and an increased commitment to local stewardship (National Oceanic Atmospheric Administration, 2018). Participating students also demonstrate improved academic learning and engagement (Ernst, 2015). To support and sustain these shifts in practices, Rivers2Lake staff intentionally foster the development of an expanded professional learning community of teachers, non-formal educators, First Nations, state and non-profit natural resource professionals and scientists. Lake Superior (also known as *Gichigami*) is located within ceded and unceded territory of the Anishinaabe (Ojibwe) people. Collaboration with Anishinaabe-led organizations in the region has continually shaped the program by centering ongoing traditional lifeways and Indigenous knowledge as a pathway to place-based understanding. Place consciousness (Grunewald, 2003) and the use of a place-based approach to teacher and learning (Smith, 2002) are central to R2L

Professional Learning Cycles in Rivers2Lake

Each year, the program begins with the Rivers2Lake Summer Institute, a four-day immersion experience in the St. Louis River watershed and western Lake Superior. Over four days, twelve PK-12 teachers and R2L staff travel from the headwaters of the St. Louis River in northeastern Minnesota, USA, to the Wisconsin shore of Lake Superior. Along the way, they meet with experts and gain a valuable understanding of the environmental and human history of the river and the region. The group engages in inquiry-based projects related to water quality,

practices outdoor education skills they will later apply in their classrooms, and spends time planning together for the upcoming year.

Once the school year begins, teachers partner with R2L mentors (staff at the Lake Superior National Estuarine Research Reserve and Superior Rivers Watershed Association) to build individualized curriculum and field experiences that use authentic, ongoing scientific research and environmental stewardship as a platform for learning aligned with student-specific needs and educational standards. Teachers and mentors work together, at minimum, on a bimonthly schedule through structured meetings. As another layer of support, mentors will also co-teach lessons in order to help teachers grow more comfortable with the implementation of skills and methods learned during the Summer Institute. Through the process of Rivers2Lake professional learning and mentoring, staff and participants in the program engage in each of three learning processes identified by UNESCO (Tilbury, 2011) for guiding environmental and sustainability learning: 1) dialogue and collaboration, 2) engaging the whole system and 3) active and participatory learning.

Learning Processes of Dialogue and Collaboration

Dialogue and collaboration are important and interconnected processes in the context of ESE. Dialogue and collaboration, however, are more than discussing perspectives and working together. Discussion is often used in professional development to build upon the experiences participants bring to the context at hand and for sharing their experiences. Dialogue, however, involves a deeper, mutual exchange among learners (Crafton & Kaiser, 2011). Through dialogue, there is active negotiation of meaning and an intent to more fully understand the perspectives of others, toward shared understandings that are built upon and often subsequently revised. This can be challenging, as teachers are often accustomed to trainer-centered professional development, where participants' attention is expected to remain on the trainer in the front of the room, rather than attending to and learning from those with whom they are participating (Cole, 2004). In dialogic discourse, the instructor does not dominate, but instead learners' perspectives shape the flow of the conversation. The presence, willingness to engage, and active participation of others, each bringing knowledge and experience to the context at hand, is needed for dialogue that furthers learning.

Dialogue is critical to collaboration and collaboration is key to effective professional learning. While collaboration can occur in workshops, this form of collaboration often falls short of the dialogue and collaborative learning that occurs over time when teachers continuously seek, share, and act upon their learning. In collaborative learning, the focus shifts from developing teachers' individual knowledge and skills to schoolwide learning, capacity building, and change (Brancard & Quinnwilliams, 2012). Embracing the learning processes of dialogue and collaboration in the context of ESE teacher professional learning suggests a move from approaches that are sporadic, surface level, and disconnected from teachers' own experiences

toward approaches grounded in and driven by collaborative learning. Mentoring is one form of collaborative learning that may be particularly useful in the context of ESE. Another form is professional learning communities, which encourage teachers' collective reflection to deconstruct knowledge, followed by action to reconstruct knowledge, and collaboration with peers to co-construct knowledge (Kadji-Beltran et al., 2013). In ESE, professional learning communities are well-suited to tackle the multifaceted and deeper learning necessitated by the complexities and uncertainties that surround sustainability. Rather than a workshop, professional learning in ESE might take the form of teachers interacting with colleagues, testing ideas, processing information, challenging interpretations, and reflecting on next steps. Or it could entail facilitated opportunities for teachers to plan lessons together, observe one another's teaching, reflect on their own teaching, and plan improvements based on their observations and reflections. Depending on the context and setting at hand, professional learning communities may unfold differently. Yet these learning communities can support the dialogue and collaboration necessary for professional learning that is inclusive, authentic, continuous, and practice-focused.

*Dialogue and collaboration through Rivers2Lak*e

Teachers and R2L staff make sense of water quality data in Port Wing, Wisconsin.

Mentoring is a form of dialogue and collaboration that provides a sense of accountability, personalized support, and assistance in navigating barriers and encourages reflection on practice (Rhodes & Beneicke 2002; Ernst & Erickson, 2018). Mentoring in R2L is multi-directional, whereby classroom teachers provide expertise on their students, curricular requirements and instructional environment while mentors contribute experience in outdoor and place-based learning content and methodologies. These relationships are similar to those described in Pickett & Fraser (2002), where mentors act not as evaluators, but as "educational companions and agents of change" (p. 34). Teachers report that mentoring helps them feel valued and increases confidence and competence in ESE (Ernst & Erickson, 2018).

Mentoring relationships continue throughout the year of program implementation. Through a structured yet responsive format, teachers and mentors cooperatively plan and establish timelines, activities and clear expectations for upcoming work. Each meeting is scheduled in advance with reminders sent out beforehand. Regular discussions make space for social support related to students, colleagues, and personal experiences as well as mutual reflection on teaching practices. By listening to, clarifying and reflecting learning objectives, teacher interest, and student needs, mentors introduce aligned curricular resources, stewardship activities, field locations and texts of local cultural, ecological or historical importance. They source authentic research and land management activities in the Lake Superior watershed (including those that involve competing uses and values) that subsequently form the basis of inquiry-based student learning. Through this ongoing dialogue, teachers are supported as they navigate logistical, curricular and administrative barriers (Ernst & Erickson, 2018)

Rivers2Lake teachers share water quality data on a Lake Superior beach.

Learning Process of Engaging the Whole System

A holistic approach is inherent in environmental and sustainability learning. ESE requires seeing the world from the perspective of relationships, connectedness, and context (Stone, 2009). This viewpoint must be extended beyond the curriculum to the entire system in which students and educators teach and learn. Beyond engaging with teachers at the school-level in their professional learning, there is a need to engage with the broader education system, including not only schools and community organizations, but also businesses, teacher preparation institutions, and governmental agencies. By engaging the broader system, teachers are empowered as agents of change and ESE professional learning is brought to life. While environmental education professional development in many ways has intentionally interacted with the broader educational system, what perhaps has been missing is engagement in the innermost circle of the system – the daily life of on-the-ground teachers. It is critical to recognize that the innovations teachers are asked to implement are not implemented in isolation, but rather are intricately tied to the realities of daily school life and the school community more broadly.

Thus, in the context of ESE professional learning, engaging the whole system includes asking teachers for their input into the content and processes of their learning, as well as regarding the realities of the constraints they may face in implementing the learning at hand. Engaging the whole system also encourages consideration of teachers themselves in a holistic way, so that professional learning is not just cognitive, but affective and behavioral as well

(Penuel et al., 2007; Snow-Renner & Lauer, 2005). It can also mean recognizing that healthy systems have limits, and even when the whole system is engaged, there are still limits to what the individual and/or the system can do. Rather than ignoring these limits, acknowledging limits can be the source of creativity and innovation (Haught-Tromp, 2017). This may also mean occasionally stepping back in deliberate reflection, and encouraging teachers to consider the "big picture," as well as pausing to consider one's place within the system. And because systems are dynamic and change over time, the learning process of engaging the whole system suggests the need for professional learning that is not static, but that changes as the needs of the learners change and as the systems themselves change, again, underscoring the importance of dialogue and collaboration.

Engaging the Whole System through Rivers2Lake

In R2L, teachers are regarded as enmeshed in nested systems that influence their ability to succeed in fully engaging students in ESE. These nested systems begin with the teacher herself/himself, expand to the classroom and students, the school, the community, and the encompassing landscape of the Lake Superior watershed. The program seeks to address and engage with these systems in order to sustain teacher practice in place-based interdisciplinary teaching beyond the initial year of professional development.

Superior School District 5th grade teachers and curriculum development staff meet with R2L staff at the Reserve to identify areas of curricular focus.

R2L mentors collaborate with teachers in the classroom to engage their students. Throughout the course of a year, those students (and teachers!) may transition from novice (and sometimes disoriented) practitioners of outdoor and place-centered learning to demonstrating expertise in their school and community. Sustained direct experiences with the natural landscape, dialogue with experts in various aspects of that landscape including Indigenous leaders and elders, and meaningful inquiry-based learning and stewardship efforts facilitate student change. As teachers' abilities and confidence in adapting and using these practices are expanded, so too are students' capacities in these learning processes.

Likewise, school and school district engagement are sustained through relationships developed over time. In the context of each school, R2L mentors regularly engage teachers who are not enrolled in R2L, coordinating outdoor learning opportunities for their students and offering short duration in-school professional development, an effort to establish a schoolwide culture that values ESE. By regularly engaging in dialogue with principals, curriculum development staff and administrators and sharing progress with school boards, support for the program and the instructional innovations has increased.

The Rivers2Lake program is a core educational program at the Lake Superior National Estuarine Research Reserve, a partnership organization central to a larger network of researchers and natural resource professionals. During the Summer Institute and again throughout the school year, teachers are introduced to and engage with this network and encouraged to think of it as their own. Orienting and aligning teachers with this broader community of place-based practitioners eases their feelings of isolation in change (Ernst & Erickson, 2018). They are supported not only by their mentor, but by a larger group of educators, cultural practitioners, land managers and scientists. As they and their students engage with real world scientific processes and decisions related to land management, they gain skills in thinking systemically and asking critical questions, skills that underpin ESE (Tilbury, 2011). This engagement in the learning process directly connects to the final component of learning processes identified by UNESCO: active and participatory learning.

Active and Participatory Learning

Fourth grade students learn about a USEPA research project at the St. Louis River Summit, a scientific conference where they also presented a poster.

There exists a paradox in that teachers are encouraged to use more student-centered approaches and incorporate authentic experiences into the teaching and learning process, yet often their own professional learning takes the form of instructor-centered, transmissive formats. If environmental and sustainability learning provides a gateway to a different view of pedagogy (Sterling, 2012), the professional learning experiences provided to teachers must also reflect broader views of pedagogy. Pedagogical strategies such as project- and problem-based learning as well as fieldwork and outdoor learning are often highlighted, yet these approaches are less often used in teacher professional learning (McConnell, Parker & Eberhardt, 2019). There are other active and participatory strategies that could be used in teacher professional learning as springboards in the early stages of professional learning community formation, such as case studies, reflexive accounts, and critical reading and writing. Modeling active and participatory learning is key in teacher professional learning, because it allows for teachers to practice doing what is being asked of students in ESE: ask critical questions; clarify values; envision more positive futures; think systemically; and respond through applied learning (UNESCO, 2011). When active and participatory learning is embraced in teacher professional learning, the aim shifts from getting teachers to implement new strategies to encouraging teachers to learn more deeply about new ways of doing things. Rather than simply learning what to think and how to teach, teachers are engaged in changing their way of thinking (Bourn, 2016).

Thus, teachers' changes in practice are informed by a deep understanding of why the new practices are needed and how they align with the direction of their schools and their learners. In essence, the aim in active and participatory teacher professional learning is to provide teachers with the same high-quality learning that is recognized as being needed for students (Garet et al., 2001). This means providing professional learning that is designed to meet the on-the-ground realities of teachers. High quality, learner-centered professional learning requires coherence and relevance, or in other words it must be connected to teachers' work (Darling-Hammond, 2017). It means providing time for planning, practice, revision and on-going support (Garet et al., 2001). And finally, active and participatory professional learning helps move teachers along a continuum of higher-level thinking and self-reflection, as opposed to simply adopting a new curriculum or teaching practice.

Active and Participatory Learning through Rivers2Lake

Direct experience, augmented with mentoring and reflection, forms the basis of teacher professional learning in Rivers2Lake. In addition to mentoring, two professional development events offer space for teachers to engage actively and directly with the landscape and practice inquiry-based learning firsthand. The Summer Institute is a four-day event where teachers and staff are immersed in the watershed (sometimes literally). The one-day Winter Symposium strengthens and expands those skills six months later, providing a forum for teachers to share progress and challenges in adapting the use of outdoor and place-based learning to their classrooms. The Winter Symposium addresses the seasonality of the northern climate and offers tools and techniques that support teachers in engaging outdoor student learning in the cold, even in subzero temperatures and snowfalls ranging from inches to feet. Both experiences offer a combination of learning with local experts, outdoor experiences, and practice with R2L methods and model curriculum. Time is included for planning and reflection.

R2L teachers and staff paddle the Pokegama River in the Lake Superior National Estuarine Research Reserve, Superior, Wisconsin.

R2L staff consider the final two months of the school year to be a phase of peak participatory learning, where full integration of Rivers2Lake methods into classrooms cements the professional learning process. Warmer weather and reduced academic pressure allow teachers creative space to develop unique learning experiences for and with their students. As a culmination of skill attainment, mentoring, trial and error, reflection, and adapted student expectations and skills in new learning modalities, teachers and their students often achieve significant milestones in the final months of school.

An Anishinaabe elder helps fifth graders plant trees on Wisconsin Point.

One Rivers2Lake 5th grade teacher provided an example of this phenomenon in 2019. Early in the year, this teacher decided to focus on a connection many of her students had to Wisconsin Point, a culturally significant and highly valued beach near her school. The class visited the Point multiple times and learned about it throughout the year. Students investigated the biology and ecology of the place. A final visit in May illuminated how much students connected with and cared about Wisconsin Point. They relished in it and dug, literally, deeper into their learning about this place. Students planted cedar trees with the help and support of an Anishinaabe elder in a location he remembered them growing in his youth. They explored the water under their own power in canoes, and created in-situ art. The teachers' full commitment, and thereby her students' full commitment, to new skills, expectations, and learning modalities built to a meaningful cumulative experience.

In recent correspondence with this teacher, she talked about her unfolding love of engaging students in the natural world: "Every time I hear a woodpecker, see lichen on a tree, smell the fresh air in the early morning, watch a loon dive under the water...I think to myself: I wish my students were here to experience this!" The positive learning experiences over the past school year reinforced her commitment to ESE in the year following her participation in Rivers2Lake. Through participatory and experiential professional development, teachers such as this 5th grade teacher are supported in adopting experiential teaching practices they themselves experienced in R2L professional development. But perhaps more importantly, they are encouraged and supported through mentoring to engage in more reflective practice and to learn more deeply about new ways of doing things. Rather than simply learning how to teach, teachers are engaged in changing their way of thinking about teaching, guided by a deeper understanding of why the new practices are needed and how they align with the direction of their schools and their learners.

Conclusion

The aim of ESE learning is sometimes described through a question: How can we think and act in ways that reflect the complexity and interconnectedness of the real world? A similar question can be posed for teacher professional learning in ESE: How can teachers be supported in learning how to educate in ways that reflect the complexity, interconnectedness, and uncertainties of the real world? As pointed out by David Orr (2004), education has not succeeded in teaching people to think broadly and systemically, nor to live as whole persons. Thus, more of the "same" education for students and teachers is likely to fall short of what is needed to meaningfully contribute to the challenging issues in the realm of sustainability. Innovations in environmental and sustainability student learning require innovations in professional learning. If the need is for students to be skilled in thinking creatively, holistically, and systemically and to be able to draw on high levels of self-reflection as they understand, evaluate, and adopt sustainability values, and if students are expected to be able to apply theory to practice and practice to theory to work in transdisciplinary and collaborative ways, there needs to be a congruent set of underpinnings or guideposts for those who design and provide teacher professional learning in ESE.

The Rivers2Lake program offers reflections on transdisciplinary and collaborative work in teacher professional development, all of which merit further investigation:

- *Dialogue and collaboration* are generated by an extended amount of time invested into the professional learning of a smaller group of teachers. Because fewer individuals participate at a time, this approach may appear less impactful externally but produce more sustainable and expansive results over time. Metrics used to assess outcomes in similar education programs should be reconsidered accordingly.
- Collaboration generated by mentoring appears to result in compounded investments, where sustained professional development generates and influences community practices. By *engaging with the whole system*, ripple effects result from building networks between R2L teachers and the broader ecological and social contexts of their community. Further investigation of the specific actions and conditions that support these networks may identify various points of pressure that activate pedagogical shifts towards sustained place-based learning, including engagement with local Indigenous communities.
- *Active and participatory learning* grounds teaching practice in the immediate landscape, connecting to the direct experience of all learners (teachers and students) and engaging a deeper understanding of and resonance with their place. This approach may increase programmatic sustainability because it grounds teaching practices in the experience of that which is immediately relevant and found outside the door. The nature of our places for teaching and learning have variable attributes, some of which may prove more compelling for learners.

While the lens of sustainability encourages innovation to be considered alongside tradition, the learning processes that typically undergird teacher professional development are often paradoxical to the aims that are sought. The learning processes highlighted here are not meant to be comprehensive or prescriptive. However inspiration and learning from the pockets of innovation in ESE teacher professional learning, such as those highlighted by Rivers2Lake, can

be combined using the transformative power and nature of ESE learning to produce a meaningful contribution to a more sustainable future.

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